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# 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

Isabel S Moore <sup>1</sup>, Kay M Crossley <sup>2</sup>, Kari Bo <sup>3,4</sup>, Margo Mountjoy <sup>5</sup>, Kathryn E Ackerman <sup>6</sup>, Juliana da Silva Antero <sup>7</sup>, Jorunn Sundgot Borgen,<sup>3</sup> Wendy J Brown <sup>8,9</sup>, Caroline S Bolling <sup>10</sup>, Benjamin Clarsen,<sup>11</sup> Wayne Derman <sup>12</sup>, Paul Dijkstra <sup>13,14</sup>, Amber Donaldson,<sup>15,16</sup> Kirsty J Elliott-Sale,<sup>17</sup> Carolyn A Emery <sup>18</sup>, Lene Haakstad,<sup>3</sup> Astrid Junge <sup>5,19</sup>, Nonhlanhla S Mkumbuzi <sup>20,21,22,23</sup>, Sophia Nimphius <sup>24</sup>, Debbie Palmer,<sup>25,26</sup> Mireille van Poppel,<sup>27</sup> Jane S Thornton <sup>28,29</sup>, Rita Tomás,<sup>30</sup> Phathokuhle C Zondi <sup>31</sup>, Evert Verhagen <sup>32</sup>

For numbered affiliations see end of article.

## Correspondence to

Dr Isabel S Moore, Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff CF5 2YB, UK; imoore@cardiffmet.ac.uk

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## ABSTRACT

The IOC made recommendations for recording and reporting epidemiological data on injuries and illness in sports in 2020, but with little, if any, focus on female athletes. Therefore, the aims of this supplement to the IOC consensus statement are to (i) propose a taxonomy for categorisation of female athlete health problems across the lifespan; (ii) make recommendations for data capture to inform consistent recording and reporting of symptoms, injuries, illnesses and other health outcomes in sports injury epidemiology and (iii) make recommendations for specifications when applying the Strengthening the Reporting of Observational Studies in Epidemiology-Sport Injury and Illness Surveillance (STROBE-SIIS) to female athlete health data. In May 2021, five researchers and clinicians with expertise in sports medicine, epidemiology and female athlete health convened to form a consensus working group, which identified key themes. Twenty additional experts were invited and an iterative process involving all authors was then used to extend the IOC consensus statement, to include issues which affect female athletes.

Ten domains of female health for categorising health problems according to biological, life stage or environmental factors that affect females in sport were identified: menstrual and gynaecological health; preconception and assisted reproduction; pregnancy; postpartum; menopause; breast health; pelvic floor health; breast feeding, parenting and caregiving; mental health and sport environments.

This paper extends the IOC consensus statement to include 10 domains of female health, which may affect female athletes across the lifespan, from adolescence through young adulthood, to mid-age and older age. Our recommendations for data capture relating to female athlete population characteristics, and injuries, illnesses and other health consequences, will improve the quality of epidemiological studies, to inform better injury and illness prevention strategies.

## INTRODUCTION

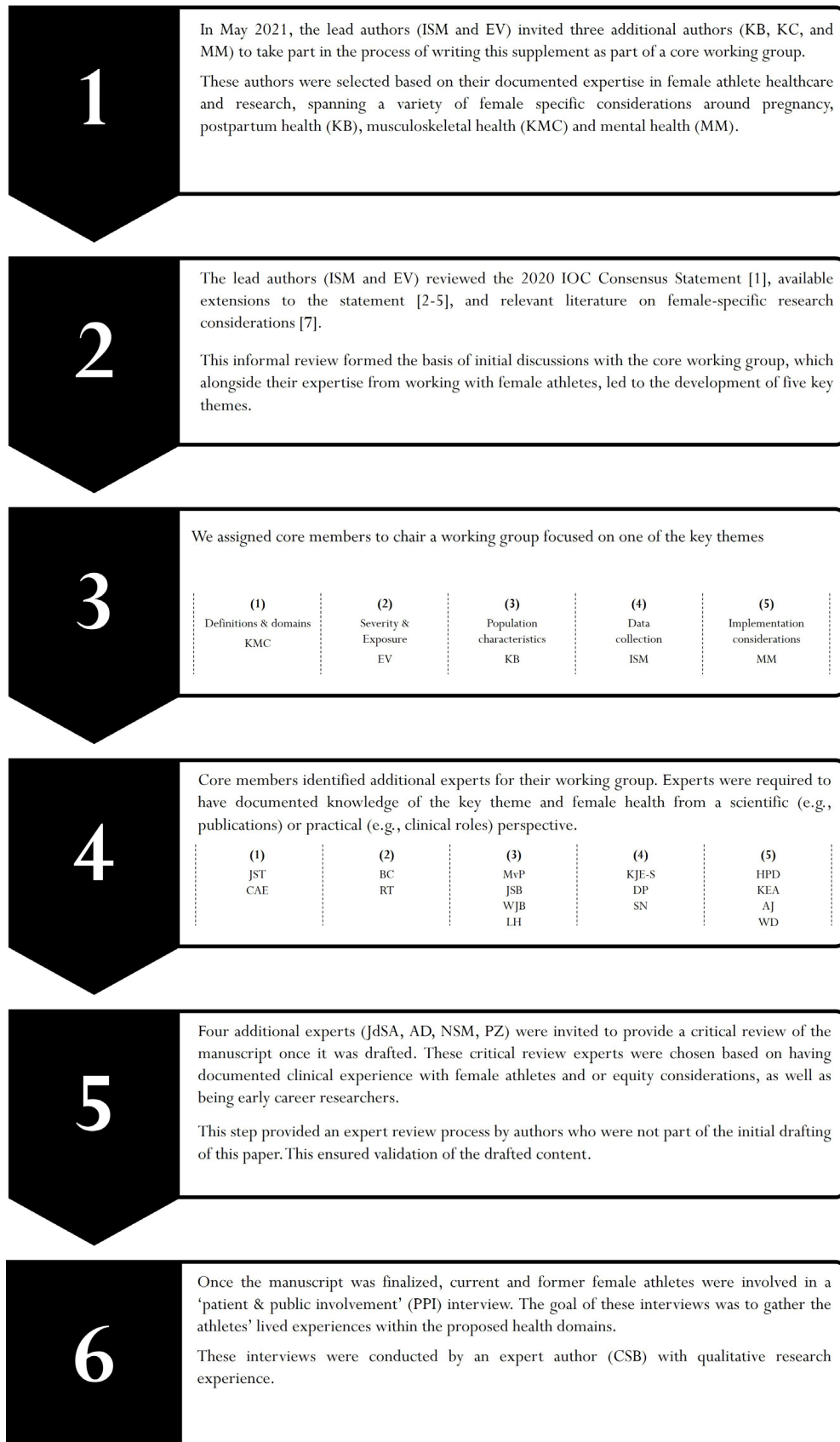
Injury and illness surveillance is a fundamental element in our efforts to protect the health of athletes. Hence, in 2020 the IOC published a consensus statement that describes standards to monitor and report health problems in sports.<sup>1</sup> This consensus aims to ensure consistency in the definitions and methods used, and to guide the collection of comparable epidemiological data across studies. Since then, several sports-specific<sup>2-4</sup> and population-specific<sup>5</sup> extensions have been produced, further supporting the appropriate and consistent application of the IOC recommendations across different settings.

