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# Prioritise safety, optimise success! Return to rugby postpartum

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## Abstract

Pregnancy and childbirth involve substantial physical, physiological and psychological changes. As such, postpartum rugby players should be supported and appropriately prepared to return to the demands of rugby alongside the additional demands of motherhood. This review aims to discuss specific perinatal considerations that inform a rugby player's readiness to return-to-sport postpartum and present an approach to rehabilitation. Before engaging in full rugby training and matchplay, postpartum players should have progressed through the initial phases of rehabilitation and graded sports-specific training to prepare them for the loads they will be exposed to. Additional rehabilitation considerations include minimising deconditioning during pregnancy; medical concerns; the abdominal wall; the pelvic floor; perinatal breast changes, breastfeeding and risk of contact breast injury; body mass; nutritional requirements; hormonal considerations; athlete identity and psychological considerations; joining team training; return to contact and tackle training; evaluating player load tolerance and future research, policy and surveillance needs. A whole-systems, biopsychosocial approach following an evidence informed return-to-sport framework is recommended when rehabilitating postpartum rugby players. Health and exercise professionals are encouraged to use the perinatal-specific recommendations in this review to guide the development of postpartum rehabilitation protocols and resources.

## KEYWORDS

guidance, load tolerance, perinatal, postnatal, return to sport

## Highlights

- Unlike an injury, the postpartum period is a transitional time with unique biopsychosocial considerations, many of which can be anticipated and prepared for during pregnancy.
- Player education should commence early before they likely transition into motherhood.
- Before engaging in rugby postpartum, players should progress through the initial phases of a postpartum return-to-sport framework to respect tissue healing and prepare for the progressive loads they may be exposed to.

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- Welfare and long-term player health should focus across the player lifespan and playing level (from girls and community to the elite women's game). It also serves to educate others involved in the women's game (match officials, coaches, fans and family members) regarding key aspects of women's physical and mental well-being (e.g., pregnancy and postpartum).

## 1 | INTRODUCTION

Women's rugby has become increasingly popular with an estimated six million female players expected to participate worldwide by 2026 (Curry, 2016). Accordingly, the number of perinatal (pregnant and postpartum) rugby players is expected to increase in line with the overall growth in women's participation. To date, there has been limited guidance to inform return-to-sport postpartum, yet research suggests that postpartum women who return to high volumes of training too soon may have increased susceptibility to injury (Kimber et al., 2021). Furthermore, athletes from various sports and levels have expressed a desire for better support and guidance while transitioning from athlete to mother-athlete (Culleton-Quinn et al., 2022; Davenport et al., 2022, 2023a).

In 2016, as part of a series of systematic reviews on perinatal athletes undertaken by an International Olympic Committee (IOC) expert panel, factors relating to postpartum exercise were explored and recommendations for recreational and elite return-to-sport proposed (Bø et al., 2017, 2018). The IOC review concluded that decision-making for postpartum return-to-sport is complex, and there is a lack of evidence informing recommendations. They proposed using a three-phased model from an existing return-to-sport following injury framework (Ardern et al., 2016) alongside perinatal considerations to aid decision-making. Subsequent works have expanded on the IOC reviews by highlighting the need for an integrated interdisciplinary approach to postpartum return-to-sport (Deering et al., 2020; Donnelly, Moore, et al., 2022) and emphasising the need for a proactive approach to perinatal athlete care (Donnelly, Moore, et al., 2022). This is important as while return-to-sport postpartum can be viewed as a rehabilitation period, similar to following injury, it also has distinct differences. Unlike an injury, the transition to becoming a postpartum rugby player can be anticipated, thus allowing for further education and planning to reduce deconditioning during pregnancy and support successful return-to-sport thereafter. Additionally, the postpartum transition presents unique considerations, including possible birth-related tissue changes and injury from vaginal or abdominal childbirth (see Donnelly et al. (2024) in this special issue), alongside unique biopsychosocial factors that are associated with pregnancy, childbirth and postpartum (Donnelly, Brockwell, et al., 2022; Moore et al., 2021; Tighe et al., 2023).

Recently, sports organisations have developed guidance for supporting perinatal athletes and specifically rugby players (e.g., World Rugby Postpartum guidelines; England Rugby Union maternity leave policy) (England Rugby, 2023; Rugby Australia, 2023; UK Sport, 2023; World Rugby, 2024). However, these guidelines and policies consistently highlight a lack of high-quality research on postpartum return-

to-sport, particularly for contact sports like rugby. With the number of perinatal rugby players predicted to increase, there is a need to build upon the existing guidance with the emerging research investigating the perinatal population (Bø et al., 2022; Christopher et al., 2023; Darroch et al., 2023; Deering et al., 2024; Donnelly, James, et al., 2022; James et al., 2022; Massey et al., 2022; Moore et al., 2021, 2023; Prevett et al., 2023; Sundgot-Borgen et al., 2019; Tighe et al., 2023).

This review aims to discuss the current understanding of specific perinatal considerations that inform a postpartum rugby player's readiness to return-to-sport. Where possible, evidence-informed recommendations regarding how to support a safe return-to-sport will be proposed, and future research, policy and surveillance needs outlined. Within this review, we use the term *postpartum player* to include all levels of a rugby player, from community (grassroots and recreational) to elite (international and professional). Where appropriate (e.g., differences in access to services), we explicitly refer to the relevant levels of women's rugby (e.g., community and elite).

## 2 | RETURN-TO-SPORT POSTPARTUM

For postpartum rugby players, return-to-sport is preceded by return to rugby training. However, several rehabilitation phases need to be completed before engaging in full training. For the purpose of this review, the *6 Rs Framework* (Donnelly, Moore, et al., 2022) will be applied and discussed as one example of a return-to-sport postpartum framework. However, it should be noted that to date no return-to-sport framework has been validated for the postpartum population. The *6 Rs Framework* builds upon foundational works in this field by incorporating population-specific evidence alongside pre-established criteria-based return-to-sport assessments and recommendations (Ardern et al., 2016; Bø et al., 2017, 2018; Deering et al., 2020). Like previous recommendations (Bø et al., 2017, 2018; Deering et al., 2020), it supports the inclusion of wider multidisciplinary team members, including pelvic health physiotherapists and obstetric and gynecology specialists, to ensure that an individualised approach is possible. Importantly, it advocates for a 'proactive' approach to postpartum return-to-sport which can begin as soon as a player is trying to conceive or becomes pregnant. Specifically, the *6 Rs Framework* outlines six phased progressions that use sports medicine concepts typically applied to injury rehabilitation (e.g., respecting tissue healing and implementing progressive loading) alongside pregnancy and postpartum-specific considerations: *ready*, *review*, *restore*, *recondition*, *return* and *refine*. Postpartum players considering returning to training should have already transitioned through earlier *ready*, *review* and *restore* phases (Donnelly, Moore,

et al., 2022). These phases should focus on individual needs in relation to the pelvic floor muscles (PFMs), abdominal wall, breast health, mental health, cardiovascular conditioning, muscle strengthening and skill work. This means that postpartum players will gradually increase their exposure from lighter exercise (e.g., walking, postpartum yoga and pilates) in the initial postpartum weeks (*review and restore*) and progress to more exertional exercise (e.g., walk-run intervals, light strength training and static cycle) as tolerated (*recondition*) (Donnelly et al., 2020, 2022a). Ideally, if a postpartum player is pain free, asymptomatic of pelvic floor dysfunction (PFD) during impact and strength progressions (Donnelly et al., 2024; World Rugby, 2024) and has adequate upper and lower body muscle strength (World Rugby, 2024), they can transition to non-contact and then contact training. Whilst the existing sources of guidance for return-to-sport postpartum provide comprehensive population-specific guidance (Bø et al., 2017, 2018; Deering et al., 2020; Donnelly, Moore, et al., 2022), they do not account for sport-specific considerations such as the variety of intense activities (e.g., tackling, scrummaging, rucking, jumping and running) required in rugby. Future research and guideline development should inform rugby-specific considerations.

### 3 | SPORT-SPECIFIC CONSIDERATIONS

Preparing for a safe and successful return-to-sport requires the demands of the sport to be considered during postpartum rehabilitation. All codes of rugby are collision sports involving a high number of contacts per game between players (e.g., tackling, scrummaging and rucking) and with the ground or ball (Brisbine et al., 2020). Rugby also requires players to perform a variety of high-intensity, multi-directional activities such as accelerations, decelerations, high-speed running, change of directions and position-specific skills (e.g., catching, passing and kicking the ball) (Dane et al., 2022; Emmonds et al., 2020). Non-physical aspects of rugby require consideration too as player welfare includes the mental and social health, holistic development and safety and rights of players. For instance, the male-dominated culture of rugby has led to several inequalities for women in terms of access, visibility, participation, employment and governance compared to men (World Rugby, 2023; Joncheray, 2021). Furthermore, the global reach of rugby means that aspects such as geographic location can affect inequalities and player welfare (See Non and colleagues in this special issue Non et al., 2024). Therefore, postpartum players around the world need to be supported and appropriately prepared to return to the demands of rugby alongside the additional demands of motherhood (e.g., sleep deprivation and childcare).

### 4 | BIOPSYCHOSOCIAL CONSIDERATIONS DURING THE PERINATAL TRANSITION

The female body experiences many physical, physiological and psychological changes as it transitions into pregnancy and postpartum (Bjelica et al., 2004; Soma-Pillay et al., 2016). Additionally,

postpartum players may experience social and environmental adjustments as they navigate new parental responsibilities, altered family dynamics, increased financial demands and a shift/change in athletic and occupational identity. To appropriately support postpartum players who wish to return-to-sport, a whole-systems approach is recommended. This approach considers and accounts for the entire person and all their bodily systems within an applied biopsychosocial context (Donnelly, Brockwell, et al., 2022). According to Public Health Scotland (2022), a whole-systems approach also involves applying systems thinking, methods and practice to better understand and address challenges. In the context of postpartum return-to-sport, it includes the promotion of strategic, integrated approaches across healthcare sectors, rugby codes and rugby levels. For example, governing bodies have a responsibility to develop resources and guidance and ensure that they are accessible to all levels of rugby (e.g., community to elite). While the impact of perinatal changes is likely to be player-specific and contextualised to each individual's pre-pregnancy levels, environment and social circumstance, key considerations and their relevance to rehabilitating a postpartum player to return-to-sport are outlined below.

#### 4.1 | Minimising deconditioning during pregnancy

To minimise deconditioning during pregnancy and achieve clinically meaningful benefits associated with exercise, rugby players should follow current guidelines and aim to engage in at least 150 min of moderate intensity exercise per week consisting of aerobic and muscle-strengthening activities (Hayman et al., 2023). While pregnant players should cease contact training as soon as pregnancy is suspected and confirmed, they may want to continue to engage in a similar level of exercise as they did pre-pregnancy by participating in other types of exercise and non-contact rugby activities (e.g., skills, cardiovascular conditioning and strength training). Although there is no established 'upper limit' to exercise volume or intensity during pregnancy, research suggests that previously highly active women safely continue to train during pregnancy with exercise intensities as high as 90% of maximum heart rate and support from appropriate health professionals (Beetham et al., 2019; Wowdzia et al., 2023). Furthermore, elite runners have been shown to maintain training volume throughout pregnancy by engaging in cross-training and achieving between 2 and 3 times the current physical activity guidelines (Darroch et al., 2023). Engaging in elite-level sport prior to and during pregnancy is also associated with increased odds of returning to running within 6 weeks postpartum and achieving higher training volumes compared to sedentary controls (Kimber et al., 2021). Furthermore, research into high intensity interval training (HIIT) during pregnancy is emerging. A single HIIT session involving a 3-round resistance circuit at a maximum intensity for 20:60 s work to rest ratio and 2 min recovery between rounds demonstrated no adverse foetal effects (Anderson et al., 2021). Another study demonstrated that a single HIIT session consisting of 10 repeated 1-min near maximal to maximal exertions interspersed

by 1-min recovery was well tolerated by the mother and fetus (Wowdzia et al., 2023). However, longitudinally performing HIIT throughout pregnancy requires further research.

As pregnancy progresses, players are likely to require training modifications to accommodate the associated physical changes (e.g., increased abdomen size and change in center of gravity). If they start to experience urinary incontinence or discomfort while exercising, they may also replace high impact exercise (e.g., running) with low impact options (e.g., cross-trainer and stationary bike) (Darroch et al., 2023). Importantly, where medically safe, players should continue to engage in whatever level and form of exercise they can to reduce deconditioning, which may delay return-to-sport postpartum (Moore et al., 2021). We suggest that pregnant players (i) achieve at least 150 min of moderate intensity exercise per week, including resistance training; (ii) engage with an appropriately qualified health professional who can monitor their health and well-being and that of their baby while they continue training and (iii) modify training as required to accommodate physical changes and reduce discomfort or dysfunction.

## 4.2 | Medical considerations

Similar to sports injury rehabilitation, postpartum medical reviews with a qualified sports medicine physician, general practitioner or

obstetrician are necessary for evaluating recovery and medical readiness for return-to-sport. They are also important for identifying postpartum-specific red flags (Table 1) that indicate the need for further medical investigation or management (Donnelly & Moore, 2023; Donnelly et al., 2024; NICE CKS, 2021) before proceeding with rehabilitation and return-to-sport. A medical review should be undertaken by 6–8 weeks postpartum with follow-up review(s) (as service provision allows) to determine readiness and tolerance of return-to-sport and performance (Donnelly, Moore, et al., 2022).

