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Supporting female performance in sport and fitness

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About this free course

This free course is an adapted extract from the Open University course .

This version of the content may include video, images and interactive content that may not be optimised for your device.

You can experience this free course as it was originally designed on OpenLearn, the home of free learning from The Open University –

There you'll also be able to track your progress via your activity record, which you can use to demonstrate your learning.

Intellectual property

Contents

Introduction and guidance

Introduction and guidance

This free badged course, *Supporting female performance in sport and fitness*, lasts 24 hours with eight sessions. You can work through the course at your own pace, so if you have more time one week there is no problem with pushing on to complete a further study session. The eight sessions are linked to ensure a logical flow through the course. They are:

1. Mind the gap: gender differences in sport science research and its impact on female athletes
2. Demystifying the menstrual cycle
3. Hormonal contraception: a solution or new challenges?
4. Pelvic floor muscles: out of sight and often overlooked
5. Breast health and choosing the correct breast support
6. Injuries and the female athlete
7. Low energy intake and missed periods: the risks
8. Effective support of female athletes

Each session should take you around 3 hours. There are a number of activities throughout the course where you are asked to note down your response. A text box is provided for you to do this, however if you would prefer to record your answers in another way that is fine.

At the end of each session there is also a quiz to help you check your understanding. And, if you want to receive a formal statement of participation, at the end of Sessions 4 and 8 there is a quiz which you need to pass.

Watch the introductory video presented by one of the co-authors, Simon Rea, which explains what the course includes, who it is relevant to and what you will get out of studying it.

Video content is not available in this format.

After completing this course, you should be able to:

- understand the physiological and psychological differences between men and women and between individual women
- identify female-specific issues that need to be considered to promote the health, fitness, and wellbeing of female athletes
- recognise the gender gap in research between males and females and its impact on female health and performance.

A note on terminology

The content in this course applies to anyone who identifies as female but is mainly focused on those people who have female genitals, have gone through puberty as a female and have (or had) a menstrual cycle.

Moving around the course

In the ‘Summary’ at the end of each week, you will find a link to the next week. If at any time you want to return to the start of the course, click on ‘Full course description’. From here you can navigate to any part of the course.

It’s also good practice, if you access a link from within a course page (including links to the quizzes), to open it in a new window or tab. That way you can easily return to where you’ve come from without having to use the back button on your browser.

The Open University would really appreciate a few minutes of your time to tell us about yourself and your expectations for the course before you begin, in our optional start-of-course survey. Participation will be completely confidential and we will not pass on your details to others.

What is a badged course?

While studying *Supporting female performance in sport and fitness* you have the option to work towards gaining a digital badge.

Badged courses are a key part of The Open University's *mission to promote the educational well-being of the community*. The courses also provide another way of helping you to progress from informal to formal learning.

Completing a course will require about 24 hours of study time. However, you can study the course at any time and at a pace to suit you.

Badged courses are available on The Open University's OpenLearn website and do not cost anything to study. They differ from Open University courses because you do not receive support from a tutor, but you do get useful feedback from the interactive quizzes.

What is a badge?

Digital badges are a new way of demonstrating online that you have gained a skill. Colleges and universities are working with employers and other organisations to develop open badges that help learners gain recognition for their skills, and support employers to identify the right candidate for a job.

Badges demonstrate your work and achievement on the course. You can share your achievement with friends, family and employers, and on social media. Badges are a great motivation, helping you to reach the end of the course. Gaining a badge often boosts confidence in the skills and abilities that underpin successful study. So, completing this course could encourage you to think about taking other courses.

How to get a badge

Getting a badge is straightforward! Here's what you have to do:

- read each session of the course
- score 50% or more in the two badge quizzes in Session 4 and Session 8.

For all the quizzes, you can have three attempts at most of the questions (for true or false type questions you usually only get one attempt). If you get the answer right first time you will get more marks than for a correct answer the second or third time. Therefore, please be aware that for the two badge quizzes it is possible to get all the questions right but not score 50% and be eligible for the badge on that attempt. If one of your answers is incorrect you will often receive helpful feedback and suggestions about how to work out the correct answer.

For the badge quizzes, if you're not successful in getting 50% the first time, after 24 hours you can attempt the whole quiz, and come back as many times as you like.

We hope that as many people as possible will gain an Open University badge – so you should see getting a badge as an opportunity to reflect on what you have learned rather than as a test.

If you need more guidance on getting a badge and what you can do with it, take a look at the OpenLearn FAQs. When you gain your badge you will receive an email to notify you and you will be able to view and manage all your badges in My OpenLearn within 24 hours of completing the criteria to gain a badge.

Get started with Session 1.

Session 1: Mind the gap: gender differences in sport science research and its impact on female athletes

Introduction

Real change, enduring change, happens one step at a time.

(Ruth Bader Ginsberg)

The delayed 2020 Olympic Games in Tokyo were the first Games where equal numbers of events and medals were available to females and males. The gap in the number of competitors has started to even out with around 52% athletes competing in male events and 48% in female events. In the 2020s there has been a shift in media coverage of sport with female sports gaining increasing amounts of airtime and coverage online and in the press. Increasingly there are improvements in the language used around female sports, like footballers, cricketers and rugby players not constantly being prefixed by ‘female’ or ‘women’. In cricket the terms ‘batsman’ and ‘batswoman’ have been changed to ‘batters’.

Figure 1 The gap between male and female participation in sport is narrowing.

Although progress has been made, significant inequalities remain between male and female sport. One such inequality is a shortage of sports science and medical research using female subjects exclusively.

This first session will celebrate the progress that female athletes have made but it will also shine a light on areas where female sport is lagging behind and the impact that may be having on their health and performance.

By the end of this session, you should be able to:

- understand the benefits of research evidence for both males and females in sport and exercise
- investigate why the majority of sports science research is conducted on males and the impact of this on active females
- identify the gender gap that impacts on female performance and participation in sport and fitness activities.

The Open University would really appreciate a few minutes of your time to tell us about yourself and your expectations for the course before you begin, in our optional start-of-course survey. Participation will be completely confidential and we will not pass on your details to others.

1 Original gamechangers: still breaking barriers

Figure 2 Fallon Sherrock throws in her match against Glen Durrant during the day.

In August 2022 the England Lionesses won Euro 2022 to secure the first major senior trophy for an England team since 1966. Their victory was witnessed by an 87,192-strong crowd at Wembley, which is a record for a European Championships, men's or women's. This historic event comes on the back of several other ground-breaking achievements by female athletes. In April 2021 Rachel Blackmore created history by becoming the first female jockey to win the Grand National on what was the 173rd running of the event, while in September 2021 Fallon Sherrock became the first woman to reach the final of a Professional Darts Corporation final.