Consensus statements were traditionally developed and applied to record injuries without focused consideration of the female athlete.<sup>6</sup> Indeed, the 2020 IOC consensus statement<sup>1</sup> does not mention the female athlete in its recommendations. Historically, injury and illness data that inform the development of injury surveillance systems and consensus statements are typically from male athletes, with such systems then being more frequently used in men's sport.<sup>6</sup> However, female athletes have additional specific biological, sociocultural and environmental considerations that could impact sports exposure or health outcomes. For example, circulating concentrations of both endogenous and exogenous oestrogen and progesterone influence several health conditions,<sup>7</sup> which vary with events (eg, puberty, pregnancy, menopause) and across life stages (eg, adolescence, young adulthood, mid-age). Postpuberty population characteristics are rarely reported but may influence injury and illness onset and recovery.<sup>8-10</sup> Breast health issues likely go unreported as, like other body regions, the breast does not have a specific diagnosis category in commonly used coding systems<sup>11</sup> and, until 2020, did not appear in these coding systems at all. Therefore, female-specific health risks across the lifespan remain largely undocumented, with limited quality data on female athlete health.



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**Figure 1** A flow diagram providing an overview of the six-step process undertaken in writing this extension, including the authorship contributions in each step.

**Table 1** Female health domains and their definitions

Health domain	Domain abbreviation	Definition
Menstrual and other gynaecological health	D-MG	The health of the menstrual cycle and female reproductive organs and tract.
Preconception/Assisted reproduction	D-AR	Undergoing treatments to assist in becoming pregnant without sexual intercourse. <sup>33</sup>
Pregnancy	D-PR	The condition of being pregnant. <sup>34</sup>
Postpartum	D-PO	Immediately follows childbirth until 2 years* postchildbirth.
Menopause	D-ME	The transitional time between perimenopause and postmenopause, when menstruation surceases. <sup>7</sup>
Breast health	D-BH	The health of the mammary glands. <sup>34</sup>
Pelvic floor health	D-PF	The physical and functional integrity of the pelvic floor unit through the life stages of an individual (male or female). <sup>35</sup>
Breast feeding, parenting and caregiving	D-BP	Providing direct care for another individual who needs help taking care of themselves (eg, a baby, child, the elderly, chronically ill), including suckling milk from a mother's breast.
Mental health†	D-MH	The psychological, emotional and social well-being <sup>36</sup> of an athlete.
Sport environment†	D-SE	The physical and social context within which athletes train and compete.

\*Based on WHO breastfeeding recommendation<sup>37</sup> and mental health outcomes.<sup>38</sup>

†This health domain is particularly prevalent but not unique to female athletes only. Consideration should be given to all athletes.

To help achieve high quality and consistent female athlete injury and illness epidemiological data, an agreed taxonomy of health domains for categorising health problems is warranted. Using an agreed taxonomy could help identify female-specific injury and illness patterns, and their health and performance interactions. Furthermore, improved reporting methods would aid in determining female-specific risk factors and mechanisms for physical and mental health problems, and lead to female-specific evidence-informed prevention initiatives.

The aims of this supplement to the IOC consensus statement are to: (i) propose a taxonomy for categorisation of female athlete health problems across the lifespan; (ii) make recommendations for data capture to inform consistent recording and reporting of symptoms, injuries, illnesses and other health outcomes in sports injury epidemiology and (iii) make recommendations for specifications when applying the Strengthening the Reporting of Observational Studies in Epidemiology-Sport Injury and Illness Surveillance (STROBE-SIIS) to female athlete health data. This document is intended to be read and applied in conjunction with the IOC consensus statement, rather than as a stand-alone document.

### SCOPE OF THIS SUPPLEMENT

This supplement focuses on cisgender female athletes (assigned female at birth) due to the sex-specific health issues outlined. We also acknowledge mental health and the gendered sports environment, which may influence injury risk<sup>12</sup> and health outcomes.<sup>13,14</sup> These are not unique to cisgender female athletes, but are more prevalent than in cisgender male athletes.<sup>14</sup> Additionally, women and girls with variations of sex development, transgender women and girls and gender diverse athletes may experience some of the same health concerns and gendered experiences as cisgender female athletes. Therefore, much of the data capture and reporting recommendations outlined in this paper will also apply beyond cisgender female athletes. However, a specific and comprehensive supplement should be written in the future to support athletes with variations of sex development and/or who are transgender or gender diverse. The detail required to sufficiently cover the diversity of unique health considerations is beyond the scope of the current paper.

### METHODS

The process of writing this supplement started in May 2021, and followed the six-step process detailed in figure 1. Throughout

the process, various expert authors were suggested by the core team and invited by the lead authors (ISM and EV). Two invited experts did not agree to take part. This resulted in a panel of 25 international experts who were selected based on their involvement in various academic and clinical disciplines across different sports. Our panel includes epidemiologists, physiotherapists, sport and exercise physicians, psychologists, sports scientists, an endocrinologist, former elite athletes and coaches with expertise in female athlete or female para athlete health. Six panel members (MM, BC, WD, CAE, AJ, EV) also contributed to the original IOC consensus group.

The working groups were instructed to meet and discuss their tasked theme via video conference as the work was undertaken during the COVID-19 pandemic. Subsequent communication within the working groups was conducted through email or video conference as necessary, leading to the creation of initial drafts for their tasked theme. Each working group was instructed to reach agreement on their initial drafts and ISM and EV subsequently compiled the initial drafts into a first complete draft of this supplement. This was circulated to the entire panel via email and discussed in a group video conference, during which we discussed necessary revisions. All panel members were invited to review the manuscript and suggest edits, and to participate in further video conferences, until consensus was reached. In total, there were seven iterations of the manuscript.