While specific studies investigating the impact of postpartum medical reviews are lacking, expert experience and understanding indicate that they should involve a thorough subjective assessment to capture information about a player's pre-pregnancy baseline (pre-existing conditions, training level, etc.), mode of delivery, perinatal complications, psychological well-being, current symptom profile, menstruation and breastfeeding status (Donnelly et al., 2022a, 2022b). Ideally, additional factors, such as energy availability and individual goals and concerns, should also be considered (Deering et al., 2023; Donnelly, Moore, et al., 2022). However, it is recognised that the level of sports medicine knowledge will be determined by whom and where the medical review is accessed. For example, elite rugby players may access designated health professionals within a sports medicine team but most women's rugby teams are unlikely to receive such support. This means that the majority of players will

TABLE 1 Postpartum return to rugby red flag signs and symptoms.

Red flag	Signs and symptoms
Lochia (Fletcher et al., 2012)	Increased lochia associated with increased activity or return of lochia that extends beyond 6 weeks postpartum
Potential medical sources of concern (NICE, 2015, 2021b; NICE CKS, 2021)	Temperature, sweats, malaise, foul smelling discharge, abdominal pain, pelvic pain, urinary tract infection, thrush and bacterial vaginosis
Breast abscess or mastitis (NICE CKS, 2022)	Breast pain, difficulty breastfeeding, temperature, sweats, malaise, redness or swelling in the breast
Potential serious pathology (NICE, 2015; NICE CKS, 2021)	<p>Pelvic masses</p> <p>Neurological signs and symptoms including, but not limited to, cauda equina: Reduced saddle sensation, loss of urinary urge, loss of fecal control, widespread neurological signs and symptoms</p> <p>Suspected cancer (bladder, bowel, cervical and vulva): Screen for established cancer related signs including unremitting night pain, night sweats, unexplained mass/growths, skin lesions, weight loss or gain and neurological signs</p> <p>Gynaecological-related symptoms including excessive abdominal bloating, feeling of fullness early with eating and unexplained and or persisting vaginal bleeding</p> <p>Persisting urinary retention or any postpartum urinary retention</p>
Pain associated with weight-bearing or activity especially foot, hip, pelvic, back and/or wrist pain (Mountjoy et al., 2018)	May indicate bony stress injury. Relative energy deficiency may need investigating especially if co-existing with menstrual changes or absence
Perinatal mental health concern (Leinweber et al., 2022; Wang et al., 2021)	Low mood, inability to cope, anxiety that negatively impacts upon daily activity, lack of bonding or desire to care for newborn, loss of interest in things around them, extreme mood swings, lack of self-care, irrational and or negative thoughts and unable to sleep at night
Birth trauma (Leinweber et al., 2022)	Low mood, inability to cope, tearfulness, lack of bonding or desire to care for newborn, sexual dysfunction, scar tissue hypersensitivity and recall of a negative birth experience

access medical reviews via public or privately sourced services, which are unlikely to be approached in the context of return-to-sport nor include all the recommended considerations within this review. If outside of the expertise of the reviewing medical professional, postpartum players should be signposted to appropriate health or exercise professionals who can oversee the return-to-sport process (World Rugby, 2024). Rugby governing bodies should also develop open-access, evidence-based resources covering important information (e.g., England Rugby Football Union's Rugby Toolkits on menstrual, breast and pelvic health) (England Rugby, 2023). Additionally, players should be encouraged to source a pelvic health physiotherapy assessment from approximately 6 weeks postpartum, particularly if symptoms of PFD are identified (AIS, 2021; Donnelly et al., 2024; NICE, 2021a; World Rugby, 2024). Ideally, the medical practitioner carrying out the postpartum medical screening should be aware of wider, multidisciplinary involvement, signpost according to individual player need(s) and oversee whether a review with a pelvic health physiotherapist has been completed. Where possible, the following aspects should be considered within a postpartum player's medical screening and will be discussed below: abdominal wall; PFM; perinatal breast changes, breastfeeding and risk of contact-related injury; body mass; nutritional requirements; hormonal considerations and athlete identity and psychological considerations.

### 4.3 | Abdominal wall

As the uterus grows during pregnancy, the abdominal wall stretches, lumbar flexion range of motion becomes limited (Conder et al., 2019) and abdominal strength and endurance naturally reduces (Conder et al., 2019; Deering et al., 2018). Following pregnancy, the abdominal muscles have higher fatigability at 26 weeks postpartum (Deering et al., 2018) and potentially longer; however, this theory needs further investigation. This means that regardless of delivery mode, all postpartum players will present with reconditioning needs; however, those who experience caesarean section (C-section) delivery will have further tissue healing considerations. Toward the end of pregnancy, the linea alba connective tissue joining the rectus abdominis muscles in the midline will stretch increasing the inter-recti distance (IRD) (Mota et al., 2015). This tends to naturally reduce toward pre-pregnancy IRD in the first 8–12 weeks postpartum and changes can continue beyond 6 months (Coldron et al., 2008; Mota et al., 2015). However, approximately one third of postpartum women have diastasis rectus abdominis (DRA) (Mota et al., 2015), referring to the persistence of increased IRD beyond normative values (Tuominen et al., 2022) and the risk of DRA is suggested to increase with C-section (Cardailac et al., 2020; Fan et al., 2020; Turan et al., 2011). DRA can negatively impact abdominal strength, abdominal comfort, body image and quality of life (Fuentes Aparicio et al., 2021), and therefore, screening and management in all postpartum players are recommended.

Further to changes to the abdominal wall, support teams should be cognisant of the risk of umbilical hernia (Henriksen et al., 2020)

or subcutaneous fat defect (Campanelli, 2021). A subcutaneous fat defect may occur when the linea alba is thinned, attenuated and somewhat 'threadbare' in appearance and pre-peritoneal fat protrudes through it (Plumb et al., 2021). Evaluating for such defects (Donnelly, 2019; Reinpold et al., 2019) before returning to contact rugby is important, as a small proportion of the abdominal wall peritoneum and bowel is believed to only be covered by skin and fascia, potentially exposing players to increased risk of injury or complication. According to Gillard et al. (2018), IRD measurements in postpartum women are wider when imaged in standing versus lying. Therefore, in postpartum players presenting with midline bulging or a lump, ultrasound imaging in both lying and standing may be helpful to measure IRD and determine whether a defect is present. Any suspected or identified abdominal wall defects should be referred for surgical evaluation before return-to-sport. Regardless of the presence or absence of DRA, we believe that postpartum rehabilitation programmes progressing abdominal load should respect individual tissue healing timescales, especially following C-section or in the presence of abdominal wall defects. Understanding of tissue healing timeframes in return-to-sport is contextualised by the severity of tissue injury (Almadani et al., 2021; SantAnna et al., 2022). For example, the healing of minor grazes and tears are considered to take only a few days, whilst more significant partial or full muscular and ligamentous tears can extend up to 62 days post injury (Ekstrand et al., 2013).

### 4.4 | Pelvic floor muscles

Considerations for the PFMs when returning to rugby are discussed briefly below. However, a comprehensive and related review of this topic is discussed elsewhere within this Special Issue (Donnelly et al., 2024). PFM function refers to the role of the PFMs and associated connective tissues in continence (bladder and bowel), excretion (bladder and bowel), pelvic organ support and sexual function (Donnelly et al., 2023). Compromise to any of these roles signifies PFD and negatively impacts women's engagement in sport (Dacic et al., 2021; Moore et al., 2021). Athletes demonstrate a higher prevalence of PFD than the general population (Dacic et al., 2021; de Mattos Lourenco et al., 2018; Donnelly et al., 2023; Giagio et al., 2021) and their risk increases during transitional times such as pregnancy and postpartum (Bø et al., 2020; NICE, 2019). This is supported by studies showing that rugby players have a high prevalence of rugby-related urinary incontinence (McCarthy-Ryan et al., 2024; Sandwith et al., 2021), with postpartum players being particularly at risk (McCarthy-Ryan et al., 2024), and the tackle-event (McCarthy-Ryan et al., 2024; Sandwith et al., 2021), running and jumping (McCarthy-Ryan et al., 2024) more readily provoking symptoms. However, rather than PFD being attributed to a single or defined set of factors, it is likely that combinations of whole-system factors (e.g., anatomical, physiological, genetic, lifestyle and reproductive) interact throughout a woman's lifespan to influence their likelihood of experiencing symptoms. This means that despite inciting events (e.g., childbirth

and return-to-sport) some postpartum players may develop superior PFM function during their earlier lifespan resulting in them never experiencing sufficient deterioration to expose symptoms. Whereas, other players may have a lower baseline of PFM function enabling inciting events to predispose symptoms (DeLancey et al., 2008). This highlights a role for early education and focused PFM training for younger rugby players (e.g., adolescent) to limit the influence of predisposing factors to PFD during later phases of life.

Screening for PFD is not commonplace and unfortunately, some health and exercise professionals in high impact sports do not believe it is necessary (Dakic et al., 2023). The pelvic floor health domain is an important part of female-specific injury and illness surveillance, which may help to change these beliefs (Moore et al., 2024). In support of this, we propose that screening and surveillance should be an ongoing part of the postpartum return-to-sport process as players are exposed to different activities and training loads. For example, PFD may first present as postpartum players increase their exposure to impact and exertion (McCarthy-Ryan et al., 2024). Additionally, the onset or worsening of stress urinary incontinence associated with PFM fatigue (Thomaz et al., 2018) may only be exposed as training demands and volume increase. Several validated PFD screening tools exist [for example, the Australian Pelvic Floor Questionnaire (Baessler et al., 2009) and the International Consultation on Incontinence Questionnaire (ICIQ) (Avery et al., 2004)]. However, these tools do not identify sports-related symptoms. A recently developed sports-specific screening tool, the *PFD SENTINEL* (Giagio et al., 2023), is currently undergoing validation testing. It includes risk profiling, whereby certain factors (e.g., muscle damage associated with mode of delivery) may increase a player's susceptibility to symptoms of PFD depending on other individualised factors.

For postpartum players who have PFD, conservative rehabilitation consisting of education and advice regarding PFM training should be undertaken and where services allow, an assessment with a specialist pelvic health physiotherapist should be sought (Donnelly et al., 2023; NICE, 2021b). Some symptomatic postpartum players may wish to continue training while they access PFM rehabilitation (Christopher et al., 2022; Donnelly et al., 2023). In such circumstances, the player can be supported in their informed choice, and pelvic health physiotherapists can guide them on their suitability for supporting devices and adjuncts (e.g., urethral support devices and pessaries) (Donnelly et al., 2023, 2024).

#### 4.5 | Perinatal breast changes, breastfeeding and risk of contact breast injury

During the perinatal period, women experience changes in breast tissue composition (Faguy, 2015; Vandeweyer et al., 2002), increases in breast density (Vashi et al., 2013), volume (Beesley and TIFoGa, 2008; Cox et al., 1999; Vashi et al., 2013), vascularisation (Beesley and TIFoGa, 2008) and sensitivity (Morris et al., 2017). Postpartum women experience frequent breast size fluctuation associated with milk production and removal (Costantakos

et al., 1982) and this continues until breastfeeding is ceased and post lactation involution is initiated (Vashi et al., 2013). Given these perinatal and lactogenesis-specific changes, postpartum players returning to rugby will likely experience increased breast motion and associated exercise-induced breast pain. Therefore, postpartum players should be equipped with correctly fitting, comfortable and supportive sports bras relative to their breast size and intensity of exercise. Due to the frequent breast size fluctuation, breastfeeding players may need different bra size options as well-fitting, supportive sports bras are also recommended to reduce the prevalence of clogged ducts and mastitis (NICE CKS, 2022). The importance of sufficient breast support and breast health education for all players is discussed in greater detail by Wakefield-Scurr and colleagues within this Special Issue (Wakefield-Scurr et al., 2024). Additionally, England Rugby Football Union have produced a specific educational toolkit focusing on breast health for players (England Rugby, 2023); however, evidence pertaining the efficacy of breast protection is needed.

The World Health Organisation recommends that infants be exclusively breastfed for 6 months and continue being breastfed beyond 2 years of age (World Health Organisation, 2023). As such, postpartum players should be supported in their breastfeeding choice and ability. Support includes considering the impact of return-to-sport on the player and baby's breastfeeding routine. For example, players may find expressing helpful to maintain training schedules (Ekstrand et al., 2013) and relieve breast heaviness and discomfort before training. Even with support, coaches should be aware that athletes, including rugby players, may encounter breastfeeding difficulties (Davenport, Ray, et al., 2023). Breastfeeding is associated with reduced maternal sleep hours (7 h per 24 h period) and more time awake at night (Smith et al., 2021). Athletes have perceived such sleep changes as negatively impacting their recovery from training and competition (Giles et al., 2016). It is acknowledged that for all postpartum players, sleep quantity and quality will likely be negatively impacted by the needs of a newborn baby and this may extend beyond the first postpartum year. For breastfeeding players, sleep disturbance may be further heightened with all feeding needs falling to them. Therefore, lactation status and sleep should be considered in postpartum players with advice and support implemented as able. Interventions to improve perceived sleep quality include sleep hygiene protocols, naps (Cunha et al., 2023) and mindfulness (Jones et al., 2020); however, studies have not examined this in the context of return-to-sport while breastfeeding. Importantly, a lack of awareness and education surrounding breastfeeding and return-to-sport has been reported by athletes (Giles et al., 2016) such that access to lactation consultants and education to support breastfeeding is recommended.