You would be right to think it is about time we started to see women and men competing on an equal footing. However, it has taken until the second decade of the twenty-first century for female England players to be awarded professional contracts in football, rugby union and cricket which has allowed them to play full time and focus on their sport. Although, the campaign to achieve equality in other areas, such as pay and prize money, continues.

Female athletes

When the term 'athlete' is used, this means anyone who is active in a sport or fitness pursuit. This encompasses all levels of activity from the person involved in walking for health reasons, someone attending a gym to improve their fitness, up to an elite athlete challenging for gold medals. Some people may not classify themselves as an athlete, or identify as an athlete, but we would still use this term for them if they were active.

The first activity looks at some of the highlights of women's sport over the last century.

Activity 1 A brief history of achievement by women in sport

Allow about 10 minutes

Watch the video at the link below which highlights some of the milestones of sporting achievement by female athletes since the start of the twentieth century. Then answer the following questions:

1. What content in the video made the greatest impact on you and why?
2. What reason was given to women to prevent them from playing sport?

You can find the video (with the caption '#changethegame - History of women's sport') part way down this following article on the BBC website:
A game-changing decade for women's sport.

Text boxes are provided in all activities. You can use these to note down your answers to the questions. Once you click Save, your answers will be stored, and you can return to them at any point to view or amend your response. Your responses will only be visible to you. However, if you would prefer to make notes using pen and paper or a different format you can.

Provide your answer...

Discussion

1. There are many things that may have made an impact but the fact that man could walk on the moon in 1969 but it was considered too dangerous for females to play football until 1971 now seems unbelievable. Football for females was banned by the Football Association between 1921 and 1971.
2. Female physiology was often held up as a reason why women should not play sport. In the video the presenter says women were seen as being 'too frail, too delicate, too weak to break records'.

2 It does not have to be this way!

Sport and society have progressed far beyond these concepts of women being too weak to play sport. Events of the last century have shown that women are equally as capable as men to participate in all sports. However, for women and men to have equal opportunities to fulfil their potential in sport, we must have an equal understanding of women's and men's bodies. These differences are often ignored in medical and sport science research as they are seen to increase the complexity of research. Figure 3 shows some of the topics that need to be considered when supporting female athletes who are training for or competing in sport.

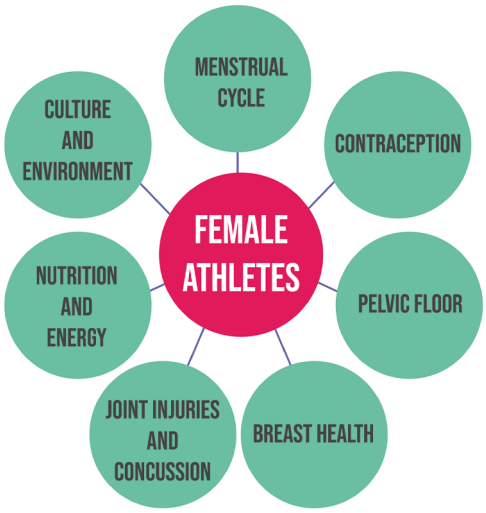


Figure 3 What to consider when training female athletes.

Activity 2 What if?

Allow about 15 minutes

Consider how much more progress would have been made if women and coaches had understood the elements outlined in Figure 3 which represents the contents of this course.

Provide your answer...

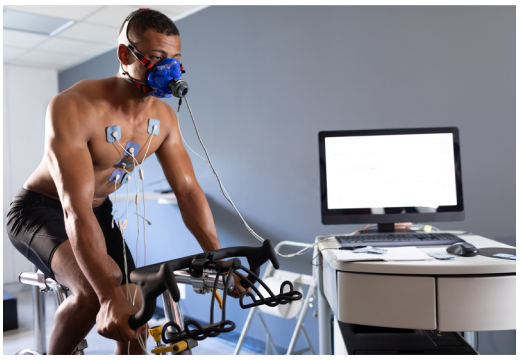
Discussion

While it is difficult to fully assess the impact that understanding more about females and the factors that impact on their sports performance, it is very likely that with an increased understanding, we would have seen higher participation rates and more rapid improvements in performance.

The safety of female athletes and their health is compromised by the lack of research and knowledge that exists. For example, females' physical and biomechanical differences to males leave them more at risk of joint injuries and concussions, their reproductive function can be affected by their nutritional status and energy availability, and this is turn impacts on bone health. These topics will be explored in the upcoming sessions.

Let's explore how and why these topics have been overlooked for so long.

3 The default male in sports science research



You'll start with Dr Emma Ross from The Well HQ explaining the gap that exists between the number of research studies using male and female subjects and why this is so problematic.

Activity 3 How much research is female specific?

Allow about 10 minutes

Watch the video below where Dr Emma Ross explains the number of research studies that are done on females only and the impact it has on female athletes. Then answer the following questions:

1. How much sports science research is conducted exclusively on females?
2. Why are mixed male and female athlete studies of limited use to female athletes?

Video content is not available in this format.

Provide your answer...

Discussion

1. The number of research studies conducted exclusively over a five-year period between 2016 and 2020 showed that 6% of research is female specific. This is almost a 50% increase on the previous five-year period but is still surprisingly low. There are studies that include both make and female subjects but this is still low. According to Cowley *et al*. (2021) this figure is around 34%.
2. The menstrual cycle with its fluctuating hormones creates physiological differences throughout its course so research that will benefit females needs to take these changes into consideration. But it makes research more expensive and time consuming. Many mixed research studies control this by studying females when their hormones are lowest, in the early stages of the menstrual cycle, as this will have less impact on the research findings. However, when a female's hormones are low their physiology will most resemble men's physiology, and this limits the value of any research when applied to female athletic performance.

This limited amount of female-specific research has a serious impact on female performance, as research conducted predominantly on men, or when women most resemble men, is not useful when developing training schedules and maximising female athletic performance.

This focus on male research is referred to as 'the default male in research' and it is not a positive situation for females who have a menstrual cycle, periods, breasts and slight differences in the structure of their skeleton. As well as this, females experience the physiological changes across their lifecycle through puberty, fertility, that may include pregnancy and post-natal periods, and finally the menopause.

These physical and physiological differences combined with a reluctance to talk about them, due to a lack of knowledge and understanding as well as their being taboo in some social circles, means that the 'female part' of being a female athlete or exerciser is often overlooked. As a result sport and fitness environments are often not optimised for women and limit their chances of positive outcomes.

4 Why is the female ‘problematic’ in sports science research?

One of the main objectives of this course is to fill in the knowledge and communication gaps by providing athletes, coaches and trainers with the knowledge they need to support the design and delivery of safe and effective programmes for female athletes. Ideally, with this added knowledge coaches and trainers will feel more confident and less embarrassed to have conversations with female athletes around subjects such as menstruation, breast support and pelvic floor health.

In Activity 4, Dr Emma Ross explains more about why females may be a ‘complication’ to researchers and the impact it can have.

