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

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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. 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 and population-specific 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. Indeed, the 2020 IOC consensus statement 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 being more frequently used in men’s sport.

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, 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. 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 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.
In May 2021, the lead authors (ISM and EV) invited three additional authors (KB, KC, and MM) to take part in the process of writing this supplement as part of a core working group. These authors were selected based on their documented expertise in female athlete healthcare and research, spanning a variety of female specific considerations around pregnancy, postpartum health (KB), musculoskeletal health (KMC) and mental health (MM).

The lead authors (ISM and EV) reviewed the 2020 IOC Consensus Statement [1], available extensions to the statement [2-5], and relevant literature on female-specific research considerations [7].

This informal review formed the basis of initial discussions with the core working group, which alongside their expertise from working with female athletes, led to the development of five key themes.

We assigned core members to chair a working group focused on one of the key themes

<table>
<thead>
<tr>
<th>(1) Definitions &amp; domains</th>
<th>(2) Severity &amp; Exposure</th>
<th>(3) Population characteristics</th>
<th>(4) Data collection</th>
<th>(5) Implementation considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMC</td>
<td>EV</td>
<td>KB</td>
<td>ISM</td>
<td>MM</td>
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</table>

Core members identified additional experts for their working group. Experts were required to have documented knowledge of the key theme and female health from a scientific (e.g., publications) or practical (e.g., clinical roles) perspective.

<table>
<thead>
<tr>
<th>(1) JST</th>
<th>(2) BC</th>
<th>(3) MeP</th>
<th>(4) KJE-A</th>
<th>(5) HDV</th>
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<tr>
<td>CAE</td>
<td>RT</td>
<td>JB</td>
<td>DP</td>
<td>KEA</td>
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</table>

Four additional experts (JdSA, AD, NSM, PZ) were invited to provide a critical review of the manuscript once it was drafted. These critical review experts were chosen based on having documented clinical experience with female athletes and or equity considerations, as well as being early career researchers.

This step provided an expert review process by authors who were not part of the initial drafting of this paper. This ensured validation of the drafted content.

Once the manuscript was finalized, current and former female athletes were involved in a ‘patient & public involvement’ (PPI) interview. The goal of these interviews was to gather the athletes’ lived experiences within the proposed health domains.

These interviews were conducted by an expert author (CSB) with qualitative research experience.

**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.
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-SIS) 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 and health outcomes. These are not unique to cisgender female athletes, but are more prevalent than in cisgender male athletes. 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 23 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 themed task. 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 1** Female health domains and their definitions

<table>
<thead>
<tr>
<th>Health domain</th>
<th>Domain abbreviation</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Menstrual and other gynaecological health</td>
<td>D-MG</td>
<td>The health of the menstrual cycle and female reproductive organs and tract.</td>
</tr>
<tr>
<td>Preconception/Assisted reproduction</td>
<td>D-AR</td>
<td>Undergoing treatments to assist in becoming pregnant without sexual intercourse.23</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>D-PR</td>
<td>The condition of being pregnant.24</td>
</tr>
<tr>
<td>Postpartum</td>
<td>D-PO</td>
<td>Immediately follows childbirth until 2 years post childbirth.</td>
</tr>
<tr>
<td>Menopause</td>
<td>D-ME</td>
<td>The transitional time between perimenopause and postmenopause, when menstruation ceases.1</td>
</tr>
<tr>
<td>Breast health</td>
<td>D-BH</td>
<td>The health of the mammary gland.24</td>
</tr>
<tr>
<td>Pelvic floor health</td>
<td>D-PF</td>
<td>The physical and functional integrity of the pelvic floor unit through the life stages of an individual (male or female).30</td>
</tr>
<tr>
<td>Breast feeding, parenting and caregiving</td>
<td>D-BP</td>
<td>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.</td>
</tr>
<tr>
<td>Mental health†</td>
<td>D-MH</td>
<td>The psychological, emotional and social well-being of an athlete.</td>
</tr>
<tr>
<td>Sport environment†</td>
<td>D-SE</td>
<td>The physical and social context within which athletes train and compete.</td>
</tr>
</tbody>
</table>

*Based on WHO breastfeeding recommendation37 and mental health outcomes.38
†This health domain is particularly prevalent but not unique to female athletes only. Consideration should be given to all athletes.
## Table 2  Female health domains, with frequently associated health problems and consequences, and examples of potential effects on performance and participation