Lastly, consideration of the higher risk of contact-related breast injury associated with increased breast vascularisation, size and sensitivity in breastfeeding players is also necessary (Moore et al., 2024) including the potential negative impact to breastfeeding (Sircar et al., 2010). If a contact breast injury occurs, health and exercise professionals should adopt suitable treatment strategies for breast injury management and consult with lactation and medical specialists

to support informed decision-making regarding if and how to continue breastfeeding (McGhee et al., 2023). Currently, in women's rugby, breast injuries are under-reported and there is also a lack of current understanding of breastfeeding behavior amongst players. Female-specific injury surveillance systems should be implemented to better understand the prevalence of breastfeeding, and the incidence, severity and mechanisms of breast injury in women's rugby. These data will allow effective policy and injury management strategies to be developed (Moore et al., 2023, 2024). Specifically, there is a need for a breast injury care pathway in women's rugby (Wakefield-Scurr et al., 2023, 2024).

#### 4.6 | Body mass

The baseline physique of women's rugby players differs across positions with backs being smaller and having a lower body mass and percentage body fat than forwards (Escrivá et al., 2021; Scantlebury et al., 2022). Healthy body mass gain (often referred to as gestational weight gain) during pregnancy ranges between 11 and 16 kg. However, excessive increases in body mass during pregnancy can be problematic. For example, higher maternal body mass index (BMI) increases the risk of developing health conditions (e.g., gestational diabetes) (Rahnemaei et al., 2022). Additionally, not losing pregnancy-related increases in body mass within the first 6 months postpartum increases a woman's risk of obesity (Rooney et al., 2002). This carries serious negative health consequences, such as cardiovascular disease or musculoskeletal disorders (Cardaillac et al., 2020), and may affect a player's ability to engage in or continue training. For example, a higher BMI is found in players sustaining breast-related contact injuries and is a risk factor for rugby-related urinary incontinence (Donnelly et al., 2023). Health and exercise professionals supporting perinatal rugby players should be aware of the health implications associated with a high body mass and the pressures felt by elite athletes to return to pre-pregnancy body composition (Davenport et al., 2022). Therefore, helping postpartum players to achieve a healthy body mass that is appropriate for their playing position must be undertaken in a supportive, evidence-informed, safe manner by appropriately qualified professionals and, where possible, within a multidisciplinary approach (e.g., sports medicine consultant, sports dietician, strength and conditioning coach).

#### 4.7 | Nutritional requirements

No specific research has been identified informing the nutritional needs of postpartum rugby players. It is acknowledged that various factors will be relevant to the postpartum player's nutritional needs including body mass, the degree of tissue trauma during childbirth, sleep quality and breastfeeding status. A balanced diet that offers

adequate fueling to promote tissue healing, support hypertrophic gains and meet the energy demands for postpartum players to return-to-sport is essential. Calorific demands of breastfeeding should be factored into player fueling to ensure that an energy deficit and subsequent predisposition to problematic low energy availability do not present (Deering et al., 2023; Mountjoy et al., 2018; World Rugby, 2024). Additionally, awareness of the impact that return-to-sport may have on the demand for a breastfeeding player's fluid intake should be highlighted with objective insights including the baby's weight trajectory and the player's surveillance of their own perceived thirst and frequency, volume and concentration of urine output serving as potential indicators of adequate fluid intake (Perrier et al., 2016; Tucker et al., 2020). More recently, research into the impact of exercise on female fertility has emerged. A recent mini-review by Mussawar et al. (2023) highlighted that even healthy women trying to conceive could experience negative consequences to fertility (e.g., anovulation and luteal phase defect) related to regular, vigorous exercise and insufficient calorie intake. Players trying to conceive may be encouraged to increase their calorie intake on training days. Where possible, individual player nutritional needs should be guided by a suitably qualified professional (e.g., sports dietician). For example, iron status is an important consideration for the health of rugby players and potentially at risk subgroups (e.g., pregnant and lactating) should be screened for iron deficiency at regular intervals. Those with signs or symptoms of iron deficiency should be investigated and addressed accordingly through increased dietary and supplementary iron intake (Kuwabara et al., 2022; World Health Organization, 2016).

#### 4.8 | Hormonal considerations

During pregnancy ovarian steroid hormone levels increase to supraphysiological levels; meaning that estrogen and progesterone are approximately 73 and 9 times higher, respectively, at term than during the menstrual cycle (Elliott-Sale and Hackney, 2023). These hormones are known to have non-reproductive functions (e.g., substrate utilisation) (Hackney, 2021) and therefore, may influence athletic performance. To date, no studies have investigated the direct effects of increasing estrogen and progesterone levels experienced during pregnancy on rugby performance, which limits our ability to determine if female rugby players will be directly influenced (i.e., athletic function and capacity) by reproductive hormonal changes during pregnancy. In addition, as estrogen and progesterone levels decline rapidly following childbirth, with some women experiencing lactational amenorrhoea (Calik-Ksepka et al., 2022), the postpartum changes in ovarian steroid hormone levels on rugby training and performance also warrant investigation. Monitoring the return of menstruation should be undertaken in all players (Mountjoy et al., 2023), particularly those experiencing lactational amenorrhoea (Deering et al., 2023). Lastly, we suggest that consideration be



given to postpartum bone health given the contact nature of rugby and the possibility of bone stress injuries in postpartum athletes (Kimber et al., 2021). Monitoring estrogen levels and bone characteristics during the 12–24 months following childbirth (noting that the World Health Organisation recommends women to breastfeed beyond two years postpartum (World Health Organisation, 2023)) and appropriately reviewing and managing players who experience bony stress injury following return-to-sport is recommended.

#### 4.9 | Athlete identity and psychological considerations

Transitioning into and beyond pregnancy requires a player to adapt to a changing body, identity and lifestyle (Table 2). The psychology of return-to-sport after injury is a crucial part of the return-to-sport process (Ardern et al., 2016) and female athletes have unique stressors and responses to injury (van Niekerk et al., 2023), which may also apply to postpartum return-to-sport (e.g., body image and sport inequities). Similarly, the psychological impact of ceasing contact training during pregnancy and the uncertainty of if, when and how they will return-to-sport postpartum should be considered. Alterations in a player's athletic and physical identity may occur due to the perinatal physical and physiological changes and associated

performance reductions (Davenport, Ray, et al., 2023; Massey et al., 2022). Additionally, support teams should be vigilant to the risk that women have of experiencing perinatal mental health challenges such as postpartum depression—up to 40% in some regions of the world (e.g., South Africa) (Wang et al., 2021). Moreover, the experience of childbirth can cause distressing emotions, leading to short- and long-term negative impacts on their overall well-being (Leinweber et al., 2022). This psychological experience, referred to as 'birth trauma,' is reported in up to 20%–68% of postpartum women (Sun et al., 2022) and can incur ongoing adverse effects including persistent pain, catastrophising and compromised mental health (Leinweber et al., 2022; Shorey et al., 2022).

Few sports psychological concepts have been investigated in the postpartum population. Fear of movement (kinesiophobia) is an excessive, irrational and debilitating fear of carrying out a physical movement due to feeling vulnerable to a painful injury or re-injury (Kvist et al., 2022). When kinesiophobia is experienced by perinatal women, it can reduce the odds of returning to running postpartum (Moore et al., 2021), which will likely have implications for returning to rugby. It is recommended that health and exercise professionals screen postpartum players for perinatal mental health and/or fear avoidance behavior and signpost to specialist services as appropriate (e.g., general practitioner and clinical psychologist).

TABLE 2 Rugby player changes and demands during the transition into motherhood.

Type	Possible changes and demands
Physical and physiological (body)	<ul style="list-style-type: none"> <li>• Generalised deconditioning</li> <li>• Abdominal wall changes (lengthening, loading and trauma)</li> <li>• Pelvic floor changes (lengthening, loading and trauma)</li> <li>• Increased body mass</li> <li>• Lactation and breast size fluctuation</li> <li>• Hormonal fluctuation</li> <li>• Nutritional requirements</li> <li>• Menstrual changes (cessation during pregnancy, return depending on individual factors e.g., lactation, problematic low energy availability and contraception)</li> </ul>
Identity and psychological	<ul style="list-style-type: none"> <li>• Mother</li> <li>• Mother-athlete</li> <li>• Perception as an athlete</li> <li>• Family/relationships dynamic</li> <li>• Occupational identity</li> <li>• Shift in priorities</li> <li>• Mood alterations</li> <li>• Perinatal mental health</li> </ul>
Lifestyle and societal	<ul style="list-style-type: none"> <li>• Disrupted and reduced levels of sleep</li> <li>• Disrupted routine</li> <li>• Altered eating habits</li> <li>• Reduced self-care</li> <li>• Initiating and maintaining breastfeeding</li> <li>• Higher cost of living</li> <li>• Social disruption</li> <li>• Social support from friends, family and rugby club</li> <li>• Parental responsibility and demand</li> <li>• Occupational responsibility and demands</li> <li>• Pressure to return to rugby from external sources (e.g. sponsors, rugby club, coaches and financial)</li> </ul>

## 5 | JOINING TEAM TRAINING

Allowing players to interact with teammates and coaches can be beneficial during injury rehabilitation (Johnson et al., 2016), and the benefits are likely to apply to the transition into motherhood (Davenport et al., 2022, 2023b). For postpartum players looking to join team training before being ready for full contact activity (e.g., *review, recondition restore* phases of the 6 Rs), this can be facilitated in several ways. Where available, players can be involved in video analysis sessions during early postpartum rehabilitation. Additionally, players can engage in some non-contact training activities before being able to perform all non-contact movements (e.g., being a ball feeder) or participating in modified team gym sessions. Players can then progress toward greater involvement as their rehabilitation progresses. Furthermore, recently published expert consensus on returning to running postpartum suggests that asymptomatic players may be able to re-engage in running activities following a minimum recovery time of 3–6 weeks postpartum (Christopher et al., 2023). Coaches are encouraged to work with the player and health and exercise professionals to facilitate team inclusion.

## 6 | RETURN TO CONTACT AND TACKLE TRAINING

A key component of rugby training is player-to-player contact, particularly tackling. The physical, psychological, tactical and technical ability to engage safely and effectively in the tackle is primarily developed during training (Dane, Foley, & Wilson, 2023). Given the frequency of match tackle events and the high risk of injury, it is important that postpartum players are sufficiently prepared to perform the tackle safely and effectively in training and matches (Starling et al., 2023; West et al., 2021). Players must demonstrate physical and psychological readiness to begin contact training following a period of avoiding contact participation while pregnant and early postpartum. In some cases, the time avoiding contact training may be longer than one of the most severe rugby injuries (e.g., anterior cruciate ligament reconstructions, ACLR) (Gokeler et al., 2022). Unlike established ACLR rehabilitation, postpartum rehabilitation research is scarce and there is limited evidence to inform postpartum return-to-sport. Using principles from the tackle skill training framework and return-to-sport following injury frameworks, the return to contact and tackle training should progress from a controlled modified environment to uncontrolled full engagement (Geldenhuys et al., 2022; Hendricks et al., 2018; Taberner et al., 2020). Contact skill retraining should evaluate psychological well-being alongside wider technical, tactical and physical considerations and be adaptable to complex individual player needs (e.g., playing position, learning preferences, playing experience and training ages) (Dane, Foley, Hendricks, & Wilson, 2023; Stodter & Dane, 2024). Players should first be exposed to 'simple' controlled movements before transitioning to 'complex' uncontrolled movements (Buckthorpe et al., 2019; Myer et al., 2006) gradually

undertaking activities that increase intra-abdominal pressure (Shaw et al., 2014). An example progression for engaging with front-on tackles would begin with static tackle profile positions before adding resistance, movement tracking (contact proficiency) and progressing from one-on-one scenarios to small-sided live contact games with tackling under fatigue (contact capacity) (Hendricks et al., 2018). Affording additional time for contact skill training, video feedback and player engagement in decision-making are key factors for building a player's confidence in the return-to-contact process (Dane, Foley, Hendricks, & Wilson, 2023). Although not specific to the postpartum player, 'contact confident' is an evidence-informed, freely available online coaching resource that includes training activities designed to promote physical competence, confidence and safety in the contact area in women's rugby (World Rugby, 2022). Specific considerations for contact and tackle training in women's rugby are discussed in greater detail by Stodter and Dane (2024), and detailed information for progression toward contact training are covered in World Rugby's postpartum guidelines (World Rugby, 2024).