Activity 4 Good excuses for not using females in research

Allow about 10 minutes

Watch the video below where Dr Emma Ross explains why researchers may leave females subjects out of their research. Then answer the following:

> Explain why researching female athletes can make research more time consuming and expensive.

Video content is not available in this format.

Provide your answer...

Discussion

There are additional things that you need to do when effectively researching female athletes. Because the females’ hormones impact on their physiology you need to test them at different stages of their menstrual cycle. Collecting more data increases the time and cost of the study. In addition, you will need to take blood samples to measure hormone levels which again increases cost but also requires specific expertise.

While research with female subjects may have more variables, it is also incredibly important that we understand more about how these factors impact on active females. This is the only way that we can start to effectively understand female athletes and become able to support their needs properly.

5 Why do we need to study women separately?

Research lacking female participants has many implications for female athletes, not least that we may never know if something that is safe for men is also safe for women. Or it may be that some types of training are more beneficial for women than men.

Dr Stacy Sims is an exercise physiologist who used her own experiences of rowing to ask uncomfortable questions about why female performance can vary significantly on different days. In Activity 5 she explains the impact the menstrual cycle can have on the fuel used by females during exercise and other variations that affect female sporting performance.

Activity 5 Are women the anomaly or is it really the men?

Allow about 15 minutes

Watch the TedTalk below by Dr Stacy Sims as she explains her own experiences of gender differences in performance as an academic and an athlete. Watch from 01:17 ('I was a cross country runner for most of my life…') until 06:10 ('… if we work on skill and development we'll be fine'). Then answer the following questions:

1. What differences does Dr Sims identify between male and female athletes?
2. What are the differences between males and females that occur at puberty?

Video content is not available in this format.

Provide your answer...

Discussion

1. Dr Sims identifies that female athletes use differing amounts of fat and carbohydrates as fuel for exercise dependent on which phase of their cycle

they are in. Dr Sims explains how men do not experience this variation to the same extent and they also experience fewer differences in how they tolerate heat from day to day. These hormonal differences experienced by women are often seen as limiting factors to performance, but they also offer opportunities, as you shall see in Session 2.

2. At puberty, males become stronger and faster due to the increased presence of testosterone and its impact on their muscular system. Females have a very different experience, as oestrogen causes them to lay down more body fat, their hips widen to facilitate childbearing, and they start getting periods that cause fluctuations in hormones, energy and mood.

Interestingly, Dr Sims makes the point that as there slightly more females than males in the world it must be men who are the anomaly, but females are regarded as such because they are more complicated to conduct research on.

You are now going to look at puberty and ask why it is such an important stage for maintaining female sports participation.

6 Why is there a post-puberty dropout?

In the video in the previous section, Dr Sims highlighted the different experiences males and females have at puberty as males become stronger, faster, fitter and more aggressive and well suited to playing sport while the changes females experience can lead to dropout from sport. This is supported by research as by the age of 12 only 8% of females do enough physical activity to benefit their health compared to roughly twice this number for males (Women in Sport, 2016).

Slater and Triggerman (2010) identified that dropout from sport was often due to peer pressure as sport is not viewed as being 'cool' or 'feminine' with their peers prioritising socialising as being more important than sport. Furthermore, young females often have concerns about their body image and for some sports clothing can accentuate their anxieties. The Sport England campaign This Girl Can was designed to challenge the perception that it is unfeminine or uncool for adolescent females to play sport (Forsyth and Roberts, 2019).

Dr Sims partly attributes adolescent female dropout from sport after puberty to the effect that increasing levels of hormones have on their coordination and the plateau of fitness gains at this time. Managing periods, dealing with the physical and emotional symptoms of the menstrual cycle and a body that is changing shape are all things which impact on girls' confidence and their motivation to participate in exercise or sport.

Her partial solution is that at this time when the female body is going through developmental changes, it is a good time to work on skill and technique as this will increase their competence and give them confidence to stay in sport (Sims, 2019).

Up to this point you have looked at the effect that male bias in research has on female sports performance and participation, but it is prevalent too in medical research as you shall discover in the final section.

7 Females being left out of medical research: another example of male bias?

While females being largely left out of sport science research may prevent them from optimising their performance, being left out of medical research can have serious health impacts. In Activity 6 Dr Alyson McGregor, an emergency medical doctor, looks at the outcomes when medical research is exclusively conducted on men and its results are then applied to women.

Activity 6 The male model as the framework for medical research

Allow about 15 minutes

Watch the TedTalk below by Dr Alyson McGregor as she explains the effects that medicines tested exclusively on males can have on female health. Watch from the start until 04:10 ('… what else are we missing?'). Then answer the following questions:

1. Why do you think medical research uses predominantly male subjects?
2. What are the potential health impacts of this practice on women?

Video content is not available in this format.

Provide your answer...

Discussion

It is quite shocking that most drugs that have been withdrawn are due to their side effects on women. This means women are essentially being used as test subjects in many cases.

1. To ensure that research studies can be published the data needs to be reliable. Reliability means that if it you did the test on different days you would get the same results. This works when testing on men as they do not have the same degree of fluctuations in hormone levels that may skew any data. Thus, it becomes easier and cheaper to test men and then assume males and females are alike and will respond to drugs in the same way.
2. This practice ignores that females may respond differently to the effect of drugs, such as in the example of Ambien where this sleep aid is metabolised more slowly by women meaning it may still be active when they are driving to work the next day. Although not mentioned in the video, you may be aware that Aspirin is another example of a drug that has different effects on males and females as it protects men against heart attacks but can be harmful to healthy women (McGregor, 2020).

It is not just women who have a cycle of hormones. Men have a daily cycle where levels of testosterone and cortisol change and this can impact on research findings.

A well-controlled research study would incorporate factors such as testing participants at the same time of day, controlling their exercise, food and drink intake prior to testing.

However, for females the influence of the menstrual cycle has to be factored in. This means that testing of female participants would have to take place at the same time of their menstrual cycle (e.g. all participants were tested on day 5 of their menstrual cycle), and if repeated tests were done, they would need to be done at the same time of their cycle.

8 This session's quiz

Well done – you have reached the end of Session 1. You can now check what you've learned this week by taking the end-of-session quiz.

Session 1 practice quiz

Open the quiz in a new or window and come back here when you have finished.

9 Summary of Session 1

You now have an understanding that females have been underrepresented in both sport and medical research due to a range of factors, including the perception that the female menstrual cycle adds a layer of complexity to the research. Male orientated research findings applied to the design of training and nutritional strategies for females are never a perfect fit because they ignore so many factors.

The remaining seven sessions of this course explore what we have considered to be the most important topic areas for you to expand and develop your knowledge and skills in supporting female performance and participation in sport and exercise.