Current and former female athletes were involved in a 'patient and public involvement' interview. Athletes from various sports and with lived experiences across the female health domains were identified via the authors and invited by email to participate. For some health domains, we could not find athletes willing to share their experiences. We looked for experiences previously shared in the public domain for those health domains. Before their interview, athletes were provided with a summary of the project, an explanation of the health domains and their role within the project and a draft of this paper. The interview was meant only to allow for a practical illustration of the domains; each athlete only shared about the domain they had experience with. During the interviews, athletes were asked how they experienced the domain during their career and its impact on their health and performance. The interviews were open conversations and hence, no interview guide was necessary. Quotes were selected to illustrate their experiences and were included in the manuscript following review by the interviewed athlete. All athletes provided consent to include their lived experiences and

**Table 2** Female health domains, with frequently associated health problems and consequences, and examples of potential effects on performance and participation

Health domain	Frequently associated health problem(s) and consequences	Examples of how female health domains might (directly or indirectly) affect participation and performance
D-MG	Dysmenorrhoea Amenorrhoea Oligomenorrhoea Menorrhagia Iron deficiency/Anaemia Endometriosis Fibroid-related pain Polycystic ovarian syndrome Premenstrual syndrome Catamenial migraine Gynaecological cancers—uterine, endometria Urinary incontinence ► <i>Stress urinary incontinence (SUI)</i> ► <i>Urgency urinary incontinence (UUI)</i> ► <i>Mixed urinary incontinence (MUI)</i>	An athlete being unable to compete, due to severe menstrual cramps. An athlete experiencing anxiety around visible menses due to having menorrhagia and is fearful of training and competition. An athlete with fibroid-related pain may be unable to complete training sessions. An athlete with urinary incontinence is afraid of smell and visible leakage, which affects performance. An athlete using impromptu sanitary materials experiences anxiety of visible menses and is fearful of training and competition. An athlete with premenstrual syndrome may present sleep disturbances that can affect recovery and performance, and/or may avoid certain sports activities due to breast tenderness.
D-AR	Ovarian hyperstimulation Nausea Abdominal pain	An athlete may need to miss training depending on time of ovulation, due to pain and menstrual cramps.
D-PR	Pregnancy loss Hypertension Deep vein thrombosis/pulmonary emboli Back pain Pelvic girdle pain Iron deficiency/Anaemia Calcium deficiency Gestational diabetes Placental abruption Urinary incontinence (SUI and UUI) Placenta previa Urinary infections Cervical insufficiency	Pregnant athletes are recommended to avoid activities that involve physical contact or danger of falling, and scuba diving; and use caution with activities in excessive heat, especially with high humidity, high altitude (if lowlander) and exercising in a supine position.
D-PO	Urinary incontinence (SUI, UUI, MUI) Mastitis Anal incontinence Pelvic organ prolapse Pelvic floor pain Reduced bone mineral density Postpartum anxiety Postpartum depression Iron deficiency/Anaemia Calcium deficiency Postpartum haemorrhage Postoperative recovery following a caesarean section Episiotomy recovery Perineal tear	An athlete with a sensation of a bulge coming down into or outside vagina (eg heaviness) may be unable to return to training and competition. An athlete with urinary incontinence may avoid or cease activities that cause leakage.
D-ME	Fatigue Iron deficiency/Anaemia Mental health symptoms or disorders secondary to menopause Health problems secondary to weight gain (eg, diabetes, metabolic syndrome) Sleep disturbance Tendon pain (eg, Achilles, rotator cuff gluteal) and joint pain (eg, hip, knee, shoulder, wrist, elbow) Reduced bone mineral density Vasomotor symptoms	An athlete has sleep disturbances due to vasomotor symptoms, which may affect her ability to train and recover. An athlete's joint pain may be mistaken for joint injury or may exacerbate previous joint injury/pain symptoms.
D-BH	Breast tenderness Back and/or shoulder pain (secondary to poor bra support) Breast trauma/injury Breast cancer Mastitis Non-cancerous breast mass	An athlete in a contact sport may be tentative about participating in a full contact training or match play due to breast tenderness. Large breast size may cause back and/or shoulder pain and may impede an athlete's ability to participate in contact sport. An athlete undergoing breast cancer treatment may have lower immunity, upper extremity lymphoedema and signs and symptoms of depression/anxiety and fatigue.

Continued



Table 2 Continued

Health domain	Frequently associated health problem(s) and consequences	Examples of how female health domains might (directly or indirectly) affect participation and performance
D-PF	Urinary incontinence (SUI, UUI, MUI) Vulvar dysfunctions Pelvic organ prolapse Perineal or pelvic organ trauma from sexual assault Anal incontinence Constipation	An athlete may reduce the amount she trains due to embarrassment and fear of urinary leakage. An athlete with vulvar dysfunction may feel pain during and after prolonged biking. Urinary frequency/urgency may be disruptive for an athlete during longer competitions (eg, a marathon).
D-BP	Fatigue Breast tenderness Mastitis Energy deficiency Changing breast volume	An athlete's caregiving responsibilities may reduce time to attend training, increasing injury risk and mental and physical fatigue. Due to discomfort and fluctuating breast size, breast feeding may lead to changes in an athlete's biomechanics, energy expenditure and tissue physiology, which affects her ability to train and recovery.
D-MH*	Mental health symptoms or disorders Depression Eating disorders/disordered eating	Female athletes have higher reported levels of psychological distress, depression and eating disorders/disordered eating than male athletes.
D-SE*	Sexual harassment Sexual abuse Physical abuse Psychological abuse Neglect Less access to training environments (including weight rooms) Trauma from sexual assault	Sexual harassment and abuse (sexual, physical and/or psychological) can lead to an athlete's withdrawal from training and/or competition, be fearful of exposure to the perpetrator or experience heightened anxiety/hypervigilance. An athlete has an increased risk of REDs and disordered eating due to body-shaming (psychological abuse). An athlete may be unable to train appropriately for demands of the sport due to lack of access to sports pitches.

For domain abbreviation, refer to table 1.

\*This health domain is particularly prevalent but not unique to female athletes only. Consideration should be given to all athletes. REDs, relative energy deficiency in sport.

specifically stated they wanted their names to be included in the acknowledgements of this manuscript. They were also invited to review the final version of this text.

### SUPPLEMENTAL RECOMMENDATIONS TO THE IOC CONSENSUS ON INJURY AND ILLNESS SURVEILLANCE

The IOC consensus defines an athletic health problem as ‘any condition that reduces an athlete’s normal state of full health, irrespective of its consequences on the athlete’s sports participation or performance or whether the athlete sought medical attention’.<sup>1</sup> The injury and illness definitions and examples provided by the IOC recommendations are universal and apply to female and male athletes. However, for the female athlete, we should also account for specific health-related domains that may influence sports participation while the athlete is—in fact—‘healthy’ (eg, the menstrual cycle, pregnancy or menopause). Therefore, using an adaptation of the recommendations by Dodd *et al*,<sup>15</sup> we propose a taxonomy for categorisation of health problems in female athletes, which, when combined with sports participation as the primary risk exposure, may influence overall health or injury and illness risk in the short and long term (tables 1 and 2). In this taxonomy, health problems are grouped into 10 domains that have the potential to impact female athletes’ sports participation, performance or health outcomes, irrespective of their state of full health or whether they sought medical attention. We provide domain definitions in table 1 to enable consistent application of the taxonomy. Each of the 10 domains identified in table 1 offers a unique lens for observing, classifying and documenting a range of health problems that are relevant to female athlete health and performance. While this approach complements the recommendations described in the IOC consensus,<sup>1</sup> it extends the reporting requirements to include female athlete health domains.