## 7 | EVALUATING AND MONITORING PLAYER LOAD TOLERANCE AND WORKLOAD

Load tolerance refers to the ability of tissue to withstand a load without damage (Cook & Docking, 2015) and represents an important part of determining a postpartum rugby player's readiness for return-to-sport. Evaluating a postpartum player's ability to perform strength and conditioning exercises and rugby-specific activities should occur at each stage of rehabilitation (Donnelly et al., 2024; World Rugby, 2024). Objective testing is recommended to make informed decisions about return-to-sport progression following injury (Ardern et al., 2016) and a similar approach can be applied when evaluating return-to-sport postpartum. There is limited evidence to support what objective tests to use to inform return-to-sport with several load and impact tests clinically proposed for return-to-running strength and endurance evaluation (Deering et al., 2024; Goom et al., 2024). In the context of rugby, neck, shoulder and lower limb strength are considered key contributors to proficient tackle technique (Meintjes et al., 2021; Speranza et al., 2017) and should be assessed given the likelihood for generalised deconditioning in postpartum players. If pre-pregnancy data are available for strength assessments, these can be used to benchmark against as a player progresses through their rehabilitation. Example criteria for evaluating load tolerance of a postpartum player in the *recondition* phase (approximately 6–14 weeks postpartum) has been adapted from the World Rugby Postpartum guidelines (World Rugby, 2024) and is shown in Table 3.

Evaluation should consider internal (the player's individual ability to tolerate load e.g. postpartum PFM strength and endurance) and external (e.g., number of tackle events) load. Sudden spikes in training load may increase the risk of injury (Blanch et al., 2016) and consideration should also be given to a player's non-rugby life, female-specific and environmental factors (e.g., sleep deprivation, lactation, fear of movement and body image) (Christopher et al., 2023; Deering

TABLE 3 Example load tolerance testing criteria for the recondition phase (6–14 weeks) of return to rugby postpartum<sup>a</sup>.

Pelvic floor	Strengthening	Conditioning	Skills	Progression milestones
<p>Ability to do pelvic floor exercises in standing to include:</p> <ul style="list-style-type: none"> <li>• 8–12 reps of max voluntary contractions building up toward 10 s holds</li> <li>• 60 s submaximal 30%–50% contraction</li> <li>• Repeat 1–2 times a week</li> <li>• Integrate strategies to support pelvic floor strength training and plyometrics in symptomatic players</li> <li>• Access to repeat pelvic floor assessment at 8–10 weeks for more individual progression</li> </ul>	<p>Tolerate addition of progressive weight to exercises in all planes</p> <p>Rugby position specific exercises</p>	<ul style="list-style-type: none"> <li>• Symptom free toleration of non-impact conditioning as symptoms and comfort allow (e.g. bike, cross-trainer and swimming)</li> <li>• Progress plyometric exercises from horizontal movements to vertical movements</li> <li>• Progress running by increasing vertical load. Running volume should gradually increase within each progression. Example running progressions: <ul style="list-style-type: none"> <li>◦ Incline/anti-gravity/stairs</li> <li>◦ Straight line</li> <li>◦ Increased velocity</li> <li>◦ Change of direction, acceleration and deceleration drills</li> </ul> </li> </ul>	<p>Tolerate skill progression from static to walking to jogging</p> <p>Begin position specific non-contact skills progressions</p>	<p>No symptoms of pelvic floor dysfunction during strength progressions, plyometrics or running</p> <p>Pain free during running</p> <p>No onset of breast pain with return to impact exercise</p> <p>Lower limb strength markers within 85% of baseline (if pre-pregnancy data available)</p> <p>Single leg lower limb muscle endurance between 20 and 30 repetitions (e.g. hamstring bridge, calf raise and body weight squat)</p>

<sup>a</sup>Adapted from World Rugby's Return to Rugby Union Postpartum Guidelines (World Rugby, 2024).

et al., 2023, 2024; Donnelly, Brockwell, et al., 2022; van Niekerk et al., 2023). The identification of poor load tolerance suggests the need to modify or regress training. Progression of postpartum players who present with symptoms, such as urinary incontinence, should be reasoned in terms of their risk to proceeding with return-to-sport in the context of a whole-systems approach (Donnelly, Brockwell, et al., 2022). Therefore, decision-making will be player specific and informed by what is best for their overall well-being. In the absence of robust research to inform practice, it is currently proposed that players who tolerate rugby load and contact training consistently for 3 weeks and are at least 16 weeks postpartum (World Rugby, 2024) can progress toward matches and performance, signifying the *return* and *refine* stages of the *6 Rs framework* (Donnelly, Moore, et al., 2022). The *refine* stage aligns with established return-to-sport injury frameworks (Ardern et al., 2016; Gledhill et al., 2022) by promoting a phase of individual player monitoring and testing that focuses beyond rehabilitation (Draovitch et al., 2022).

## 8 | RECOMMENDATIONS FOR FUTURE RESEARCH, POLICY DEVELOPMENT AND SURVEILLANCE

Governing bodies and clubs are encouraged to engage with players, coaches, health professionals and academics to develop appropriate policy, guidance and surveillance systems to continue the advancement of player welfare in women's rugby. Policy should provide cultural, financial and medical support to postpartum players as they navigate the challenges of being a mother-athlete. A shift toward advancing player welfare in the women's game has led to the recently

established *maternity, pregnant parent and adoption leave policy* for contracted England rugby women's players (England Rugby, 2023) and World Rugby's *Return to Rugby Postpartum Guidelines* (World Rugby, 2024). They aim to facilitate equity across the globe for postpartum players in terms of guidance and recommendations, but further equity work is needed on other aspects of the women's game (see Non's Special Edition paper Non et al., 2024). Additionally, to enable players to make informed choices surrounding family planning, education on fertility, understanding signs that may indicate a pregnancy and awareness around returning to fertility postpartum are encouraged.

Importantly, policy, guidance and surveillance may need to differ based on available resources. For example, the support structures for postpartum players should be considered when determining training activities (e.g., what they *can* undertake), training times (e.g., childcare provision) and venues (e.g., pram accessibility and breastfeeding, changing and toilet facilities). Moreover, better support provisions for childcare are necessary in women's rugby to enable female athlete development and retention within sport. This is particularly pertinent in the professional game where rugby constitutes a postpartum players career. Injury and illness surveillance during the postpartum period has been highlighted within different sections of this review and can be adapted to suit the resources available by applying different injury definitions and reporting procedures (Brown et al., 2019). Such surveillance should include female athlete health domains (Moore et al., 2023), and, where possible, non-time-loss health problems (Table 4) (Moore et al., 2023, 2024; World Rugby, 2024). See Moore and colleagues in this Special Edition (Moore et al., 2024). Fundamentally, welfare and long-term player health should go beyond player surveillance with a need to focus on access to

TABLE 4 Recommendations for policy development, surveillance, and future research for female return to rugby.

Recommendation	Justification/specific examples
Policy should be created for pregnancy, maternity and adoption leave	To ensure female players can make an informed decision regarding playing careers and family
Guidance on return to rugby postpartum	To provide guidance to all rugby clubs on how to support postpartum players to safely return to rugby. Such guidance should include: <ol style="list-style-type: none"> <li>1) Minimising deconditioning during pregnancy and planning for postpartum return to sport (education and early postpartum recovery planning)</li> <li>2) Access to medical and/or pelvic health physiotherapy review 6–8 weeks postpartum</li> <li>3) A phased return to rugby underpinned by an appropriate return to sport framework (e.g. the 6 Rs)</li> <li>4) Acknowledgment of the need for a multi-disciplinary healthcare team</li> <li>5) Screening of the pelvic floor muscles, abdominal wall and signs and symptoms of pelvic floor dysfunction</li> <li>6) Screening of whole-body strength and musculoskeletal pain</li> <li>7) Whole-system considerations (e.g. a biopsychosocial approach)</li> <li>8) Practical and flexible measures in place to support postpartum return to sport (e.g. access to breastfeeding/expressing space and training time)</li> </ol>
Female-specific injury and illness surveillance systems (Moore et al., 2023)	To better inform injury prevention strategies in women's rugby female athlete, health domains should be included and non-time-loss health problems recorded (e.g. DRA, symptoms of PFD, breast injuries, pain, whole-body strength and mental health). For full list of recommendations see Moore et al. (Moore et al., 2024) in this special issue.
Research on injury, female health and physical performance with a perinatal focus	Perinatal-specific research is essential for evidence-informed policy and guidance. Examples for future research that can be undertaken across all codes and levels of rugby include: <ol style="list-style-type: none"> <li>1) Proactive approaches to postpartum return-to-sport</li> <li>2) The recovery of the pelvic floor muscles in rugby players</li> <li>3) Determining the prevalence of breastfeeding and associated breast health problems (including incidence, severity and mechanisms of contact induced trauma)</li> <li>4) Examining the forces the breasts are exposed to in rugby</li> <li>5) Quantify the level of deconditioning and identify most effective reconditioning intervention(s)</li> <li>6) Nutritional needs of female rugby players</li> </ol>

Abbreviations: DRA, diastasis rectus abdominis; PFD, pelvic floor dysfunction.

education and support across the player lifespan and levels of play (e.g., from girls and community to the elite women's game) alongside player involvement in decision-making and collaboration throughout the process (Gledhill et al., 2022). Applied to this context, it is proposed that such approach may improve women's rugby development, performance and retention. It also serves to educate others involved in the women's game (match officials, coaches, fans and family members) regarding key aspects of women's holistic wellbeing.

High-quality research across several areas is needed to enable evidence to inform policy and guidance in women's rugby. Unfortunately, the current body of rugby research predominantly focuses on males. A Delphi consensus (Heyward et al., 2022) identified three priority research areas in women's rugby: injury, female health and physical performance. While these priorities encompass the entirety of the women's game and the consensus cohort had limited player representation, they may be applied to the postpartum period. Injuries

during and pain following, return-to-sport postpartum have been reported (Kimber et al., 2021; Moore et al., 2021). Understanding the incidence and risk factors of injury during this time would be beneficial to inform progressions during postpartum return-to-sport. Female health covers a myriad of considerations, and research is needed to improve knowledge relating to several focuses outlined in Table 4. Undertaking female-specific perinatal rugby research across injury, health and physical performance, including consideration for preventative approaches, will ensure future policies and guidance can be grounded by rugby-specific evidence. Finally, there is a need to evaluate postpartum specific return-to-sport frameworks, and this is likely to be best executed within specific sports. Drawing from the findings of an injury prevention program evaluation in women's elite football (Bruder et al., 2024), implementing and testing return-to-sport postpartum protocols should include key stakeholders at multiple ecological levels (e.g., organisation, coaches and athletes).

## 9 | CONCLUSION

A whole-systems, biopsychosocial approach following an evidence informed return-to-sport framework is advocated when rehabilitating postpartum rugby players to return-to-sport. We have outlined several considerations that are specific to the perinatal player and encourage health and exercise professionals working in women's rugby to devise postpartum-specific rehabilitation protocols and resources with these in mind. Recommendations made within this review can serve as the foundation for such protocols, resources and support provided to postpartum rugby players in their return-to-sport.

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### CONFLICT OF INTEREST STATEMENT

The authors report that there are no competing interests to declare.