The main learning points of this first session are:

- Only around 6% of research studies in sport science is conducted specifically using female subjects.
- The shortage of research using female subjects impacts on their health and safety as females are more at risk of joint injuries and their reproductive function can be impacted by their nutritional status.
- The presence of the menstrual cycle in females is often viewed as a complication in research as it can impact on reliability of data, as well as making it more costly and time consuming.
- There are significant differences in male and female physiology that need to be considered to enable females to exercise safely and optimise their performance.
- Males and females experience puberty differently as testosterone makes males stronger and faster while oestrogen prepares females for childbearing.
- Changes in females that happen at puberty can make them more susceptible to dropping out of sport.
- Medical research that uses predominantly male subjects can be dangerous to female health as females can produce different responses to treatments and medicines.

In the next session, you will explore the menstrual cycle and how changes in hormones can affect females and their performance in sport and exercise.

You can now go to Session 2.

Session 2: Demystifying the menstrual cycle

Introduction

If men had periods menstruation would become an inevitable boast-worthy, masculine event: men would brag about how long and how much.

(Gloria Steinem, 1978)

At the start of this session you will hear from Manchester City and England footballer, Steph Houghton, about an initiative by the English Institute of Sport (EIS) to increase understanding of female health issues like the menstrual cycle. This shows that progress is being made in addressing female health issues and that it is increasingly being seen as an important topic in optimising performance of female athletes.

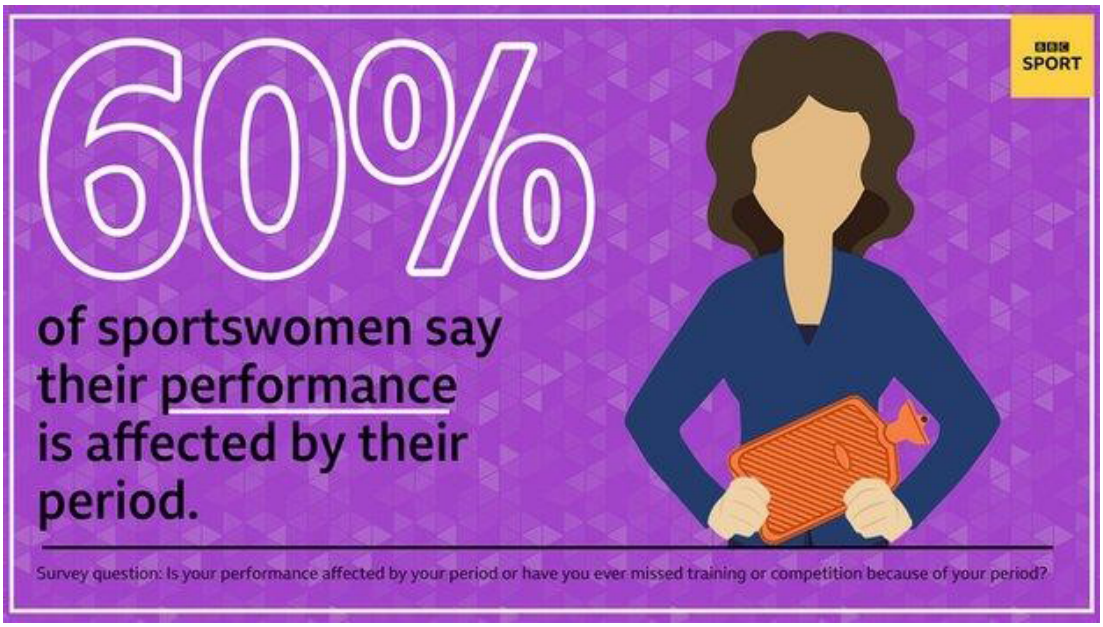
In this session you will develop your understanding of the menstrual cycle and the hormones involved including exploring the impact it can have on exercising females. You will also see how females can manage symptoms and consider adapting their training accordingly.

By the end of this session, you should be able to:

- understand the physiology of the menstrual cycle and how it can be experienced by women
- identify the potential impact of the menstrual cycle on training and athletic performance
- appreciate how female athletes and coaches can manage menstrual cycle symptoms and optimise performance.

Watch this video where Steph Houghton explains the research collaboration between Manchester City and the EIS: Periods in sport.

1 Does the menstrual cycle impact on exercising females?



The BBC Elite British Sportswomen's Survey (2020) showed that 60% of sportswomen considered that their athletic performance had been affected by their period. This included missing training or competitions due to their period. British Tennis player Heather Watson, cited symptoms of her menstrual cycle as contributing to her early exit from the 2015 Australian Open. However, as is common with many human experiences, the menstrual cycle affects all females differently. For example, Paula Radcliffe broke the World Marathon world record in 2002 on the day her period started.

Clearly women experience their period and their menstrual cycle in different ways as each one's body is unique, so there cannot be a one-size fits all approach to considering its impact. Recently, with help from social media, conversations around the menstrual cycle have become more common but there is still some discomfort about discussing it. Indeed in some social circles it is even taboo to discuss menstruation.

In the BBC Elite British Sportswomen's Survey 40% of athletes said they did not feel comfortable discussing their period with their coach. Due to a shortage of knowledge many coaches and fitness trainers may not be having these important conversations with their athletes.

Some females can find that for a number of days each month, symptoms of their cycle such as cramping, bloating and pain impact or prevent their training. If so many days were being lost to a more openly accepted issue such as a knee injury or recurring migraines, then the athlete and those who support her would no doubt be exploring all possible solutions. The silence around periods and the menstrual cycle means that so many athletes still find it impacts their training and performance, when this shouldn't be the case.

Organisations such as the English Institute of Sport (EIS) and The Well HQ are working hard to increase awareness of these issues. Before looking at the menstrual cycle complete Activity 1 to get you thinking about some the issues around the menstrual cycle.

Activity 1 Menstrual cycle myths and facts

Allow about 10 minutes

Answer True or False to the following statements about the menstrual cycle:

1. Blood loss during a period can cause fainting and reduce aerobic endurance in most females.

- ○ True
- ○ False

Discussion

False – on average you will lose about 2-3 tablespoons (45 ml) of blood over the length of a period which will have no impact on aerobic endurance. However, around 10% of females will experience heavy bleeding that may cause them to feel faint or dizzy, or even lead to iron deficiency.

2. Exercising during your period is not recommended for most women.

- ○ False
- ○ True

Discussion

False – this is a very dated view from the times when menstruating women were regarded as being 'sick'. Exercise has beneficial effects during the period, like reducing menstrual cramping and period pain (Chisholm, 2020).

3. It is best to do strength training at certain stages of your menstrual cycle.

- ○ True
- ○ False

Discussion

True – there is some truth to this as research is showing that strength gains are increased in the early phase (days 1 to 14) of the menstrual cycle (Pitchers and Elliott-Sale, 2019).

4. Women who live or play in teams together will start synchronising their periods.

- ○ True
- ○ False

Discussion

False – although there is some anecdotal evidence this may happen it is regarded as a myth. The myth developed partly due to a 1971 study which has now been discredited due to the method it used and its results have never been replicated in further studies.