### Domains of female health, associated health problems and their relationship with sports participation

In table 2, we provide an overview of the 10 domains of female health we identified, with frequently associated consequences or

health problems, and examples of potential direct and indirect effects on performance and participation. All health domains are illustrated with athletes’ lived experiences (table 3). We have provided abbreviations for each domain to enable consistent reporting across epidemiological studies (table 1).

There are likely to be several ways these health domains and sports participation interact to affect health problems (ie, injury or illness). Some health domains may not necessarily influence sports participation but may be an intermediate variable on the causal pathway between sports participation and health problems (mediator). Other health domains may confound (distort) the relationship between sports participation and health problems, while also affecting participation. Health domains may also be effect modifiers in the causal pathway between participation and health problems. That is to say that the relationship between sports participation and the health problem may differ by the level of a particular health domain (eg, stage of pregnancy or menopause). We have presented female-specific examples for each of these potential relationships between health domains and health problems (ie, causal, mediation, confounding and effect modification) in figure 2.

### Classifying female health domains and their related health problems and sports participation

The 10 female health domains proposed will aid improvements in (i) accurately classifying and categorising diagnoses for female athlete monitoring, reporting and/or research, (ii) facilitating recognition of temporal trends and between-group comparisons of female athletes (eg, different teams, leagues, sports) or risk factor studies and (iii) creating databases from which cases can be extracted for research on specific types of injuries and illnesses in female athletes.<sup>1</sup> In some health domains, there is a need for further clarification to enable more granular, relevant data on specific health problems to be documented (eg, breast injury, health effects of sexual assault, relative energy deficiency in sport).

**Table 3** Female health domains, with athlete quotes on their lived experience with domains

Health domain	Athlete quotes on their lived experience with the female health domains
D-MG	<p>"If I reflect early in my career, there wasn't really anyone to talk to. And I guess that is probably why a lot of our athletes, myself included, had issues with having no periods, you know. Or it was like celebrated that you didn't get a period".</p> <p>"Early in my career, I didn't marry up the relationship between high performance sport and your menstrual cycle or your female health, I guess. This was a bit dangerous in hindsight because you, you know, think, oh, missing a period's great. But actually, what that means is you probably did not recover properly, or you probably did not eat the right foods. Or you, you know, it could be a multitude of things".</p> <p>"Even little things when you got your period, I do a water sport, and the logistics around that is awkward. Even uniform stuff, like, can we have black tights? You know, and we were getting these like really light-coloured green tights. Not doable. And then once we started to talk about it more, I think the first time it kind of came across our table was because one of the girls in our squad had not had a period for, I think it was nine months or something".</p> <p>"My iron levels didn't go up. And I think it, it was in that time that we discovered that the tablets that I was taking didn't up my iron levels. So, then the next step was to get infusions. And then it was like, okay, cool, how can, how can we prevent your iron from dropping even more? And then a natural way was just to stop my period".</p>
D-AR	<p>"I'm lucky I guess that I was able to fall pregnant quickly and easily and there was no issues. Obviously, if you have an irregular period or you have, you know, something else going on, it might be harder for you to fall pregnant. And I think that that conversation isn't happening within sport".</p> <p>"As an older athlete, I spoke with my husband the other day. If I wanted to keep going after Paris, I don't think I want to, but if I do, how about freezing eggs? Like how does that work? what does that look like? Because I mean, in some sports you probably can't spend the time to be pregnant and have a year off. Or financially you might not be able to, or you know, you've only got a small life span in sports. I mean obviously that's an away from sports thing, but how does that impact, or how does that work in with a training cycle or a competition cycle"? </p> <p>"that was also the first time like when I went and met with a woman's health specialist while I was being diagnosed with anorexia in 2020 and this doctor Women's Health doctors it's like. Did you like thought about family planning? what's your plan for having children? Do you know if you're fertile? All of those questions that like no one had ever asked me before that was kind of like, wow, why don't we talk about this more"? </p>
D-PR	<p>"They'll fund you for two years from your last event. So basically, I'm funded from Tokyo through to August next year. So, I have to raise a major event within that period. Our world championships are August next year. So, I mean, that helps because if you don't have that if you fall pregnant you just lose everything".</p> <p>"The recommendations that were given to us had not a lot of research behind them, but I liked having something. I know they were giving them to us being cautious. And so, I knew that, like the 90% heart rate rule of max heart rate was okay, because they're not going to give me a number that is unsafe and get everyone into trouble".</p> <p>"In the first two trimesters, I didn't really start showing. So, I just looked like my normal self, and people were treating me like normal. And then, yeah, when I started to have that big bump, no one wanted to help me that much really".</p> <p>"I guess what I struggled with a little bit, and I guess maybe other women might struggle with it a bit more, are the changes in your body. As athletes we are so used to being in a peak condition. Particularly, I guess most athletes in Olympic sports and Paralympic sports, will try to fall pregnant straight after the Games. And so, you go from, you know, the fittest and strongest you've ever been to pregnant and that changes the body a lot".</p> <p>"One of my training partners, for example, he had a baby. But I mean, he wasn't the one carrying it for nine months and nurturing and everything. Or put like his whole career on hold. He could have a baby, but I obviously had to make a choice".</p> <p>"It's funny because as professional athletes you think, or as you say as an adult you would think, that there would be more conversation and more understanding behind pregnancy. Because we are human. Our bodies were meant to have babies. It is very interesting that there is a lack of understanding on that side. Is it ok for female athletes to take breaks and to start a family? If we can't have babies, if it's adoption, if it's IVF? We have love to have a maternal instinct. It is just very interesting to me there is a lack of guidance that comes from sport".</p>
D-PO	<p>"In the postpartum period everyone's like, you know, do you have to stay under, what are the rules? And it's like, there are no rules. And I think this is wrong. We are treating it like a return from an injury. And it feels wrong to say that, that it's a return from injury, but, you know, it's a pretty big injury".</p> <p>"Not that many athletes get pregnant and come back. Most retire. And I think that's probably to do with our funding. But to see so many international people that I raced against do it, I was like, okay, well, you know, happy days. It's doable".</p> <p>"We got to Tokyo, and in my sport, kayaking, every podium had at least one mum on it".</p> <p>"I think for some moms it is tough. I mean, in the beginning I was struggling, you know, like with traveling all over and, you know, competing and obviously having this goal. And suddenly, I'm at home, with a baby and this is now life. I obviously enjoyed it, but I think that transition may be for some athletes quite tough. Being just a mom, and that's maybe why they want to get back".</p>
D-ME	<p>"I slammed into some of these changes head on. It felt almost like going over your handlebars on your bike when you don't see it coming. All of a sudden, I was like: Where did my muscle tone go? Where did this weight come from? Why everything seemed to change? I'm sure it was not overnight but it sure felt that way".<sup>39</sup></p> <p>"I have very quickly gained three kilograms at the end of this year. Out of nowhere. Bear in mind, I'm exercising six days a week. I'm very conscious of what I eat, and very strict and disciplined with my nutrition. It was not through eating. I am having difficulty sleeping and I have joint pain which makes it very difficult for me to do what I want to do to support my cycling".<sup>40</sup></p>
D-BH	<p>"I suffered an injury this season, where they suspected there might have been some slight tearing from the breast tissue. At the time, I didn't report it. Only recently, coming up to this level. My most recent injury, I reported that one".<sup>41</sup></p> <p>"I wish I knew more about these injuries when I began playing because I think a lot of damage could have been prevented".<sup>41</sup></p>
D-PF	<p>"I felt embarrassed. I went to the loo and sorted myself out and changed my leotard. People probably knew what had happened".<sup>42</sup></p> <p>"It causes a bit of uncomfortableness and anxiety, which can obviously be distracting and can throw you off".</p> <p>"Yeah, I had two C sections so that is different than obviously having the childbirth and I think that's important to recognize like how soon or not soon you can train afterwards and then how carefully you need to be. So that was a big thing for me to be monitored by an osteopath and physiotherapist from a scar tissue perspective but also from a strength perspective with pelvic floor and you know reengaging my abdominals and things like that so taking care of the strength and kind of putting my body back together before I started to do full training".</p>
D-BP	<p>"I stopped breastfeeding a few weeks ago and more so because I just felt I was struggling. Towards the end I was getting annoyed, or more so, frustrated. Because I felt like I couldn't fuel myself. I was getting back into a higher training load while trying to breastfeed, and I was noticing my supply was just dropping. I spoke to my dietician and stuff, but I just couldn't seem to get enough in. And then you are trying to balance the whole weight thing as well, which I was fine with and obviously breastfeeding took precedence, but I just couldn't, I just couldn't seem to lift my supply back up".</p> <p>"I take my hat off for girls or females that have families and are still doing their career. As with breastfeeding, caregiving, and like sleeping. You need to get your recovery. All of that. You think you're missing out. You've got mama guilt, you know. All of those things".</p> <p>"That was a big one for me. Just having somebody for two or three hours a day to come in and take care of my three week old. I could just go out for a walk and then a bike ride and then a run. Having family or some people that you trust to take care of your very little baby".</p>