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### REFERENCES

- AIS. 2021. *Pelvic Health for Pregnant and Post-Natal Athletes*. Australian Institute of Sport: Australian Institute of Sport.
- Almadani, Yasser H., Joshua Vorstenbosch, Peter G. Davison, and Amanda M. Murphy. 2021. "Wound Healing: A Comprehensive Review." *Seminars in Plastic Surgery* 35(3): 141–4. Epub 20210715 PubMed PMID: 34526860; PubMed Central PMCID: PMC8432991. <https://doi.org/10.1055/s-0041-1731791>.
- Anderson, Julie, Jessica Pudwell, Colin McAuslan, Logan Barr, Jessica Kehoe, and Gregory A. Davies. 2021. "Acute Fetal Response to High-Intensity Interval Training in the Second and Third Trimesters of Pregnancy." *Applied Physiology Nutrition and Metabolism* 46(12): 1552–8. Epub 20210825 PubMed PMID: 34433004. <https://doi.org/10.1139/apnm-2020-1086>.
- Ardern, Clare L., Philip Glasgow, Anthony Schneiders, Erik Witvrouw, Benjamin Clarsen, Ann Cools, Boris Gojanovic, et al. 2016. "Consensus Statement on Return to Sport from the First World Congress in Sports Physical Therapy, Bern." *British Journal of Sports Medicine* 50(14): 853–64. Epub 20160525PubMed PMID: 27226389. <https://doi.org/10.1136/bjsports-2016-096278>.
- Avery, Kerry, Jenny Donovan, Tim J. Peters, Christine Shaw, Momokazu Gotoh, and Paul Abrams. 2004. "ICIQ: A Brief and Robust Measure for Evaluating the Symptoms and Impact of Urinary Incontinence." *Neurourology and Urodynamics* 23(4): 322–30. PubMed PMID: 15227649. <https://doi.org/10.1002/nau.20041>.
- Baessler, Kaven, Sheila M. O'Neill, Christopher F. Maher, and Diana Battistutta. 2009. "Australian Pelvic Floor Questionnaire: A Validated Interviewer-Administered Pelvic Floor Questionnaire for Routine Clinic and Research." *International Urogynecology Journal and Pelvic Floor Dysfunction* 20(2): 149–58. Epub 20081029 PubMed PMID: 18958382. <https://doi.org/10.1007/s00192-008-0742-4>.
- Beesley, R. J. J. 2008. In *The Breast during Pregnancy and Lactation*, edited by Obstetrics TIFoGa. The Alliance for Global Women's Medicine: Glob. libr. women's med.
- Beetham, Kassia S., Courtney Giles, Michael Noetel, Vicki Clifton, Jacqueline C. Jones, and Geraldine Naughton. 2019. "The Effects of Vigorous Intensity Exercise in the Third Trimester of Pregnancy: A Systematic Review and Meta-Analysis." *BMC Pregnancy and Childbirth* 19(1): 281. Epub 20190807 PubMed PMID: 31391016; PubMed Central PMCID: PMC6686535. <https://doi.org/10.1186/s12884-019-2441-1>.
- Bjelica, Artur, and Petronila Kapor-Stanulovic. 2004. "Pregnancy as a Psychological Event." *Medicinski Pregled* 57(3–4): 144–8. PubMed PMID: 15462597. <https://doi.org/10.2298/mpns0404144b>.
- Blanch, Peter, and Tim J. Gabbett. 2016. "Has the Athlete Trained Enough to Return to Play Safely? the Acute: Chronic Workload Ratio Permits Clinicians to Quantify a Player's Risk of Subsequent Injury." *British Journal of Sports Medicine* 50(8): 471–5. Epub 20151223 PubMed PMID: 26701923. <https://doi.org/10.1136/bjsports-2015-095445>.
- Bø, Kari, Raul Artal, Ruben Barakat, Wendy J. Brown, Gregory A. L. Davies, Michael Dooley, Kelly R. Evenson, et al. 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." *British Journal of Sports Medicine* 51(21): 1516–25. <https://doi.org/10.1136/bjsports-2017-097964>.
- Bø, Kari, Raul Artal, Ruben Barakat, Wendy J. Brown, Gregory A. L. Davies, Michael Dooley, Kelly R. Evenson, et al. 2018. "Exercise and Pregnancy in Recreational and Elite Athletes: 2016/2017 Evidence Summary from the IOC Expert Group Meeting, Lausanne. Part 5. Recommendations for Health Professionals and Active Women." *British Journal of Sports Medicine* 52(17): 1080–5. <https://doi.org/10.1136/bjsports-2018-099351>.
- Bø, Kari, Karoline Næss, Jette Stær-Jensen, Franziska Sifarikas, Marie Ellström Engh, and Gunvor Hilde. 2022. "Recovery of Pelvic Floor Muscle Strength and Endurance 6 and 12 Months Postpartum in Primiparous Women—A Prospective Cohort Study." *Int Urogynecol J* 33(12): 3455–64. Epub 20220901 PubMed PMID: 36048249; PubMed Central PMCID: PMC9666345. <https://doi.org/10.1007/s00192-022-05334-y>.
- Bø, Kari, and Ingrid Elisabeth Nygaard. 2020. "Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review." *Sports Medicine* 50(3): 471–84. PubMed PMID: 31820378; PubMed Central PMCID: PMC7018791. <https://doi.org/10.1007/s40279-019-01243-1>.
- Brisbine, Brooke R., Julie R. Steele, Elissa Phillips, and Deirdre E. McGhee. 2020. "Breast Injuries Reported by Female Contact Football Players Based on Football Code, Player Position and Competition Level." *Science and Medicine in Football* 4(2): 148–55. <https://doi.org/10.1080/24733938.2019.1682184>.
- Brown, James C., Matthew Cross, Michael England, Caroline F. Finch, Gordon W. Fuller, Simon P. Kemp, Ken Quarrie, et al. 2019. "Guidelines for Community-Based Injury Surveillance in Rugby

- Union." *Journal of Science and Medicine in Sport* 22(12): 1314–8: Epub 20190812 PubMed PMID: 31445950. <https://doi.org/10.1016/j.jsams.2019.08.006>.
- Bruder, Andrea M., Brooke E. Patterson, Kay M. Crossley, Andrea B. Mosler, Melissa J. Haberfeld, Martin Hägglund, Adam G. Culvenor, Sallie M. Cowan, and Alex Donaldson. 2024. "If We Build it Together, Will They Use it? A Mixed-Methods Study Evaluating the Implementation of Prep-To-Play PRO: An Injury Prevention Programme for Women's Elite Australian Football." *British Journal of Sports Medicine* 58(4): 213–21: bjsports-2023-107518. <https://doi.org/10.1136/bjsports-2023-107518>.
- Buckthorpe, Matthew, Francesco Della Villa, Stefano Della Villa, and Giulio Sergio Roi. 2019. "On-field Rehabilitation Part 2: A 5-Stage Program for the Soccer Player Focused on Linear Movements, Multidirectional Movements, Soccer-specific Skills, Soccer-specific Movements, and Modified Practice." *Journal of Orthopaedic & Sports Physical Therapy* 49(8): 570–5: Epub 20190710 PubMed PMID: 31291556. <https://doi.org/10.2519/jospt.2019.8952>.
- Calik-Ksepka, Anna, Monika Stradczuk, Karolina Czarnecka, Monika Grymowicz, and Roman Smolarczyk. 2022. "Lactational Amenorrhoea: Neuroendocrine Pathways Controlling Fertility and Bone Turnover." *International Journal of Molecular Sciences* 23(3): 1633: Epub 20220131 PubMed PMID: 35163554; PubMed Central PMCID: PMC8835773. <https://doi.org/10.3390/ijms23031633>.
- Campanelli, G. 2021. "Umbilical Hernia, Epigastric Hernia and Diastasis Recti: An Open Discussion." *Hernia* 25(3): 559–60. <https://doi.org/10.1007/s10029-021-02436-2>.
- Cardaillac, Claire, Sarah Vieillefosse, Anne Oppenheimer, Yolaine Joueidi, Thibault Thubert, and Xavier Deffieux. 2020. "Diastasis of the Rectus Abdominis Muscles in Postpartum: Concordance of Patient and Clinician Evaluations, Prevalence, Associated Pelvic Floor Symptoms and Quality of Life." *European Journal of Obstetrics & Gynecology and Reproductive Biology* 252: 228–32: Epub 20200623 PubMed PMID: 32623254. <https://doi.org/10.1016/j.ejogrb.2020.06.038>.
- Christopher, Shefali Mathur, Gráinne Donnelly, Emma Brockwell, Kari Bo, Margie H. Davenport, Marlize De Vivo, Sinead Dufour, et al. 2023. "Clinical and Exercise Professional Opinion of Return-To-Running Readiness after Childbirth: An International Delphi Study and Consensus Statement." *British Journal of Sports Medicine* 58(6): 299–312: bjsports-2023-107489. <https://doi.org/10.1136/bjsports-2023-107489>.
- Christopher, Shefali Mathur, Sandra Gallagher, Amanda Olson, Sara Cichowski, and Rita E. Deering. 2022. "Rehabilitation of the Postpartum Runner: A 4-Phase Approach." *The Journal of Women's & Pelvic Health Physical Therapy* 46(2): 73–86: PubMed PMID: 01274882-202204000-00003. <https://doi.org/10.1097/jwh.000000000000230>.
- Coldron, Yvonne, Maria J. Stokes, Di J. Newham, and Katy Cook. 2008. "Postpartum Characteristics of Rectus Abdominis on Ultrasound Imaging." *Manual Therapy* 13(2): 112–21: Epub 20070105 PubMed PMID: 17208034. <https://doi.org/10.1016/j.math.2006.10.001>.
- Conder, Rebecca, Reza Zamani, and Mohammad Akrami. 2019. "The Biomechanics of Pregnancy: A Systematic Review." *J Funct Morphol Kinesiol* 4(4): 72: Epub 20191202 PubMed PMID: 33467386; PubMed Central PMCID: PMC7739277. <https://doi.org/10.3390/jfmk4040072>.
- Cook, Ji, and Si Docking. 2015. "Rehabilitation Will Increase the 'capacity' of Your ...insert Musculoskeletal Tissue here..." Defining 'tissue Capacity': a Core Concept for Clinicians." *British Journal of Sports Medicine* 49(23): 1484–5. <https://doi.org/10.1136/bjsports-2015-094849>.
- Costantakos, Anastasia V., and Susan M. Watkins. 1982. "Pressure Analysis as a Design Research Technique for Increasing the Comfort of Nursing Brassieres." *Home Economics Research Journal* 10(3): 271–8. <https://doi.org/10.1177/1077727X8201000306>.
- Cox, David B., Jacqueline C. Kent, Tammy M. Casey, Robyn A. Owens, and Peter E. Hartmann. 1999. "Breast Growth and the Urinary Excretion of Lactose during Human Pregnancy and Early Lactation: Endocrine Relationships." *Experimental Physiology* 84(2): 421–34: PubMed PMID: 10226182. <https://doi.org/10.1111/j.1469-445x.1999.01807.x>.
- Culleton-Quinn, Elizabeth, Kari Bø, Neil Fleming, David Mockler, Cinny Cusack, and Déirdre Daly. 2022. "Elite Female Athletes' Experiences of Symptoms of Pelvic Floor Dysfunction: A Systematic Review." *International Urogynecology Journal* 33(10): 2681–711: Epub 20220830 PubMed PMID: 36040507; PubMed Central PMCID: PMC9477953. <https://doi.org/10.1007/s00192-022-05302-6>.
- Cunha, Lúcio A., Júlio A. Costa, Elisa A. Marques, João Brito, Michele Lastella, and Pedro Figueiredo. 2023. "The Impact of Sleep Interventions on Athletic Performance: A Systematic Review." *Sports Medicine - Open* 9(1): 58: Epub 20230718 PubMed PMID: 37462808; PubMed Central PMCID: PMC10354314. <https://doi.org/10.1186/s40798-023-00599-z>.
- Curry, A. 2016. The Future of Rugby: HSBC Report: [12/08/2023]. Available from: <https://br.kantar.com/media/1290229/the-future-of-rugby-an-hsbc-report>.
- Dacic, Jodie G., Jill Cook, Jean Hay-Smith, K.-Yin Lin, and Helena Frawley. 2021. "Pelvic Floor Disorders Stop Women Exercising: A Survey of 4556 Symptomatic Women." *Journal of Science and Medicine in Sport* 24(12): 1211–7. <https://doi.org/10.1016/j.jsams.2021.06.003>.
- Dacic, Jodie G., Jean Hay-Smith, Jill Cook, K.-Yin Lin, and Helena C. Frawley. 2023. "Screening for Pelvic Floor Symptoms in Exercising Women: a Survey of 636 Health and Exercise Professionals." *Journal of Science and Medicine in Sport* 26(2): 80–6. <https://doi.org/10.1016/j.jsams.2023.01.008>.
- Dane, Kathryn, Geraldine Foley, Sharief Hendricks, and Fiona Wilson. 2023. "'It's Always the Bare Minimum' - A Qualitative Study of Players' Experiences of Tackle Coaching in Women's Rugby Union." *Journal of Science and Medicine in Sport* 26(2): 149–55: Epub 20230110 PubMed PMID: 36669901. <https://doi.org/10.1016/j.jsams.2023.01.002>.
- Dane, Kathryn, Geraldine Foley, and Fiona Wilson. 2023. "'Body on the Line': Experiences of Tackle Injury in Women's Rugby Union - A Grounded Theory Study." *British Journal of Sports Medicine* 57(23): 1476–83: bjsports-2022-106243. <https://doi.org/10.1136/bjsports-2022-106243>.
- Dane, Kathryn, Ciaran Simms, Sharief Hendricks, Stephen W. West, Steffan Griffin, Frank J. Nugent, Garreth Farrell, David Mockler, and Fiona Wilson. 2022. "Physical and Technical Demands and Preparatory Strategies in Female Field Collision Sports: A Scoping Review." *International Journal of Sports Medicine* 43(14): 1173–82: Epub 20220629 PubMed PMID: 35767989. <https://doi.org/10.1055/a-1839-6040>.
- Darroch, Francine, Amy Schneeberg, Ryan Brodie, Zachary M. Ferraro, Dylan Wykes, Sarita Hira, Audrey R. Giles, Kristi B. Adamo, and Trent Stellingwerff. 2023. "Effect of Pregnancy in 42 Elite to World-Class Runners on Training and Performance Outcomes." *Medicine & Science in Sports & Exercise* 55(1): 93–100: Epub 20220816 PubMed PMID: 35975937. <https://doi.org/10.1249/mss.0000000000003025>.
- Davenport, Margie H., Rshmi Khurana, Jane S. Thornton, and T.-Leigh F. McHugh. 2023. "'It's Going to Affect Our Lives, Our Sport and Our Career': Time to Raise the Bar for Pregnant and Postpartum Athletes." *British Journal of Sports Medicine* 57(14): 893–4: bjsports-2023-107256. <https://doi.org/10.1136/bjsports-2023-107256>.
- Davenport, Margie H., Autumn Nesdoly, Lauren Ray, Jane S. Thornton, Rshmi Khurana, and T.-Leigh F. McHugh. 2022. "Pushing for Change: A Qualitative Study of the Experiences of Elite Athletes during