5. Regular periods are an indicator of good health.

- ○ False

○ True

Discussion

True – regular menstrual cycles are linked to sexual function, fertility, bone health and cognitive function (Pitchers and Elliott-Sale, 2019). Any disruption to the menstrual cycle may not always be linked to exercise as it can have psychological or physiological causes.

2 What do you need to know about the menstrual cycle?

Whether you are a coach, athlete, or fitness trainer it is vital to have some knowledge about the changes that can occur in the female body each month and the effect it can have physiologically and psychologically. The menstrual cycle is explored further in Activity 2.

Activity 2 The menstrual cycle

Allow about 15 minutes

Watch the animation below that introduces you to the basic physiology of the menstrual cycle and hormones involved.

Video content is not available in this format.

Then match the following to either follicular or the luteal phase of the menstrual cycle.

Oestrogen levels reach a peak

Progesterone levels reach a peak

Time between the period and ovulation

Time between ovulation and the period starting

Match each of the items above to an item below.

Follicular

Luteal

Follicular

Luteal

You can see that the hormones released during the menstrual cycle, oestrogen and progesterone, are produced to support reproduction. These and other hormones are released from glands. Hormones are ‘chemical messengers’ that send messages out to organs and tissues to control health and behaviour. Hormones act to tell you to eat when you are hungry, give you energy when you are stressed and help you sleep at night.

Oestrogen and progesterone do not just control the menstrual cycle, they also contribute to variations in energy, mood, sexual desire, and changes in behaviour across the cycle (Hill, 2019). They also have a role to play in bone health, cardiovascular function and brain health.

3 Women's experiences of their menstrual cycle

Finch (2019) explains that each woman will experience their cycle differently and this experience can change over time and even month to month. This is why it is so important that athletes are able to talk about their menstrual cycle with their coach, trainer and support team. In Activity 3 you'll hear from three coaches who have also been athletes about their experiences of the menstrual cycle and exercise.

Activity 3 Coaches discuss their own experiences

Allow about 15 minutes

Listen to the audio below where Simon Rea interviews three female academics who are colleagues about the impact of their menstrual cycles. Then answer the following questions:

1. How do the experiences of the three females differ?
2. What benefits do they find from exercise when they experience menstrual symptoms?

Audio content is not available in this format.

Provide your answer...

Discussion

1. All three females experience their cycles in very different ways with Caroline explaining that she experiences no symptoms at all while Candice is more affected. She experiences stomach cramps and bloating as well as psychological symptoms such as being less able to deal with stress and being aware of a low mood. Jess has very specific problems where heavy menstrual bleeding led to low iron levels and feelings of fatigue and aching muscles associated with that.
2. Both Candice and Jess explained that menstrual symptoms are slightly alleviated by exercising and that it improves general psychological wellbeing.

> In particular, Jess refers to how exercise helped to alleviate stomach cramps and the lethargy she experienced during her period.

It is not always easy for some women to talk about this aspect of their health with their coach or trainer. It is very personal information to share, and it will depend on the nature of the relationship with their coach or trainer.

Also, Emma Ross (cited in Finch, 2019) points out that because female athletes have fought hard to gain the same opportunities, prize money and the same access to resources in sport as men, they may be reluctant to appear to be 'different'. Many female athletes want to be seen exclusively as athletes and do not want to be viewed or treated differently because of their reproductive system.

This is why it is so important to reframe the narrative around cycles and periods, in sport and in wider society. As you will discover in this course, a period is a vital sign of health, and a healthy menstrual cycle is reflective of a healthy body and is a positive feature of a female athlete's physiology. The hormones of the cycle have a positive influence on physical development as well as resilience and psychological health.

4 How does the menstrual cycle impact performance?

As you've seen, the primary functions of oestrogen and progesterone are to support reproduction. However, the changing levels of these two hormones across the menstrual cycle have a complex range of effects on the cardiovascular, respiratory, metabolic and muscular systems (McNulty *et al*., 2020). All these systems play important roles in athletic performance.

Before you look at the research into the impact of these fluctuating hormones on athletic performance, it is useful to explore athlete's individual experiences. In Activity 4 you'll hear from 2022 Commonwealth Games 10,000m champion, Eilish McColgan, who is coached by her mother, Liz McColgan-Nuttall, who herself was 10,000m Commonwealth Games champion in 1986 and 1990.

Activity 4 I honestly thought I was dying!

Allow about 15 minutes

Listen to an extract from the Female Athlete Podcast at the link below where Eilish McColgan explains how her performance can be affected by the different stages of her menstrual cycle. Then answer the following questions:

1. How has Eilish's performance been affected by her menstrual cycle?
2. What symptoms did she experience?

Eilish McColgan: listen from 24:38 ('So also on this podcast we like to talk about the menstrual cycle...') to 30:16 ('… I can't do this anymore').

Provide your answer...

Discussion

1. Eilish talks about how her performance dropped significantly when her period was delayed; she recorded times up to 9 seconds slower during this time. In addition to her decrement in performance Eilish also says that the only times she has dropped out of races was due to menstrual symptoms and this has happened twice.
2. Eilish clarifies that symptoms can change from one day to the next and on bad days these include heavy legs, stomach cramps and lower back pain.

In addition to the symptoms Eilish experiences, Sims (2016) identifies bloating, muscle cramps, feeling hotter, stomach upsets, headaches and changes in mood as symptoms that can occur at different stages of the menstrual cycle. Following her success at the Commonwealth Games and European Championships in 2022, Eilish spoke out about how the menstrual cycle should be discussed more:
Why is menstruation still a taboo subject?

5 What does the research say?

Any decrement in performance due to fluctuations in hormones is clearly a serious concern for athletes and their coaches. But is Eilish McColgan's experience typical and most importantly how do fluctuations in hormones impact on performance?

Activity 5 Fluctuating hormones and optimising performance

Allow about 20 minutes

Watch the video where Dr Emma Ross from The Well HQ explains the effect fluctuations in hormone levels have on the body, how they affect performance and how female athletes can use fluctuations in hormones to their advantage. Then answer the following questions:

1. How does Emma account for the different experiences that females have during their menstrual cycle?
2. What are your two key take away messages from this video?

Video content is not available in this format.

Provide your answer...

Discussion

1. Hormones have receptor sites on cells across the body and affect the brain, gut, blood vessels and muscles causing changing physical and emotional symptoms. However, each female's levels of hormones and their sensitivity to the effects of hormones will be different. This is the reason why females experience their cycle differently and experience different emotional and physical symptoms.

2. You may have different take away messages from these but you may have come up with the following.

   Firstly, that the impact of fluctuations in hormones will not affect your physiological capacity to perform. This is in terms of markers of performance, such as strength, power and aerobic endurance that don't actually change as hormones change across the cycle. However, a female's performance may be affected by symptoms that affect them physically and emotionally, such as nausea, headaches, bloating and period or back pain.