Continued

Table 3 Continued

Health domain	Athlete quotes on their lived experience with the female health domains
D-MH*	<p>"I thought like, eating disorders, or what teenage girls do to themselves to be skinny. They didn't understand that it was an actual mental health disorder. It really wasn't until I went to treatment for it that I started to grasp how intense it actually was. That is where I wish that in becoming an elite athlete, there is some educational onboarding to teach you this can happen and it's not your fault".</p> <p>"The separation in my opinion was valuable. To remember that I was more than an athlete. Because most of what fueled my eating disorder was the desire to be a perfect athlete".</p> <p>"I just felt like everything was out of my control and the voice of that, the body image issues, came to the forefront. You can just start controlling what you're putting in your body, it will make you healthier, it will make you a better athlete, and so yeah, that just really took over my brain. It happened really quickly and really powerfully".</p> <p>"So there are physical signs that are pretty well documented from a low energy deficit perspective. I think the things that I saw were deceptive. Athletes saying that they were only running this amount, but then you talked to their teammates. They ran double the minutes they told you. Or you tell them to run on that day and then you see them out running on another as well. Or you tell them that they need to increase their calories, but you can tell that they're not gaining any weight. You can just see that they're lying or that they are hiding things. That is a very big sign that they are not engaging in the process of health".</p>
D-SE*	<p>"I think it is important to create a family environment where you feel safe and comfortable. We were a group in a cell, and I had a female coach. It was easy to relate with her. We were nine para athletes training together on a high level. We were only with two girls and the rest was male, but everyone always supported each other. There were no comments or degrading like, you know, male, female, kind of, you know, stuff. So, I think that was like a major thing in my career. That's like a positive".</p> <p>"I actually didn't really know of any female practitioners growing up".</p> <p>"I think social media plays some role in it. The ability to compare yourself with many other athletes. I would see track athletes and think they were so jacked. That was the athletic body that I wanted. I was unable to be compartmental and say I want a body that makes me the best ski racer. I also wanted a body that fits this societal model. That wasn't a conversation that was happening around me. I mean, how do you want to feel vs how you want to look. My teammates and I would joke about our belly fat and pick that apart in a way that I thought was healthy, but it was getting into my head. People weren't having constructive talks about body image and about being proud of ourselves as athletes".</p> <p><i>None of the approached athletes spoke about, or were willing to share their experiences with, harassment and abuse in sports. However, there are publicly available records of female athletes' lived-experiences with this domain.</i></p>

For domain abbreviation, refer to table 1.

\*This health domain is particularly prevalent but not unique to female athletes only. Consideration should be given to all athletes.

We also consider including the 10 domains of female athlete health and their associated health problems in the context of subsequent health problems. These domains and health problems can be recorded within a surveillance system, alongside injuries and illness. Examples of hypothetical prospective injury and illness data from such a system for athletes in a team are shown in figure 3. The classification and definitions of subsequent health problems in sport should be adopted, per the IOC consensus recommendations,<sup>1</sup> with inclusion of female-specific data.