- Pregnancy." *British Journal of Sports Medicine* 56(8): 452–7. <https://doi.org/10.1136/bjsports-2021-104755>.
- Davenport, Margie H., Lauren Ray, Autumn Nesdoly, Jane Thornton, Rshmi Khurana, and T.-Leigh F. McHugh. 2023. "We're Not Superhuman, We're Human: A Qualitative Description of Elite Athletes' Experiences of Return to Sport after Childbirth." *Sports Medicine* 53(1): 269–79. <https://doi.org/10.1007/s40279-022-01730-y>.
- Deering, Rita E., Shefali M. Christopher, and Bryan C. Heiderscheit. 2020. "From Childbirth to the Starting Blocks: Are We Providing the Best Care to Our Postpartum Athletes?" *Journal of Orthopaedic & Sports Physical Therapy* 50(6): 281–4. PubMed PMID: 32476582. <https://doi.org/10.2519/jospt.2020.0607>.
- Deering, Rita E., Meredith Cruz, Jonathon W. Senefeld, Tatyana Pashibin, Sarah Eickmeyer, and Sandra K. Hunter. 2018. "Impaired Trunk Flexor Strength, Fatigability, and Steadiness in Postpartum Women." *Medicine & Science in Sports & Exercise* 50(8): 1558–69. PubMed PMID: 29554014; PubMed Central PMCID: PMC6045430. <https://doi.org/10.1249/mss.0000000000001609>.
- Deering, Rita E., Gráinne M. Donnelly, Emma Brockwell, Kari Bo, Margie H. Davenport, Marlize De Vivo, Sinead Dufour, et al. 2024. "Clinical and Exercise Professional Opinion on Designing a Postpartum Return-To-Running Training Programme: An International Delphi Study and Consensus Statement." *British Journal of Sports Medicine* 58(4): 183–95. <https://doi.org/10.1136/bjsports-2023-107490>.
- Deering, Rita E., and Margo L. Mountjoy. 2023. "REDS and the Lactating Athlete: An Evidence Gap." *British Journal of Sports Medicine* 57(17): 1065–6. PubMed PMID: 37752008. <https://doi.org/10.1136/bjsports-2023-107080>.
- DeLancey, John OL., Lisa Kane Low, Janis M. Miller, Divya A. Patel, and Julie A. Tumbarello. 2008. "Graphic Integration of Causal Factors of Pelvic Floor Disorders: An Integrated Life Span Model." *American Journal of Obstetrics and Gynecology* 199(6): 610.e1–5. Epub 20080604 PubMed PMID: 18533115; PubMed Central PMCID: PMC2764236. <https://doi.org/10.1016/j.ajog.2008.04.001>.
- de Mattos Lourenco, Thais Regina, Priscila Katsumi Matsuoka, Edmund Chada Baracat, and Jorge Milhem Haddad. 2018. "Urinary Incontinence in Female Athletes: A Systematic Review." *International Urogynecology Journal* 29(12): 1757–63. Epub 20180319 PubMed PMID: 29552736. <https://doi.org/10.1007/s00192-018-3629-z>.
- Donnelly, G. 2019. "Diastasis Rectus Abdominis: Physiotherapy Management." *Pelvic Obstetric and Gynaecological Physiotherapy* 124: 15–9.
- Donnelly, Gráinne M., Emma Brockwell, Alan Rankin, and Isabel S. Moore. 2022. "Beyond the Musculoskeletal System: Considering Whole-Systems Readiness for Running Postpartum." *The Journal of Women's & Pelvic Health Physical Therapy* 46(1): 48–56. <https://doi.org/10.1097/jwh.0000000000000218>.
- Donnelly, Gráinne M., Megan L. James, Celeste E. Coltman, Emma Brockwell, Joanna Perkins, and Isabel S. Moore. 2022. "Running during Pregnancy and Postpartum, Part B: How Does Running-Related Advice and Guidance Received during Pregnancy and Postpartum Affect Women's Running Habits?" *The Journal of Women's & Pelvic Health Physical Therapy* 46(3): 124–31. <https://doi.org/10.1097/jwh.0000000000000240>.
- Donnelly, Gráinne M., and Isabel S. Moore. 2023. "Sports Medicine and the Pelvic Floor." *Current Sports Medicine Reports* 22(3): 82–90. PubMed PMID: 00149619-202303000-00007. <https://doi.org/10.1249/jsr.0000000000001045>.
- Donnelly, Gráinne M., Isabel S. Moore, Emma Brockwell, Alan Rankin, and Rosalyn Cooke. 2022. "Reframing Return-To-Sport Postpartum: The 6 Rs Framework." *British Journal of Sports Medicine* 56(5): 244–5. <https://doi.org/10.1136/bjsports-2021-104877>.
- Donnelly, Grainne Marie, Alan Rankin, Hayley Mills, Marlize De Vivo, Thomas SH. Goom, and Emma Brockwell. 2020. "Guidance for Medical, Health and Fitness Professionals to Support Women in Returning to Running Postnatally." *British Journal of Sports Medicine* 54(18): 1114–5. Epub 20200506 PubMed PMID: 32376675. <https://doi.org/10.1136/bjsports-2020-102139>.
- Donnelly, GM., K. Bø, LB. Forner, A. Rankin, and IS. Moore. 2024. "Up for the Tackle? The Pelvic Floor and Rugby. A Review." *European Journal of Sport Science*. <https://doi.org/10.1002/ejsc.12121>
- Draovitch, Pete, Snehal Patel, William Marrone, M. Jake Grundstein, Reg Grant, Adam Virgile, Tom Myslinski, et al. 2022. "The Return-To-Sport Clearance Continuum Is a Novel Approach toward Return to Sport and Performance for the Professional Athlete." *Arthrosc Sports Med Rehabil* 4(1): e93–101. Epub 20220128 PubMed PMID: 35141541; PubMed Central PMCID: PMC8811516. <https://doi.org/10.1016/j.asmr.2021.10.026>.
- Ekstrand, Jan, Carl Askling, Henrik Magnusson, and Kai Mithoefer. 2013. "Return to Play after Thigh Muscle Injury in Elite Football Players: Implementation and Validation of the Munich muscle Injury Classification." *British Journal of Sports Medicine* 47(12): 769–74. Epub 20130505 PubMed PMID: 23645834; PubMed Central PMCID: PMC3717808. <https://doi.org/10.1136/bjsports-2012-092092>.
- Elliott-Sale, KJ. 2023. "Pregnancy, Sex Hormones, and Exercise." In *Sex Hormones, Exercise and Women: Scientific and Clinical Aspects*, edited by A. C. Hackney, 327–49. Cham: Springer International Publishing.
- Emmonds, Stacey, Dan Weaving, Nicholas Dalton-Barron, Gordon Rennie, Richard Hunwicks, Jason Tee, Cameron Owen, and Ben Jones. 2020. "Locomotor Characteristics of the Women's Inaugural Super League Competition and the Rugby League World Cup." *J Sports Sci* 38(21): 2454–61. Epub 20200723 PubMed PMID: 32701387. <https://doi.org/10.1080/02640414.2020.1790815>.
- England Rugby. New Maternity, Pregnant Parent & Adoption Leave Policy for England Women Players England Rugby 2023 [cited 2023 07/08/2023]. Available from: <https://www.englandrugby.com/news/article/new-maternity-pregnant-parent-adoption-leave-policy-for-england-women-players>.
- England Rugby. 2023. *Rugbysafe Toolkit - Womens and Girls Healthcare Rugby Football Union: Keep Your Boots on*: Available from: <https://keepyourbootson.co.uk/rugbysafe-toolkit/women-girls-healthcare/>.
- Escrivá, Dolores, Jordi Caplliure-Llopis, Inmaculada Benet, Gonzalo Mariscal, Juan Vicente Mampel, and Carlos Barrios. 2021. "Differences in Adiposity Profile and Body Fat Distribution between Forwards and Backs in Sub-elite Spanish Female Rugby Union Players." *Journal of Clinical Medicine* 10(23): 5713. Epub 20211206 PubMed PMID: 34884415; PubMed Central PMCID: PMC8658519. <https://doi.org/10.3390/jcm10235713>.
- Faguy, K. 2015. "Breast Disorders in Pregnant and Lactating Women." *Radiologic Technology* 86(4): 419M–38M: quiz 39M–42M. PubMed PMID: 25835417.
- Fan, Chenglei, Diego Guidolin, Serena Ragazzo, Caterina Fede, Carmelo Pirri, Nathaly Gaudreault, Andrea Porzionato, Veronica Macchi, Raffaele De Caro, and Carla Stecco. 2020. "Effects of Cesarean Section and Vaginal Delivery on Abdominal Muscles and Fasciae." *Medicina (Kaunas)* 56(6): 260. Epub 20200527 PubMed PMID: 32471194; PubMed Central PMCID: PMC7353893. <https://doi.org/10.3390/medicina56060260>.
- Fletcher, Susan, Chad A. Grotegut, and Andra H. James. 2012. "Lochia Patterns Among Normal Women: A Systematic Review." *Journal of Women's Health* 21(12): 1290–4. PubMed PMID: 23101487. <https://doi.org/10.1089/jwh.2012.3668>.
- Fuentes Aparicio, Laura, Montserrat Rejano-Campo, Gráinne Marie Donnelly, and Victoria Vicente-Campos. 2021. "Self-reported Symptoms in Women with Diastasis Rectus Abdominis: A Systematic Review." *J Gynecol Obstet Hum Reprod* 50(7): 101995. Epub 20201120 PubMed PMID: 33227494. <https://doi.org/10.1016/j.jogoh.2020.101995>.
- Geldenhuys, A. Grethe, Theresa Burgess, Stephen Roche, and Sharief Hendricks. 2022. "Return to Play Protocols for Musculoskeletal Upper and Lower Limb Injuries in Tackle-Collision Team Sports: A