   Secondly, Emma advises that females improve their body literacy by tracking their cycles and understanding when hormones can make them more motivated and energetic and when their symptoms become challenging. This is important because if you can anticipate how you may be going to feel you can be proactive and make a plan for it.

   She also talks about the importance of opening up the conversation between female athletes and their coaches and trainers, so that the athletes can explain how their symptoms affect them and what the coach can do to get the best out of them on any given day.

To back up what Emma says an analysis by McNulty *et al*. (2020) that combined the results of 51 studies concluded that exercise performance in women is not significantly affected by any phase of the menstrual cycle. However, there is very little good quality research conducted on how the menstrual cycle impacts on performance. As a result it has not yet been possible to develop evidence-based guidelines for optimising exercise performance for women considering the menstrual cycle (McNulty *et al*., 2020).

6 How can hormones be used to a female athlete's advantage in exercise?

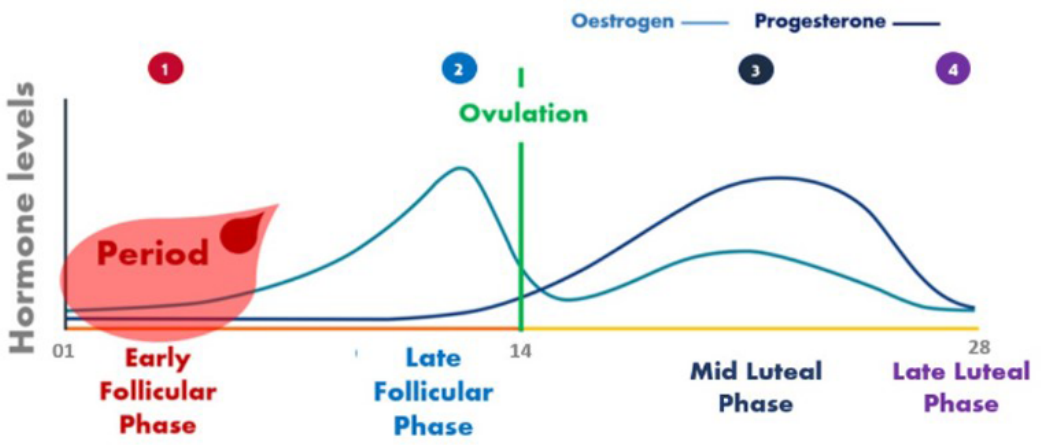


Figure 1 Changes in hormones during four phases of the menstrual cycle.

Activity 6 Using hormones to influence training effects

Allow about 20 minutes

Listen to the audio below where Simon Rea explains the fluctuations in oestrogen and progesterone (as outlined in Figure 1) and their impact on training. Then answer the following question:

What are the key implications for coaches, trainers and athletes?

Audio content is not available in this format.

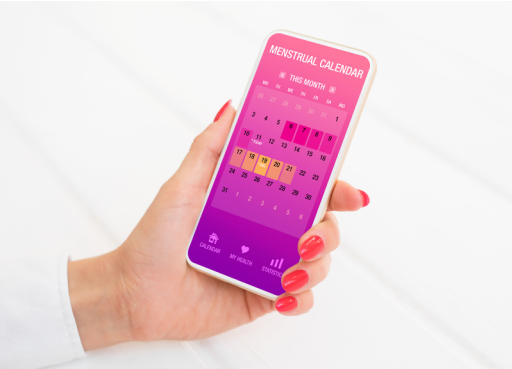
Provide your answer...

Discussion

Understanding the impact of the two hormones is so important when working with women who exercise as it might inform the type of training that is planned, the duration of recovery, or the fuelling requirements around a training session. The coach or trainer needs to be adaptable to consider the potential fluctuation in energy levels and mood of the individual athlete. While research is still in its early stages it is suggesting that athletes should take advantage of the early phase, once menstrual bleeding has stopped, to plan the more intense endurance and strength training sessions that they will do. However, soon after the midpoint of the cycle intensity may need to be reduced with a focus on rest and recovery.

It must be said again that these are 'typical' responses and not all females will experience these variations during their cycle. Some women may not even notice symptoms or need to tailor their training to their cycle.

7 How can tracking cycles help?



Tracking the menstrual cycle and becoming aware of what your own cycle feels like is an important element of self-care for women (Hill, 2019). This can be done by using a calendar, diary, or a period tracking app. There are apps that an athlete can share with their coach if they have given permission to share data. Cycle tracking has many advantages as Emma Ross pointed out in Activity 4 as if the athlete knows how she may be likely feel in the coming days preparations can be made for this.

Activity 7 Why monitor your menstrual cycle?

Allow about 15 minutes

Listen to another extract from the Female Athlete Podcast where the presenter, Georgie Bruinvels, outlines the benefits of tracking the menstrual cycle. Then answer the following question:

> What benefits may this form of self-awareness bring?

Mapping your menstrual cycle: listen from 17:51 (‘I step back and look at my younger self …’) to 21:17 (‘… using an app to work out better where you are at’).

Provide your answer...

Discussion

Dr Bruinvels is a very strong advocate of cycle tracking as she sees understanding her body as being an important part of being prepared for training and competition. This proactiveness enables her to make plans and adjustments so she can train and perform on any day. She also explains the value of tracking to assess how factors like stress, nutrition and sleep may be causing variations within a cycle. Dr Bruinvels stresses that until it is proved otherwise she believes that there is no evidence to say you can’t perform at your best on any one day; however, being proactive and having an understanding of small changes in your body during your cycle you should not be held back.

Dr Bruinvels has also worked with Chelsea Football Club who have made significant attempts to understand their players’ menstrual cycles and make adjustments where

possible to their nutrition, warm up routines, and recovery schedules. When coaching a team sport it becomes more problematic than when coaching an individual, as it is not feasible to tailor training or recovery to menstrual cycles as each player will be at a different stage of their cycle.

In squad environments, the best approach is to ensure that each player has an awareness of her own cycle, and what she might need to do to get the best out of herself on any given day. This requires that each player tracks her cycle, but then also is advised how to manage symptoms and capitalise on her changing physiology.

8 This session’s quiz

Well done – you have reached the end of Session 2. You can now check what you’ve learned this week by taking the end-of-session quiz.

Session 2 practice quiz

Open the quiz in a new or window and come back here when you have finished.

9 Summary of Session 2

You should now have an understanding of the phases of the menstrual cycle and how the changes in hormone levels impact on a female's energy and mood, as well as their energy levels and motivation for exercise.