FURTHER CONSIDERATIONS

Population baseline characteristics

To improve understanding of the factors predisposing female athletes to female-specific health risks, baseline data should be more detailed than the minimum demographic data recommended by the IOC consensus statement<sup>1</sup> (eg, date of birth, sex, gender, level of competition). For example, concerning the sports environment, female and male athletes playing at the same level of competition do not necessarily have similar years of sports exposure<sup>16</sup> and this may influence injury risk factors

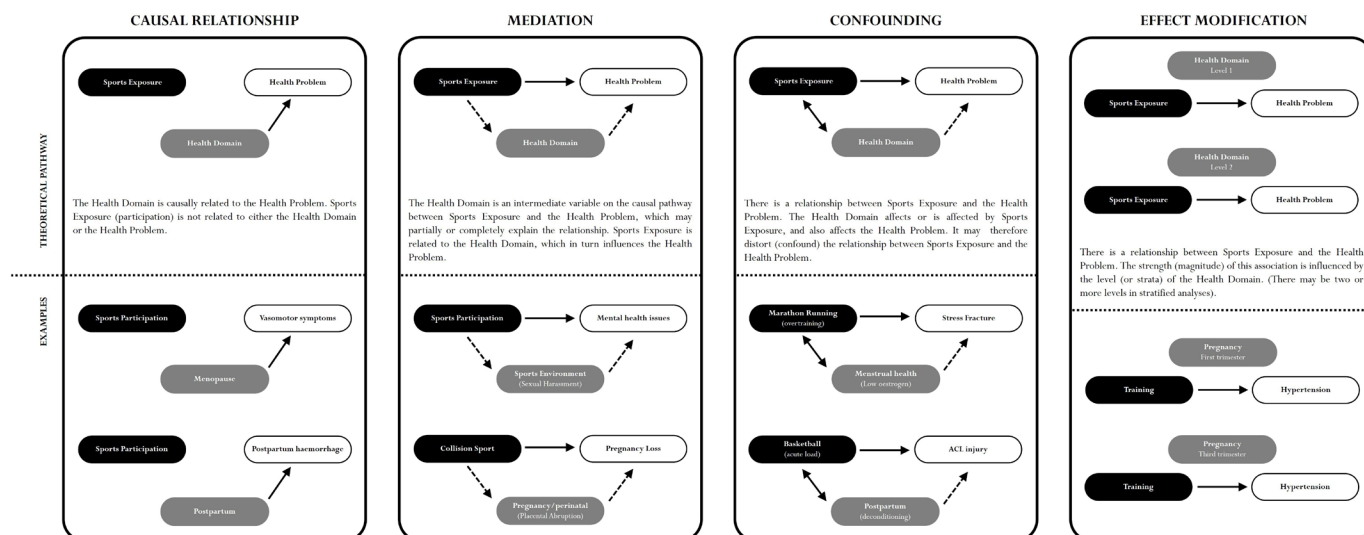
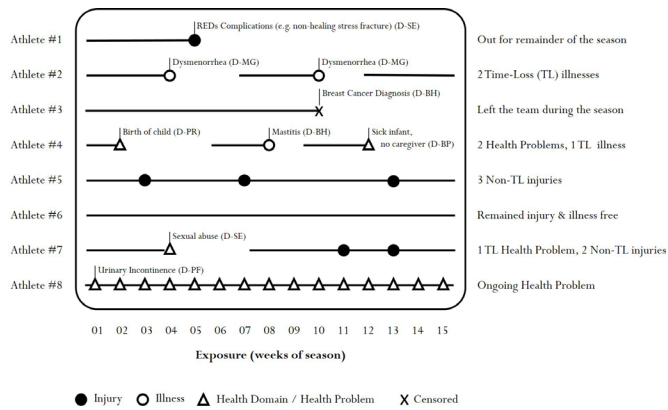


Figure 2 Theoretical pathways and female-specific examples for each of the potential relationships between health domains and health problems, that is, causal, mediation, confounding and effect modification.



**Figure 3** Examples of hypothetical prospectively collected female athlete health domains, and injury and illness data. Adapted from Bahr *et al.*<sup>1</sup> X indicates when an athlete is no longer part of the observational study due to unrelated health problems. Sexual abuse is more commonly encountered by female athletes than male athletes, and hence this has been used as an example. D-BP, breast parenting and caregiving health domain; D-MG, menstrual and other gynaecological health, health domain; D-PR, pregnancy health domain; D-PF, pelvic floor health domain; D-SE, sport environment health domain; REDs, relative energy deficiency syndrome.

(eg, movement patterns<sup>17</sup>). In general, where it concerns the professionalism of sport, differences apply too (eg, differences in financial rewards and the level and quality of medical support). Other factors that are not recorded for female or male athletes, but may impact sports exposure and health outcomes, are caregiving responsibilities outside sport and time dedicated to sport and/or dual career within the day. We acknowledge that it would be good practice for our recommendations to be recorded for all athletes and this would help further equity across many aspects (eg, gender, culture and ethnicity). But in the context of our paper, we propose that the following should be recorded for female athletes: level of competition, years of exposure to the sport, caregiving responsibilities and contribution of sport to earning a living.

The population baseline characteristics required for research should also consider the specific life stage of the athlete. Standardised definitions of puberty, menopausal status and other characteristics related to domains of female health (eg, pregnancy, postpartum) have been reported elsewhere.<sup>7</sup> We recommend using these to define individuals and cohorts under investigation. We identify three overarching stages and example baseline characteristics that could be collected in table 4. The overarching stages are: peripuberty, adult and perimenopause. Peripuberty spans the period when the onset of menarche may occur (prepuberty and puberty), adult spans postpuberty and premenopause and perimenopause spans the period when menstruation surceases (menopause to postmenopause).<sup>7</sup> As information relevant to each domain is likely to change over time, it is necessary to revisit certain baseline characteristics elements at the time of injury and illness to ascertain any change in status (eg, pubertal status, menorrhoea, pregnancy and menopause status). The elements of the relevant female health domain will depend on the life stage covered by the study (table 4).

### Data collection methods

Given the variety of data relating to each domain of female health, only the data required to address the specific research questions should be collected. Considering the potentially sensitive nature

of some female athlete health information, athletes should be provided with an explanation for why certain data are being collected and what efforts have been made to limit the amount and type of required data. If menstrual cycle-related data are collected, the education and language used in any verbal discussion or written materials should normalise the menstrual cycle rather than medicalise it. Consideration should also be given to who (eg, health professional, researcher or coach) should collect female athlete health data, given the potentially sensitive nature of many variables.<sup>18</sup> This individual may vary across different sports contexts and religio-cultural backgrounds.

Where they exist, validated questionnaires should be used to capture data relating to female health problems in each domain (eg, the Australian Pelvic Floor Questionnaire<sup>19</sup> for pelvic floor health), alongside appropriate characteristics (eg, number of pregnancies, mode of deliveries for childbirth). There are currently no validated questionnaires to record menstrual cycle information. Without standardised data collection methods, researchers must consider the most pertinent menstrual cycle information for their study (table 4).<sup>7</sup>

### Data management and sharing

Integrating health, illness and injury reporting may be helpful to avoid the repetition of data entry and burden on athletes. However, this must be balanced with data confidentiality and sensitivities surrounding sharing such data with researchers and support staff involved in each system. Therefore, clarification of who is involved in each system is needed, in addition to obtaining informed consent from athletes for any data sharing across systems. For example, where strength and conditioning coaches or nutritionists record menstrual cycle data, this information may be shared (with consent) with medical personnel and integrated with the recording of health outcomes (eg, injuries and illnesses). Considering the sensitivity of data collected, it is important to communicate that data cannot be used for any reason (eg, team selection) other than the research described and agreed to as part of the consent-giving process. Electronic systems shared between support staff may facilitate immediate data integration, but paper versions can also be used. Additionally, online platforms owned by third parties must be scrutinised to establish who owns inputted data and how they can be used. This information must be communicated to athletes to ensure they can provide informed consent. Data security of such platforms must conform to data protection laws in the specific jurisdiction(s) within which it is being used.