<table>
<thead>
<tr>
<th>Health domain</th>
<th>Frequently associated health problem(s) and consequences</th>
<th>Examples of how female health domains might (directly or indirectly) affect participation and performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-MG</td>
<td>Dysmenorrhoea, Amenorrhoea, Oligomenorrhoea, Menorrhagia, Iron deficiency/Anaemia, Endometriosis, Fibroid-related pain, Polycystic ovarian syndrome, Premenstrual syndrome, Catamenial migraine, Gynaecological cancers—uterine, endometria Urinary incontinence (SUI, UUI, MUI)</td>
<td>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 impromptus 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.</td>
</tr>
<tr>
<td>D-AR</td>
<td>Ovarian hyperstimulation, Nausea, Abdominal pain</td>
<td>An athlete may need to miss training depending on time of ovulation, due to pain and menstrual cramps.</td>
</tr>
<tr>
<td>D-PR</td>
<td>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</td>
<td>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.</td>
</tr>
<tr>
<td>D-PO</td>
<td>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</td>
<td>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.</td>
</tr>
<tr>
<td>D-ME</td>
<td>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</td>
<td>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.</td>
</tr>
<tr>
<td>D-BH</td>
<td>Breast tenderness, Back and/or shoulder pain (secondary to poor bra support), Breast trauma/injury, Breast cancer, Mastitis, Non-cancerous breast mass</td>
<td>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.</td>
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### Table 2 Continued

<table>
<thead>
<tr>
<th>Health domain</th>
<th>Frequently associated health problem(s) and consequences</th>
<th>Examples of how female health domains might (directly or indirectly) affect participation and performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-PF</td>
<td>Urinary incontinence (SUI, UUI, MUI) Vulvar dysfunctions Pelvic organ prolapse Perineal or pelvic organ trauma from sexual assault Anal incontinence Constipation</td>
<td>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 (e.g., a marathon).</td>
</tr>
<tr>
<td>D-BP</td>
<td>Fatigue Breast tenderness Mastitis Energy deficiency Changing breast volume</td>
<td>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.</td>
</tr>
<tr>
<td>D-MH*</td>
<td>Mental health symptoms or disorders Depression Eating disorders/disordered eating</td>
<td>Female athletes have higher reported levels of psychological distress, depression and eating disorders/disordered eating than male athletes.</td>
</tr>
<tr>
<td>D-SE*</td>
<td>Sexual harassment Sexual abuse Physical abuse Psychological abuse Neglect Less access to training environments (including weight rooms) Trauma from sexual assault</td>
<td>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.</td>
</tr>
</tbody>
</table>

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.

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**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.’ 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’ (e.g., the menstrual cycle, pregnancy or menopause). Therefore, using an adaptation of the recommendations by Dodd et al., 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, 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 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. 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).
Health domain Athlete quotes on their lived experience with the female health domains

D-MG “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”. 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 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, could be a multitude of things”. “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”. “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 upset 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”.

D-AR “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”. “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”? “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”?

D-PR “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”. “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 to be 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”. “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”. “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”. “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”. “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. It is 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”.

D-PO “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”. “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 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”. “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”. “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. It is 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”.

D-ME “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 wasn’t overnight but it sure felt that way”. “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”. “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”.

D-BH “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”.

D-PF “I felt embarrassed. I went to the loo and sorted myself out and changed my leotard. People probably knew what had happened”. “It causes a bit of uncomfortableness and anxiety, which can obviously be distracting and can throw you off”. “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 a 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”.

D-BP “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 breastfeeding, 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”. “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”.

“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”. Continued
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, 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 (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 and this may influence injury risk factors.
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Figure 3  Examples of hypothetical prospectively collected female athlete health domains, and injury and illness data. Adapted from Bahr et al.7 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 feeding; D-MG, menstrual and other gynaecological health; D-HP, pregnancy health domain; D-PF, pelvic floor health domain; D-SE, sport environment health domain; REDs, relative energy deficiency syndrome. (eg, movement patterns17). 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 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.7 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).7 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, menstruation, pregnancy and menopause status). The elements of the relevant female health domain will depend on the stage life 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.18 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 Questionnaire19 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).7

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.1 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).
5. 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. 

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. 

For example, stakeholders could be involved in devising the injury definition 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. 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 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. 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. 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. Finally, the implementation team should have the clinical competency to communicate with female athletes concerning their sport-related experiences during puberty, fertility, pregnancy, postpartum and menopause. The IOC consensus statement lists more general implementation recommendations.

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.

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