The main learning points of this second session are:

1. 60% of sportswomen reported that their athletic performance was affected by their period while 40% said they do not feel comfortable discussing their period with their coach.
2. The menstrual cycle involves fluctuations in hormones, including oestrogen and progesterone, across a period of between 21–35 days but typically 28 days.
3. The menstrual cycle is a vital sign of health as it impacts on reproductive function, energy, mood, bone health and cardiovascular function.
4. Due to an individual's differing level of hormones and their sensitivity to the hormones each female will have a different experience of their cycle.
5. Athletic performance, in terms of power, strength and aerobic endurance, are not impacted by the fluctuations in hormones across the menstrual cycle but changing energy levels and symptoms, such as pain and bloating, can affect a female's ability to exercise and their motivation levels.
6. Research suggests that strength and high intensity training are most effective if performed in the follicular phase, which is between days 1–14 of the menstrual cycle.
7. Tracking the menstrual cycle is an important means of improving body literacy and preparing for training and athletic performance.

In the next session you will explore hormonal contraception and assess the impact it has on the female and their athletic performance.

You can now go to Session 3.

Session 3: Hormonal contraception: a solution or more challenges?

Introduction

Contraceptives are the greatest life-saving, poverty-ending, women-empowering innovation ever created.

(Melinda Gates, Author and Philanthropist)

Figure 1 Hormonal contraceptive options – the pill, IUS and injection.

Hormonal contraceptives in the form of 'the pill' were first made available in the USA in the 1960s. Their use quickly spread around the world. There are now a range of hormonal contraceptives available including the oral contraceptive pill (OCP), intrauterine system (IUS), implants, patches and injection. Hormonal contraception use in the UK is high in the general population at 30% and even more so among athletes. Currently, 50% of (female) athletes use some form of hormonal contraception and 70% have used hormonal contraction at some stage in their athletic career (Martin *et al*., 2018).

Figure 1 shows three methods of hormonal contraceptives. These methods work by altering the hormonal environment. As you may know there are other non-hormonal methods, such as condoms and the diaphragm, that prevent conception in different ways.

In this session you will look at why athletes may choose to use hormonal contraceptives, how they impact the menstrual cycle and what influence that can have on the performance and health of the athlete. Coaches and trainers benefit from this information since they need to be confident and comfortable in having conversations with their athletes about hormonal contraception.

By the end of this session, you should be able to:

- understand the impact that hormonal contraceptives have on the naturally occurring hormones
- explain the benefits and drawbacks of hormonal contraceptives and their impact on performance.

1 How do hormonal contraceptives work?

In Activity 1 you will look at the range of hormonal contraceptives that can be used and how they impact on the menstrual cycle. In this video Emma refers to 'synthetic' hormones and these are hormones that are artificially created and then introduced into the body, rather than hormones that are naturally produced by the body. All forms of hormonal contraception involve the introduction of synthetic hormones into the body.

Activity 1 It's about more than a pill

Allow about 15 minutes

Watch the video below where Dr Emma Ross from The Well HQ introduces different types of hormonal contraception and their impact on the female athlete. Then answer the following questions:

1. Why do coaches and trainers need to be more confident when talking about contraception with their athletes?
2. What benefit may the Mirena coil have over other methods of oral contraception?

Video content is not available in this format.

Provide your answer...

Discussion

1. Knowing if female athletes are using hormonal contraception can be important for coaches and trainers, since their use can suppress the naturally occurring hormones that control reproduction and create a different physiology within the athlete. Hormonal contraception use may also mask any menstrual problems or disruptions that the athlete is experiencing. While Emma explained two main types of oral contraceptive pill, there are around 12–15 different preparations of the combined pill (containing oestrogen and progesterone) and at least 4 different types of the mini pill (containing progesterone only). These will all contain slightly different amounts of synthetic oestrogen and progesterone and thus will have slightly different effects on the body.
2. While most hormonal contraceptives suppress the production of naturally occurring menstrual cycle hormones, the exception is the Mirena coil. In women using this hormonal coil, ovulation and the cyclical release of oestrogen and progesterone can occur, because the delivery of synthetic progesterone is localised directly into the uterus, and it does not circulate more widely around the body. Pregnancy is avoided because the uterus lining remains thin but because the menstrual cycle continues it produces natural peaks and troughs.

You will appreciate that the purpose of hormonal contraceptives is to reduce the risk of pregnancy by preventing ovulation and the development of follicles in the uterus. They also reduce sperm's ability to swim effectively (motility) and the thickening of the uterus lining. But you may be wondering why introducing more oestrogen and progesterone into

the body causes it to stop producing its own hormones and why these synthetic versions do not have the same effect as naturally occurring hormones?

Tricking the brain to sit back and relax – how hormonal contraception works

To understand this you will need to refer back to the menstrual cycle that was covered in Session 2, and the hormonal signals that come from the brain to the ovaries.

Once the egg has been released at ovulation, oestrogen and progesterone are both relatively high during this second half of the cycle (the luteal phase). These high levels of hormones are a signal to the brain to ‘sit back and relax’. What the pill does is trick the brain, every day, into thinking that the body is in the second half of the menstrual cycle, when oestrogen and progesterone remain high. The pill does this by delivering a synthetic version of these hormones. In this way the brain stays in its ‘sit back and relax’ mode through the whole cycle and it does not stimulate ovulation because it thinks it is in the post-ovulatory part of the menstrual cycle.

The primary way the pill prevents pregnancy is by preventing ovulation and as no egg is released it means that the sperm has nothing to fertilise.

2 Why might athletes take hormonal contraceptives?

The 2020 BBC Elite British Sportswomen's Survey showed that almost 1 in 3 (28%) athletes took a contraceptive pill with the belief that it controls the impact that their period has on their performance. Avoiding pregnancy was the original reason that hormonal contraceptives were developed, but now they are commonly used for other reasons as well. One of these reasons is menstrual management. This and other reasons are discussed in Activity 2.

Activity 2 Menstrual management and other reasons

Allow about 15 minutes

In the video Dr Emma Ross, outlines the reasons that hormonal contraceptives are used and some of the side effects they can have. Watch the video, then answer the following question:

> If you are an athlete, why do you use hormonal contraceptives or if you support an athlete why do you think athletes use hormonal contraceptives?

Video content is not available in this format.

Provide your answer...

Discussion

As you have heard hormonal contraceptives are taken for a variety of reasons, including their intended purpose. They are also used to make their cycle more predictable and manage symptoms of the menstrual cycle, such as heavy bleeding and severe period pain. However, often active women may use them for menstrual management. The menstrual cycle can be manipulated for the convenience of sport so an athlete does not experience menstrual symptoms, or can predict when they will bleed, which makes managing their cycle around a big event or competition easier.

While menstrual management can be important and effective for athletes, it is also important that women are aware of the potential impact hormonal contraception may have on their performance, physically and psychologically, and to be vigilant for any unwanted side effects such as unwanted weight gain and low mood. There is not a one-size-fits-all best hormonal contraception choice for athletes, and it may take more than one attempt to find what suits them best. Monitoring physical and emotional symptoms when athletes start using hormonal contraception can be a useful way to understand which side effects may be present, and if and how, they impact training and performance.