- Systematic Review." *European Journal of Sport Science* 22(11): 1743–56: Epub 20210813 PubMed PMID: 34328056. <https://doi.org/10.1080/17461391.2021.1960623>.
- Giagio, Silvia, Stefano Salvioli, Tiziano Innocenti, Giulia Gava, Marco Vecchiato, Paolo Pillastrini, and Andrea Turolla. 2023. "PFD-SENTINEL: Development of a Screening Tool for Pelvic Floor Dysfunction in Female Athletes through an International Delphi Consensus." *British Journal of Sports Medicine* 57(14): 899–905. <https://doi.org/10.1136/bjsports-2022-105985>.
- Giagio, Silvia, Stefano Salvioli, Paolo Pillastrini, and Tiziano Innocenti. 2021. "Sport and Pelvic Floor Dysfunction in Male and Female Athletes: A Scoping Review." *Neurourology and Urodynamics* 40(1): 55–64: Epub 20201102 PubMed PMID: 33137211. <https://doi.org/10.1002/nau.24564>.
- Giles, Audrey R., Breanna Phillipps, Francine E. Darroch, and Roisin McGettigan-Dumas. 2016. "Elite Distance Runners and Breastfeeding." *Journal of Human Lactation* 32(4): 627–32: Epub 20160820 PubMed PMID: 27512011. <https://doi.org/10.1177/0890334416661507>.
- Gillard, S., CG. Ryan, M. Stokes, M. Warner, and J. Dixon. 2018. "Effects of Posture and Anatomical Location on Inter-recti Distance Measured Using Ultrasound Imaging in Parous Women." *Musculoskelet Sci Pract* 34: 1–7: Epub 20171122 PubMed PMID: 29195217. <https://doi.org/10.1016/j.msksp.2017.11.010>.
- Gledhill, Adam, Dale Forsdyke, Tom Goom, and Leslie W. Podlog. 2022. "Educate, Involve and Collaborate: Three Strategies for Clinicians to Empower Athletes during Return to Sport." *British Journal of Sports Medicine* 56(5): 241–2. <https://doi.org/10.1136/bjsports-2021-104268>.
- Gokeler, Alli, Alberto Grassi, Roy Hoogeslag, Albert van Houten, Tim Lehman, Caroline Bolling, Matthew Buckthorpe, et al. 2022. "Return to Sports after ACL Injury 5 Years from Now: 10 Things We Must Do." *J Exp Orthop* 9(1): 73: Epub 20220730 PubMed PMID: 35907095; PubMed Central PMCID: PMC9339063. <https://doi.org/10.1186/s40634-022-00514-7>.
- Goom, TS., G. Donnelly, and E. Brockwell. 2024. Returning to Running Postnatal - Guidelines for Medical, Health and Fitness Professionals Managing This Population 2019: Available from: [https://www.researchgate.net/publication/335928424\\_Returning\\_to\\_running\\_postnatal\\_-\\_guidelines\\_for\\_medical\\_health\\_and\\_fitness\\_professionals\\_managing\\_this\\_population](https://www.researchgate.net/publication/335928424_Returning_to_running_postnatal_-_guidelines_for_medical_health_and_fitness_professionals_managing_this_population).
- Hackney, Anthony C. 2021. "Menstrual Cycle Hormonal Changes and Energy Substrate Metabolism in Exercising Women: A Perspective." *International Journal of Environmental Research and Public Health* 18(19): 10024: Epub 20210924 PubMed PMID: 34639326; PubMed Central PMCID: PMC8508274. <https://doi.org/10.3390/ijerph181910024>.
- Hayman, Melanie, Wendy J. Brown, Alison Brinson, Emily Budzynski-Seymour, Tracy Bruce, and Kelly R. Evenson. 2023. "Public Health Guidelines for Physical Activity during Pregnancy from Around the World: A Scoping Review." *British Journal of Sports Medicine* 57(14): 940–7: Epub 20230105 PubMed PMID: 36604155. <https://doi.org/10.1136/bjsports-2022-105777>.
- Hendricks, Sharief, Kevin Till, Jon L. Oliver, Rich D. Johnston, Matthew Attwood, James Brown, David Drake, et al. 2018. "Technical Skill Training Framework and Skill Load Measurements for the Rugby Union Tackle." *Strength and Conditioning Journal* 40(5): 44–59: PubMed PMID: 00126548-201810000-00005. <https://doi.org/10.1519/ssc.0000000000000400>.
- Henriksen, NA., A. Montgomery, R. Kaufmann, F. Berrevoet, B. East, J. Fischer, W. Hope, et al. 2020. "Guidelines for Treatment of Umbilical and Epigastric Hernias from the European Hernia Society and Americas Hernia Society." *British Journal of Surgery* 107(3): 171–90. <https://doi.org/10.1002/bjs.11489>.
- Heyward, Omar, Stacey Emmonds, Gregory Roe, Sean Scantlebury, Keith Stokes, and Ben Jones. 2022. "Applied Sports Science and Sports Medicine in Women's Rugby: Systematic Scoping Review and Delphi Study to Establish Future Research Priorities." *BMJ Open Sport Exerc Med* 8(3): e001287: Epub 20220721 PubMed PMID: 35979431; PubMed Central PMCID: PMC9310180. <https://doi.org/10.1136/bmjsem-2021-001287>.
- James, Megan L., Isabel S. Moore, Gráinne M. Donnelly, Emma Brockwell, Joanna Perkins, and Celeste E. Coltman. 2022. "Running during Pregnancy and Postpartum, Part A: Why Do Women Stop Running during Pregnancy and Not Return to Running in the Postpartum Period?" *The Journal of Women's & Pelvic Health Physical Therapy* 46(3): 111–23: PubMed PMID: 01274882-202207000-00002. <https://doi.org/10.1097/jwh.0000000000000228>.
- Johnson, Urban, Andreas Ivarsson, Jón Karlsson, Martin Hägglund, Markus Waldén, and Mats Börjesson. 2016. "Rehabilitation after First-Time Anterior Cruciate Ligament Injury and Reconstruction in Female Football Players: A Study of Resilience Factors." *BMC Sports Science, Medicine and Rehabilitation* 8(1): 20. <https://doi.org/10.1186/s13102-016-0046-9>.
- Joncheray, H. 2021. *Women in Rugby*. London: Routledge.
- Jones, Bethany J., Sukhmanjit Kaur, Michele Miller, and Rebecca M. C. Spencer. 2020. "Mindfulness-Based Stress Reduction Benefits Psychological Well-Being, Sleep Quality, and Athletic Performance in Female Collegiate Rowers." *Frontiers in Psychology* 11: 572980: Epub 20200918 PubMed PMID: 33071908; PubMed Central PMCID: PMC7531189. <https://doi.org/10.3389/fpsyg.2020.572980>.
- Kimber, Miranda L., Sarah Meyer, T.-Leigh Mchugh, Jane Thornton, Rshmi Khurana, Allison Sivak, and Margie H. Davenport. 2021. "Health Outcomes after Pregnancy in Elite Athletes: A Systematic Review and Meta-Analysis." *Medicine & Science in Sports & Exercise* 53(8): 1739–47. <https://doi.org/10.1249/mss.0000000000002617>.
- Kuwabara, Anne M., Adam S. Tenforde, Jonathan T. Finnoff, and Michael Fredericson. 2022. "Iron Deficiency in Athletes: A Narrative Review." *PM&R* 14(5): 620–42. <https://doi.org/10.1002/pmrj.12779>.
- Kvist, Joanna, and Karin Grävar Silbernagel. 2022. "Fear of Movement and Reinjury in Sports Medicine: Relevance for Rehabilitation and Return to Sport." *Physical Therapy* 102(2): PubMed PMID: 34971375. <https://doi.org/10.1093/ptj/pzab272>.
- Leinweber, Julia, Yvonne Fontein-Kuipers, Gill Thomson, Sigfridur Inga Karlsdottir, Christina Nilsson, Anette Ekström-Bergström, Ibone Olza, Eleni Hadjigeorgiou, and Claire Stramrood. 2022. "Developing a Woman-Centered, Inclusive Definition of Traumatic Childbirth Experiences: A Discussion Paper." *Birth* 49(4): 687–96: Epub 20220411 PubMed PMID: 35403241. <https://doi.org/10.1111/birt.12634>.
- Massey, Kelly L., and Amy E. Whitehead. 2022. "Pregnancy and Motherhood in Elite Sport: The Longitudinal Experiences of Two Elite Athletes." *Psychology of Sport and Exercise* 60: 102139. <https://doi.org/10.1016/j.psychsport.2022.102139>.
- McCarthy-Ryan, Molly, Joanna Perkins, Gráinne M. Donnelly, Yeomans Caithriona, Mairead Liston, Karina Leahy, Kari Bø, Patrick O'Halloran, and Isabel S. Moore. 2024. "Urinary Incontinence Prevalence and Risk Factors in Female Rugby Union Players: A Common Health Problem across Four Nations." *BMJ Open Sport & Exercise Medicine* 10(1): e001832. <https://doi.org/10.1136/bmjsem-2023-001832>.
- McGhee, Deirdre E., and Julie R. Steele. 2023. "Changes to Breast Structure and Function across a Woman's Lifespan: Implications for Managing and Modeling Female Breast Injuries." *Clinical Biomechanics* 107: 106031. <https://doi.org/10.1016/j.clinbiomech.2023.106031>.
- Meintjes, Vincent, Pip Forshaw, Steve den Hollander, Lindsay Starling, Michael Ian Lambert, Wayne Viljoen, Clint Readhead, and Sharief Hendricks. 2021. "Tackler and Ball-Carrier Technique during Moderate and Severe Injuries ( $\geq 8$  Days Lost) Compared with Player-Matched and Team-Matched Injury-free Controls in Elite Rugby Union." *British Journal of Sports Medicine* 55(24): 1411–9: Epub



- 20210713 PubMed PMID: 34257066. <https://doi.org/10.1136/bjsports-2020-103759>.
- Moore, Isabel S., Kay M. Crossley, Kari Bo, Margo Mountjoy, Kathryn E. Ackerman, Juliana da Silva Antero, Jorunn Sundgot Borgen, et al. 2023. "Female Athlete Health Domains: A Supplement to the International Olympic Committee Consensus Statement on Methods for Recording and Reporting Epidemiological Data on Injury and Illness in Sport." *British Journal of Sports Medicine* 57(18): 1164–74. <https://doi.org/10.1136/bjsports-2022-106620>.
- Moore, Isabel S., Megan L. James, Emma Brockwell, Joanna Perkins, Alex L. Jones, and Gráinne M. Donnelly. 2021. "Multidisciplinary, Biopsychosocial Factors Contributing to Return to Running and Running Related Stress Urinary Incontinence in Postpartum Women." *British Journal of Sports Medicine* 55(22): 1286–92. <https://doi.org/10.1136/bjsports-2021-104168>.
- Moore, Isabel S., Molly McCarthy-Ryan, Debbie Palmer, Joanna Perkins, and Evert Verhagen. 2024. "Is Your System Fit for Purpose? Female Athlete Health Considerations for Rugby Injury and Illness Surveillance Systems." *European Journal of Sport Science: Special Issue*. <https://doi.org/10.1002/ejss.12089>.
- Morris, Kristen, Juyeon Park, and Ajoy Sarkar. 2017. "Development of a Nursing Sports Bra for Physically Active Breastfeeding Women through User-Centered Design." *Clothing and Textiles Research Journal* 35(4): 290–306. <https://doi.org/10.1177/0887302X17722858>.
- Mota, Patrícia Gonçalves Fernandes da, Augusto Gil Brites Andrade Pascoal, Ana Isabel Andrade Dinis Carita, and Kari Bø. 2015. "Prevalence and Risk Factors of Diastasis Recti Abdominis from Late Pregnancy to 6 Months Postpartum, and Relationship with Lumbopelvic Pain." *Manual Therapy* 20(1): 200–5. Epub 20140919 PubMed PMID: 25282439. <https://doi.org/10.1016/j.math.2014.09.002>.
- Mountjoy, Margo, Kathryn E. Ackerman, David M. Bailey, Louise M. Burke, Naama Constantini, Anthony C. Hackney, Ida A. Heikura, et al. 2023. "International Olympic Committee's (IOC) Consensus Statement on Relative Energy Deficiency in Sport (REDS)." *British Journal of Sports Medicine* 57(17): 1073–97. PubMed PMID: 37752011. <https://doi.org/10.1136/bjsports-2023-106994>.
- Mountjoy, Margo, Jorunn Kaiander Sundgot-Borgen, Louise M. Burke, Kathryn E. Ackerman, Cheri Blauwet, Naama Constantini, Constance Lebrun, et al. 2018. "The 2023 International Olympic Committee's (IOC) Consensus Statement on Relative Energy Deficiency in Sports (REDS)." *British Journal of Sports Medicine* 52(11): 687–97. (Accepted for publication). <https://doi.org/10.1136/bjsports-2018-099193>.
- Mussawar, Minhal, Ashley A. Balsom, Julia O. Totony de Zepetnek, and Jennifer L. Gordon. 2023. "The Effect of Physical Activity on Fertility: A Mini-Review." *F S Rep* 4(2): 150–8. Epub 20230414 PubMed PMID: 37398617; PubMed Central PMCID: PMC10310950. <https://doi.org/10.1016/j.xfre.2023.04.005>.
- Myer, Gregory D., Kevin R. Ford, Scott G. McLean, and Timothy E. Hewett. 2006. "The Effects of Plyometric versus Dynamic Stabilization and Balance Training on Lower Extremity Biomechanics." *The American Journal of Sports Medicine* 34(3): 445–55. Epub 20051110 PubMed PMID: 16282579. <https://doi.org/10.1177/0363546505281241>.
- NICE. 2015. *Suspected Cancer: Recognition and Referral*. NICE guideline [NG12].
- NICE. 2019. *Urinary Incontinence and Pelvic Organ Prolapse in Women: Management*. <https://www.nice.org.uk/guidance/ng123/chapter/recommendations>.
- NICE. 2021a. *Postnatal Care*. National Institute of Clinical Excellence. [www.nice.org.uk](http://www.nice.org.uk).
- NICE. 2021b. "Pelvic Floor Dysfunction: Prevention and Non-surgical Management." *National Institute of Clinical Guidelines*: NG210.
- NICE CKS. 2021. *Gynaecological Cancers - Recognition and Referral: Symptoms Suggestive of Gynaecological Cancers*: Available from: <https://cks.nice.org.uk/topics/gynaecological-cancers-recognition-referral/diagnosis/symptoms-suggestive-of-gynaecological-cancers/>.
- NICE CKS. 2022. *Breastfeeding Problems: Scenario: Breastfeeding Problems - Management*: Available from: <https://cks.nice.org.uk/topics/breastfeeding-problems/management/breastfeeding-problems-management/>.
- Non et al. 2024. "Towards an Intersectoral Approach to Research in Women's Rugby." *EJSS Special Issue*.
- Perrier, Erica T., Evan C. Johnson, Amy L. McKenzie, Lindsay A. Ellis, and Lawrence E. Armstrong. 2016. "Urine Colour Change as an Indicator of Change in Daily Water Intake: A Quantitative Analysis." *European Journal of Nutrition* 55(5): 1943–9. Epub 20150819 PubMed PMID: 26286348; PubMed Central PMCID: PMC4949298. <https://doi.org/10.1007/s00394-015-1010-2>.
- Plumb, AA., ACJ. Windsor, and D. Ross. 2021. "Contemporary Imaging of Rectus Diastasis and the Abdominal Wall." *Hernia* 25(4): 921–7. <https://doi.org/10.1007/s10029-021-02463-z>.
- Prevett, Christina, Miranda L. Kimber, Lori Forner, Marlize de Vivo, and Margie H. Davenport. 2023. "Impact of Heavy Resistance Training on Pregnancy and Postpartum Health Outcomes." *Int Urogynecol J* 34(2): 405–11. Epub 20221104 PubMed PMID: 36331580. <https://doi.org/10.1007/s00192-022-05393-1>.
- Public Health Scotland. 2022. *Applying a Whole System Approach* [www.publichealthscotland.scot](http://www.publichealthscotland.scot). Public Health Scotland: [cited 2024 30/01/24]. Available from: <https://publichealthscotland.scot/our-organisation/about-public-health-scotland/supporting-whole-system-approaches/applying-a-whole-system-approach/#:~:text=A%20whole%20system%20approach%20involves%20applying%20systems%20thinking%2C,Scotland%E2%80%99s%20Public%20Health%20Priorities%20is%20a%20long-term%20endeavour>.
- Rahnamaei, Fatemeh Alsatat, Fatemeh Abdi, Elham Kazemian, N. Shaterian, N. Shaterian, and Fatemeh Behesht Aeen. 2022. "Association between Body Mass Index in the First Half of Pregnancy and Gestational Diabetes: A Systematic Review." *SAGE Open Med* 10: 20503121221109911. Epub 20220722 PubMed PMID: 35898952; PubMed Central PMCID: PMC9310335. <https://doi.org/10.1177/20503121221109911>.
- Reinhold, Wolfgang, Ferdinand Köckerling, Reinhard Bittner, Joachim Conze, René Fortelny, Andreas Koch, Jan Kukleta, Andreas Kuthe, Ralph Lorenz, and Bernd Stechemesser. 2019. "Classification of Rectus Diastasis-A Proposal by the German Hernia Society (DHG) and the International Endohernia Society (IEHS)." *Front Surg* 6: 1. Epub 20190128 PubMed PMID: 30746364; PubMed Central PMCID: PMC6360174. <https://doi.org/10.3389/fsurg.2019.00001>.
- Rooney, B., and CW. Schauburger. 2002. "Excess Pregnancy Weight Gain and Long-Term Obesity: One Decade Later." *Obstetrics & Gynecology* 100(2): 245–52. Epub 2002/08/02 PubMed PMID: 12151145. [https://doi.org/10.1016/s0029-7844\(02\)02125-7](https://doi.org/10.1016/s0029-7844(02)02125-7).
- Rugby Australia. 2023. 'This is the golden ticket': Wallaroos reflect on investment announcement [Rugby.com.au](http://Rugby.com.au): Rugby Australia: [29/01/2024]. Available from: <https://www.rugby.com.au/news/this-is-the-golden-ticket-wallaroos-reflect-on-investment-announcement-2023211>.
- Sandwith, Emily, and Magali Robert. 2021. "Rug-pee Study: the Prevalence of Urinary Incontinence Among Female University Rugby Players." *Int Urogynecol J* 32(2): 281–5. Epub 20200828 PubMed PMID: 32857177. <https://doi.org/10.1007/s00192-020-04510-2>.
- SantAnna, JPC., A. Pedrinelli, AJ. Hernandez, and TL. Fernandes. 2022. "Muscle Injury: Pathophysiology, Diagnosis, and Treatment." *Rev Bras Ortop (Sao Paulo)* 57(1): 1–13. Available from: <https://doi.org/10.1055/s-0041-1731417>.
- Scantlebury, Sean, Sam McCormack, Thomas Sawczuk, Stacey Emmonds, Neil Collins, Jake Beech, Carlos Ramirez, Cameron Owen, and Ben Jones. 2022. "The Anthropometric and Physical Qualities of Women's Rugby League Super League and International Players; Identifying Differences in Playing Position and Level." *PLoS One*