### Reporting recommendations

The STROBE-SIIS checklist should guide study design and report observations following IOC recommendations.<sup>1</sup> However, it is worth noting that domains of female health do not feature in the STROBE-SIIS checklist. We recommend the following specifications when applying the STROBE-SIIS checklist:

1. Include specific domain of female health as part of the study design (SIIS-4.1).
2. Incorporate justification for the inclusion of the specific domains and health problems when defining outcomes of interest (SIIS-7.1).
3. Outline criteria used to categorise domains of female health and their associated health problems (SIIS-7.2).
4. Document the number of female athletes reporting a specific female health problem, but this should be balanced with ethical considerations such as maintaining athlete anonymity (SIIS-13.1).



**Table 4** Examples of characteristics (and their corresponding domains) that could be collected for different female life stages; these characteristics could be collected at baseline (BASE) and then confirmed at time of injury or illness (TOI)

Peripuberty	Adult	Perimenopause
	Post puberty to pre- menopause	Menopause to postmenopause
<b>Prepuberty to puberty</b>		
BASE—level of competition (domain(s): sporting environment)		
BASE—years of exposure (domain(s): sporting environment)		
BASE—caregiving responsibilities (domain(s): sporting environment and breast feeding, parenting and caregiving)		
BASE—earn a living by playing sport (domain(s): sporting environment and breast feeding, parenting and caregiving)		
BASE—puberty status TOI—check if status has changed since baseline (domain(s): menstrual and other gynaecological health)	Not applicable to adult or menopausal	
BASE—age of menarche (domain(s): menstrual and other gynaecological health and pregnancy)		
BASE—menstrual cycle data (ie, average cycle length, frequency of bleeding per year, ovulation status if known, presence or absence of luteal phase deficiency if known and presence or absence of copper intrauterine system) TOI—record the day of menstrual cycle (domain(s): menstrual and other gynaecological health and pregnancy and preconception/assisted reproduction)		
BASE—hormonal contraceptive use (Y/N) and type (ie, combined or progestin-only AND route of administration: pill (combined monophasic, biphasic, triphasic or continuous or progestin only), vaginal ring, patch, implant, injection or hormonal intrauterine system) AND brand name for dosage information TOI—record the timing of hormonal contraception usage (eg, for monophasic combined contraceptive pill users need to establish if it was a pill-free or pill-taking day) (domain(s): menstrual and other gynaecological health)		
BASE—pregnancy status (Y/N) and duration TOI—check if status has changed since baseline (domain(s): pregnancy and postpartum)	Not applicable to menopausal	
BASE—number of, and time since, previous pregnancies (domain(s): pregnancy, postpartum and pelvic floor health)		
BASE—previous mode of deliveries for childbirth (domain(s): pregnancy, postpartum and pelvic floor health)		
BASE—history/presence of pregnancy/birth/postpartum trauma (eg, perineal tear and pelvic floor muscle major injury, stress urinary incontinence, pelvic organ prolapse, diastasis recti abdominis, low back and especially pelvic girdle pain) (domain(s): pregnancy, postpartum and pelvic floor health)		
BASE—breastfeeding status (Y/N) TOI—check if status has changed since baseline (domain(s): pregnancy, postpartum and breast feeding, parenting and caregiving and breast health)	Not applicable to menopausal	
Not applicable to pubertal	BASE—menopausal status TOI—check if status has changed since baseline (domain(s): menstrual and other gynaecological health and menopause)	
BASE—hormone replacement therapy use (Y/N) and type (ie, combined or estrogen-only AND route of administration: tablets, patches, gels or vaginal AND routine: cyclical/sequential or continuous AND brand name for dosage) TOI—record the timing of hormone replacement therapy usage (eg, for cyclical monthly hormone replacement therapy users need to establish if it was an oestrogen only or oestrogen and progesterone day) (domain(s): menopause)		
Peripuberty is the time around puberty. <sup>7</sup> Puberty is the onset of menarche. <sup>34</sup> Perimenopause is the time around the occurrence of the menopause when the ovaries gradually produce less oestrogen. <sup>43</sup> Menopause is the time when menstruation ceases. <sup>7</sup> Postmenopause is the time after which a woman has experienced 12 consecutive months of amenorrhoea. <sup>7</sup> Y/N, yes/no.		

- Report information related to specific domains of female health separately from the illness data and not combined unless appropriate (SIIS-16.1/16.2/17.1). For example, pregnancy is not an illness, but a pulmonary embolus associated with pregnancy is. The 10 proposed domains of female health and their abbreviations are shown in table 1.

### Implementation considerations and recommendations

As an overarching principle, stakeholders (eg, researchers, team physicians, coaches) should plan, implement and evaluate both injury and illness surveillance and communication of results. Diligence should be taken to appreciate the ethnic and cultural backgrounds of individuals and cohorts of female athletes and stakeholders, and awareness of sensitivity concerning female-specific issues is imperative.<sup>20 21</sup> As an

example, requiring consent from athletes for recording each issue, rather than blanket consent which is typically acquired during injury and illness surveillance to record all issues. Engaging stakeholders to play an active role rather than just supplying an opinion is recommended. This is known as co-design, which may enhance the value and success of the project.<sup>22</sup> For example, stakeholders could be involved in devising the injury definition<sup>23</sup> and the feedback mechanisms of the surveillance system, and could help to pilot its use. Stakeholders also need to consider the intersection of sex, ethnicity, culture and economics.<sup>24</sup> One example is understanding athlete access to devices for use on online platforms and having other options available to ensure equity in provision.

In the current sports landscape, modern technologies allow for a breadth of athlete data to be collected and used routinely.