- 17(1): e0249803; Epub 20220131 PubMed PMID: 35100275; PubMed Central PMCID: PMC8803183. <https://doi.org/10.1371/journal.pone.0249803>.
- Shaw, Janet M., Nadia M. Hamad, Tanner J. Coleman, Marlene J. Egger, Yvonne Hsu, Robert Hitchcock, and Ingrid E. Nygaard. 2014. "Intra-abdominal Pressures during Activity in Women Using an Intra-vaginal Pressure Transducer." *J Sports Sci* 32(12): 1176–85; Epub 20140228 PubMed PMID: 24575741; PubMed Central PMCID: PMC3992988. <https://doi.org/10.1080/02640414.2014.889845>.
- Shorey, Shefaly, and Phyllis Zhi En Wong. 2022. "Traumatic Childbirth Experiences of New Parents: A Meta-Synthesis." *Trauma, Violence, & Abuse* 23(3): 748–63; Epub 20201201 PubMed PMID: 33256544. <https://doi.org/10.1177/1524838020977161>.
- Sircar, T., P. Mistry, S. Harries, D. Clarke, and L. Jones. 2010. "Seat-belt Trauma of the Breast in a Pregnant Woman Causing Milk-Duct Injury: A Case Report and Review of the Literature." *Annals of the Royal College of Surgeons of England* 92(5): W14–5; Epub 20100607 PubMed PMID: 20529454; PubMed Central PMCID: PMC5696944. <https://doi.org/10.1308/147870810x12659688851799>.
- Smith, Julie P., and Robert I. Forrester. 2021. "Association between Breastfeeding and New Mothers' Sleep: A Unique Australian Time Use Study." *International Breastfeeding Journal* 16(1): 7. <https://doi.org/10.1186/s13006-020-00347-z>.
- Soma-Pillay, P., C. Nelson-Piercy, H. Tolppanen, and A. Mebazaa. 2016. "Physiological Changes in Pregnancy." *Cardiovasc J Afr* 27(2): 89–94; PubMed PMID: 27213856; PubMed Central PMCID: PMC4928162. <https://doi.org/10.5830/cvja-2016-021>.
- Speranza, Michael JA., Tim J. Gabbett, David A. Greene, Rich D. Johnston, and Jeremy M. Sheppard. 2017. "Changes in Rugby League Tackling Ability during a Competitive Season: The Relationship with Strength and Power Qualities." *J Strength Cond Res* 31(12): 3311–8; PubMed PMID: 27379964. <https://doi.org/10.1519/jsc.0000000000001540>.
- Starling, Lindsay Toyah, Niki Gabb, Sean Williams, Simon Kemp, and Keith A. Stokes. 2023. "Longitudinal Study of Six Seasons of Match Injuries in Elite Female Rugby Union." *British Journal of Sports Medicine* 57(4): 212–7; Epub 20221125 PubMed PMID: 36428090. <https://doi.org/10.1136/bjsports-2022-105831>.
- Stodter, Anna, and Kathryn Dane. 2024. "The State of Play for Contact Training and Coaching in Women's Rugby." *European Journal of Sport Science*. <https://doi.org/10.1002/ejsc.12119>
- Sun, Xiaoqing, Xuemei Fan, Shengnan Cong, Rui Wang, Lijuan Sha, Hongyan Xie, Jingjing Han, Zhu Zhu, and Aixia Zhang. 2022. "Psychological Birth Trauma: A Concept Analysis." *Frontiers in Psychology* 13: 1065612; Epub 20230113 PubMed PMID: 36710822; PubMed Central PMCID: PMC9880163. <https://doi.org/10.3389/fpsyg.2022.1065612>.
- Sundgot-Borgen, Jorunn, Christine Sundgot-Borgen, Grethe Myklebust, Nina Sølberg, and Monica Klungland Torstveit. 2019. "Elite Athletes Get Pregnant, Have Healthy Babies and Return to Sport Early Postpartum." *BMJ Open Sport & Exercise Medicine* 5(1): e000652. <https://doi.org/10.1136/bmjsem-2019-000652>.
- Taberner, Matt, Nicol van Dyk, Tom Allen, Neil Jain, Chris Richter, Barry Drust, Esteban Betancur, and Daniel D. Cohen. 2020. "Physical Preparation and Return to Performance of an Elite Female Football Player Following ACL Reconstruction: A Journey to the FIFA Women's World Cup." *BMJ Open Sport Exerc Med* 6(1): e000843; Epub 20201201 PubMed PMID: 34422284; PubMed Central PMCID: PMC8323467. <https://doi.org/10.1136/bmjsem-2020-000843>.
- Thomaz, Rafaela Prusch, Cássia Colla, Caroline Darski, and Luciana Laureano Paiva. 2018. "Influence of Pelvic Floor Muscle Fatigue on Stress Urinary Incontinence: A Systematic Review." *Int Urogynecol J* 29(2): 197–204; Epub 20171220 PubMed PMID: 29264615. <https://doi.org/10.1007/s00192-017-3538-6>.
- Tighe, Boden Joel, Susan L. Williams, Courtney Porter, and Melanie Hayman. 2023. "Barriers and Enablers Influencing Female Athlete Return-To-Sport Postpartum: A Scoping Review." *British Journal of Sports Medicine* 57(22): 1450–6; Epub 20230927 PubMed PMID: 37758322. <https://doi.org/10.1136/bjsports-2023-107189>.
- Tucker, Matthew A., Aaron R. Caldwell, and Matthew S. Ganio. 2020. "Adequacy of Daily Fluid Intake Volume Can Be Identified from Urinary Frequency and Perceived Thirst in Healthy Adults." *Journal of the American College of Nutrition* 39(3): 235–42; Epub 20190726 PubMed PMID: 31347984. <https://doi.org/10.1080/07315724.2019.1639566>.
- Tuominen, R., T. Jahkola, T. Saisto, J. Arokoski, and J. Vironen. 2022. "The Prevalence and Consequences of Abdominal Rectus Muscle Diastasis Among Finnish Women: An Epidemiological Cohort Study." *Hernia* 26(2): 599–608; Epub 20210825 PubMed PMID: 34432175; PubMed Central PMCID: PMC9012726. <https://doi.org/10.1007/s10029-021-02484-8>.
- Turan, V., C. Colluoglu, E. Turkyilmaz, and U. Korucuoglu. 2011. "Prevalence of Diastasis Recti Abdominis in the Population of Young Multiparous Adults in Turkey." *Ginekologia Polska* 82(11): 817–21; PubMed PMID: 22384613.
- UK Sport. 2023. "Pregnancy Guidance and Support for UK Sport Funded Athletes (December 2023 update)." <https://www.uksport.gov.uk/resources/pregnancy-guidance>
- Vandeweyer, Eric, and Dina Hertens. 2002. "Quantification of Glands and Fat in Breast Tissue: An Experimental Determination." *Annals of Anatomy* 184(2): 181–4; PubMed PMID: 11936199. [https://doi.org/10.1016/s0940-9602\(02\)80016-4](https://doi.org/10.1016/s0940-9602(02)80016-4).
- van Niekerk, Maïke, Elizabeth Matzkin, and Melissa A. Christino. 2023. "Psychological Aspects of Return to Sport for the Female Athlete." *Arthrosc Sports Med Rehabil* 5(4): 100738; Epub 20230602 PubMed PMID: 37645384; PubMed Central PMCID: PMC10461158. <https://doi.org/10.1016/j.asmr.2023.04.021>.
- Vashi, Reena, Regina Hooley, Reni Butler, Jaime Geisel, and Liane Philpotts. 2013. "Breast Imaging of the Pregnant and Lactating Patient: Physiologic Changes and Common Benign Entities." *American Journal of Roentgenology* 200(2): 329–36; PubMed PMID: 23345354. <https://doi.org/10.2214/ajr.12.9845>.
- Wakefield-Scurr, Joanna, Zoe L. Saynor, and Fiona Wilson. 2023. "Tackling Breast Issues in Contact Sports." *British Journal of Sports Medicine* 57(18): 1160–1; Epub 20230705 PubMed PMID: 37407090. <https://doi.org/10.1136/bjsports-2023-106968>.
- Wakefield-Scurr, Joanna, Edward St John, K. Bibby, Nichola Helen Renwick, Neal Smith, Samantha Hobbs, and Nicola Brown. 2024. "Insights Into Breast Health Issues in Women's Rugby." *European Journal of Sport Science*. <https://researchportal.port.ac.uk/en/publications/insights-into-breast-health-issues-in-womens-rugby>
- Wang, Ziyi, Jiaye Liu, Huan Shuai, Zhongxiang Cai, Xia Fu, Yang Liu, Xiong Xiao, et al. 2021. "Mapping Global Prevalence of Depression Among Postpartum Women." *Translational Psychiatry* 11(1): 543. <https://doi.org/10.1038/s41398-021-01663-6>.
- West, Stephen W., Isla J. Shill, Christian Clermont, Nina Pavlovic, Joshua Cairns, Berlyn Seselja, Matthew V. Hancock, Simon P. Roberts, Sharief Hendricks, and Carolyn A. Emery. 2021. "Same Name, Same Game, but Is it Different? An Investigation of Female Rugby Union Match Events in Canadian Varsity Players." *International Journal of Sports Science & Coaching* 17(5): 1119–27. <https://doi.org/10.1177/17479541211051961>.
- World Health Organisation. 2023. Infant and Young Child Feeding Fact-sheet 2021: Available from: <https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding>.
- World Health Organization. 2016. Guideline: Iron Supplementation in Postpartum Women: Geneva.
- World Rugby. 2022. Contact Confident: Available from: <https://passport.world.rugby/injury-prevention-and-risk-management/tackle-ready/contact-confident/>. [Accessed 5th January 2024].
- World Rugby. 2023. World Rugby and the International Working Group (IWG) on Women & Sport Announce Strategic Relationship

through to 20262022: Available from: <https://www.world.rugby/news/741587/world-rugby-and-the-international-working-group-iwg-on-women-sport-announce-strategic-relationship-through-to-2026>.

World Rugby. 2024. Return to Rugby Union Postpartum Guidelines: Elite Pathway. <https://doi.org/10.25401/cardiffmet.24759906>.

Wowdzia, Jenna B., Tom J. Hazell, Emily R. Vanden Berg, Lawrence Labrecque, Patrice Brassard, and Margie H. Davenport. 2023. "Maternal and Fetal Cardiovascular Responses to Acute High-Intensity Interval and Moderate-Intensity Continuous Training Exercise during Pregnancy: A Randomized Crossover Trial." *Sports Medicine* 53(9): 1819–33. <https://doi.org/10.1007/s40279-023-01858-5>.