Not all data are always pertinent, nor collected, stored and used appropriately. As such, we recommend that ruling standards for collecting and storing data from athletes are followed<sup>25</sup> and data protection laws are adhered to. These recommendations can be regional and are likely to update regularly. For female athletes, given the potentially sensitive nature of health data, clear definitions of all team members' roles and responsibilities and sufficient gender and sociocultural awareness training should occur before implementation. For example, the data collector should be sensitive to the female athlete's life-stage and gender identity, particularly when surveillance involves gynaecological questions.<sup>26</sup> Adapting principles from women's health, it is important to provide a safe environment for data collection that respects privacy and dignity when discussing sexual and reproductive health issues.<sup>27</sup> In addition, the data collector should have trauma-informed training and be knowledgeable of safeguarding policies and procedures, including reporting mechanisms for allegations of harassment and abuse.<sup>28</sup> Finally, the implementation team should have the clinical competency to communicate with female athletes concerning their sport-related experiences during puberty, fertility,<sup>29</sup> pregnancy,<sup>29 30</sup> postpartum<sup>31 32</sup> and menopause. The IOC consensus statement lists more general implementation recommendations.<sup>1</sup>

## CONCLUSION

This paper extends the IOC consensus statement, to include 10 domains of female health that may affect female athletes across the lifespan, from adolescence through young adulthood, to mid-age and older age. Our recommendations for data capture relating to female population characteristics, and to injuries, illnesses and other health consequences, will improve the quality of sports medicine and epidemiological studies on the health risks specific to female athletes. Specifically, implementing our recommendations should result in consistent and more accurate reporting and help identify potential risk factors to inform better injury and illness prevention strategies that will ultimately support female athletes' physical and mental health.

### Author affiliations

<sup>1</sup>Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff, UK

<sup>2</sup>La Trobe Sport and Exercise Sports Medicine Centre, La Trobe University, Bundoora, Victoria, Australia

<sup>3</sup>Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, Norway

<sup>4</sup>Department of Obstetrics and Gynecology, Akershus University Hospital, Lorenskog, Norway

<sup>5</sup>Family Medicine, McMaster University Michael G DeGroote School of Medicine, Waterloo, Ontario, Canada

<sup>6</sup>Wu Tsai Female Athlete Program, Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts, USA

<sup>7</sup>Institut National du Sport, de l'Expertise et de la Performance, INSEP, Paris, France

<sup>8</sup>Faculty of Health Sciences and Medicine, Bond University, Gold Coast, Queensland, Australia

<sup>9</sup>School of Human Movement and Nutrition Sciences, The University of Queensland, Saint Lucia, Queensland, Australia

<sup>10</sup>Amsterdam Collaboration on Health & Safety in Sports, Department of Orthopaedic Surgery, Amsterdam Movement Science, Amsterdam UMC Locatie AMC, Amsterdam, The Netherlands

<sup>11</sup>Department of Health Promotion, Norwegian Institute of Public Health, Bergen, Norway

<sup>12</sup>Institute of Sport and Exercise Medicine, Department of Exercise, Sport and Lifestyle Medicine, Faculty Health Sciences Stellenbosch University, Cape Town, South Africa

<sup>13</sup>Medical Education Department, Aspetar Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

<sup>14</sup>Department for Continuing Education, University of Oxford, Oxford, UK

<sup>15</sup>Department of Sports Medicine, United States Olympic and Paralympic Committee, Colorado Springs, Colorado, USA

<sup>16</sup>U.S. Coalition for the Prevention of Illness and Injury in Sport, Colorado Springs, Colorado, USA

<sup>17</sup>Institute of Sport, Manchester Metropolitan University, Manchester, UK

<sup>18</sup>Sport Injury Prevention Research Centre, Faculty of Kinesiology and Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

<sup>19</sup>Institute of Interdisciplinary Exercise Science and Sports Medicine, MSH Medical School Hamburg, Hamburg, Germany

<sup>20</sup>NtombiSport, Cape Town, South Africa

<sup>21</sup>Department of Rehabilitation, Midlands State University, Gweru, Midlands, Zimbabwe

<sup>22</sup>Department of Sports, Exercise, and Rehabilitation, Northumbria University, Newcastle upon Tyne, UK

<sup>23</sup>Department of Human Movement Science, Nelson Mandela University, Qheberha, South Africa

<sup>24</sup>School of Medical and Health Sciences, Centre for Human Performance, Edith Cowan University, Perth, Western Australia, Australia

<sup>25</sup>Edinburgh Sports Medicine Research Network, Institute for Sport Physical Education and Health Sciences, University of Edinburgh, Edinburgh, UK

<sup>26</sup>School of Medicine, University of Nottingham, Nottingham, UK

<sup>27</sup>Institute of Human Movement Science, Sport and Health, University of Graz, Graz, Austria

<sup>28</sup>Western Centre for Public Health and Family Medicine, Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ontario, Canada

<sup>29</sup>Fowler Kennedy Sports Medicine Clinic, Western University, London, Ontario, Canada

<sup>30</sup>Portugal Football School, Portuguese Football Federation, Oeiras, Portugal

<sup>31</sup>High Performance Commission, Medical Advisory Committee, South African Sports Confederation and Olympic Committee, Salt Rock, South Africa

<sup>32</sup>Amsterdam Collaboration on Health & Safety in Sports, Department of Public and Occupational Health, Amsterdam Movement Science, Amsterdam UMC, Amsterdam, The Netherlands

**Twitter** Isabel S Moore @IzzyMoorePhD, Kay M Crossley @kaymrossley, Margo Mountjoy @margo.mountjoy, Kathryn E Ackerman @drkateackerman, Wendy J Brown @ProfWendyBrown, Caroline S Bolling @cs\_bolling, Wayne Derman @wderman, Paul Dijkstra @DrPaulDijkstra, Carolyn A Emery @CarolynAEmery, Nonhlanhla S Mkumbuzi @DrNoeMkumbuzi, Sophia Nimphius @docsoph, Jane S Thornton @janesthornton, Rita Tomás @rtomasmd, Phathokuhle C Zondi @phatho\_z and Evert Verhagen @Evertverhagen

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### ORCID iDs

Isabel S Moore <http://orcid.org/0000-0002-4746-3390>

Kay M Crossley <http://orcid.org/0000-0001-5892-129X>

Kari Bo <http://orcid.org/0000-0003-1176-9272>

Margo Mountjoy <http://orcid.org/0000-0001-8604-2014>

Kathryn E Ackerman <http://orcid.org/0000-0003-2626-7785>

Juliana da Silva Antero <http://orcid.org/0000-0001-6894-6693>

Wendy J Brown <http://orcid.org/0000-0001-9093-4509>

Caroline S Bolling <http://orcid.org/0000-0002-7607-4765>

Wayne Derman <http://orcid.org/0000-0002-8879-177X>  
 Paul Dijkstra <http://orcid.org/0000-0003-3166-1357>  
 Carolyn A Emery <http://orcid.org/0000-0002-9499-6691>  
 Astrid Junge <http://orcid.org/0000-0002-6815-9793>  
 Nonhlanhla S Mkumbuzi <http://orcid.org/0000-0002-4982-0662>  
 Sophia Nimphius <http://orcid.org/0000-0002-3524-0245>  
 Jane S Thornton <http://orcid.org/0000-0002-3519-7101>  
 Phathokuhle C Zondi <http://orcid.org/0000-0001-6001-5966>  
 Evert Verhagen <http://orcid.org/0000-0001-9227-8234>

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