Hormonal contraceptives have historically been used to treat loss of periods (amenorrhoea) due to disruption of the menstrual cycle. However, this approach actually masks the root cause of menstrual dysfunction, since the re-instigation of a withdrawal bleed is not the same as normal menstruation, yet it can lead athletes to falsely believe that their cycle has been resumed (Elliott-Sale and Hicks, 2019). Hormonal contraceptives will mask the root cause of menstrual dysfunction. It is important to understand what is

causing irregular or absent periods and work on restoring a healthy cycle, before considering the use of hormonal contraceptives.

3 The impact of hormonal contraception on the female and their menstrual cycle

Oral hormonal contraceptives (the pill) are typically taken over a 28-day period to replicate the length of the idealised menstrual cycle. But there are a variety of different types. Here are some interesting facts you may or may not know.

Did you know?

In some pill preparations this 28-day cycle consists of 21 days when the pills contain synthetic hormones and then 7 placebo pills, which do not contain any synthetic oestrogen or progesterone. During this time when placebo pills are taken, it is common for women to experience what is called a withdrawal bleed.

Did you know that some pill types often lead to no or lighter bleeding?

On the progesterone-only pill, one pill is taken every day for 28 days, but individuals continue straight onto the next 28-day pill packet without a break. About 50% of women find that they don't bleed at all on this type of contraception, and others have much lighter breakthrough bleeding, because the uterus lining is being kept thin all the time by the effect of the pill.

Older generation progesterone-only pills (also known as the mini pill) have strict criteria where they must be taken within the same 3 hour time slot every day to be effective. However new generation pills have a 12 hour window to take the pill which can be less restrictive and easier to manage if athletes have an unpredictable schedule or lots of travel.

The menstrual cycle is a sign of good fuelling and recovery

For athletes it is really important to understand that the withdrawal bleed experienced by women using hormonal contraception is not a period. Whereas a period can be an indication of good menstrual health, and a healthy menstrual cycle is a sign that athletes are fuelling and recovering well, having a withdrawal bleed cannot offer any of these signs of menstrual health, since the menstrual cycle is suppressed when using hormonal contraception.

The oral contraceptive cycle replaces the menstrual cycle and the symptoms produced by the hormones over a single cycle, but it is not without positive and negative symptoms of its own. Martin *et al*. (2018) reported roughly equal numbers of positive and negative side effects in hormonal contraceptive users as shown in Figure 2.

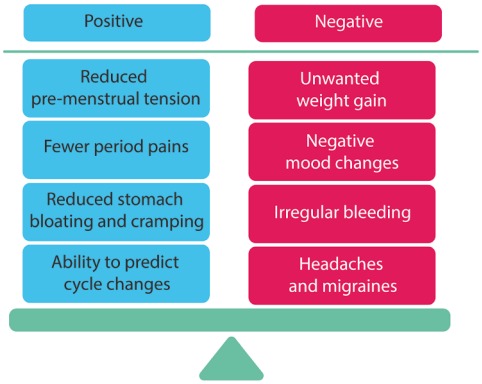


Figure 2 Positive and negative effects of hormonal contraception.

4 What does the research say?

The use of hormonal contraception provides practical benefits, such as the manipulation of menstrual cycles to prevent bleeding or symptoms at times when the athlete needs to be at peak performance. Also, hormonal contraception pills can be taken ‘back to back’ which means eliminating the 7-day withdrawal bleed. However, because the menstrual cycle is being disrupted the hormonal environment in athletes using contraception is different to those with naturally occurring menstrual cycles. This difference may have an impact on performance and is explored in Activity 3.

Activity 3 Hormonal contraceptives and athletic performance

Allow about 15 minutes

Watch the video where Dr Emma Ross discusses the research conducted into the impact of hormonal contraception on athletic performance. Then answer the following questions:

1. What does the research say about athletic performance and hormonal contraception use?
2. Why do you think it is so difficult to produce valid research about hormonal contraception use and performance?

Video content is not available in this format.

Provide your answer...

Discussion

1. Emma explains how research has shown that while measures of strength do not seem to be impacted by the synthetic hormones, aerobic endurance may be. Controlled research under laboratory conditions has shown that aerobic endurance can be decreased by as much as 11%. Although it should be said that not all studies support this finding, and no study has shown how this impact translates into endurance performance in competition.
2. Emma explains how the research she quotes was well controlled meaning that the researchers had attempted to control significant variables (things that can change). However, as we identified before, there are many different types of hormonal contraceptive pills and methods, so research design needs to ensure all subjects are using the same method and brand to be valid. This also means that there may be slightly different outcomes for the different hormonal contraceptives.

In summary, the relationship between hormonal contraceptive use and performance is not completely clear; however, an analysis of 42 studies showed that oral contraception users might have a slightly poorer endurance performance compared to those with a natural menstrual cycle (Elliott-Sale *et al*., 2020). The recommendation from Emma Ross was that an individual approach needs to be taken and active females need to find the approach that works best for them.

5 Hormonal contraception or natural cycle? An individual choice

At the time of writing in 2021 there have been no guidelines produced for athletes about the use of hormonal contraceptives and their influence on athletic performance, because the research shows that any differences in performance are very small (Elliott-Sale *et al*., 2020). As a result it comes down to individual choice, and each individual athlete experiences of their natural cycle. This would include their reasons for using hormonal contraception and their ability to find one that suits them, physically and emotionally as well as any side effects they may experience.

Information and understanding around contraception empowers women to make informed decisions that are right for them, in the context of their life and their sport. Importantly, hormonal contraception is a medication, and what and how it is used should always be discussed with a healthcare professional, such as a GP. There are good resources and information available online to help women make informed decisions, such as The Lowdown.

6 This session's quiz

Well done – you have reached the end of Session 3. You can now check what you've learned this week by taking the end-of-session quiz.

Session 3 practice quiz

Open the quiz in a new or window and come back here when you have finished.

7 Summary of Session 3

You should now be aware of the different types of hormonal contraception and have an understanding of the impact of hormonal contraception on the body and the influence it may have on athletic performance.

The main learning points of this third session are:

- Hormonal contraceptive methods include the pill, the intrauterine system (IUS), hormone patches, implants and injections.
- Hormonal contraception works by introducing synthetic versions of the hormones oestrogen and progesterone into the body.
- The synthetic hormones in hormonal contraceptives trick the brain into thinking that the body is always in the second half of the menstrual cycle and thus ovulation does not occur.
- Hormonal contraceptives may be taken by athletes for menstrual management to control symptoms such as menstrual bleeding, stomach cramps and bloating.
- Hormonal contraceptives can have significant side effects such as unwanted weight gain and experiencing low moods.
- Hormonal contraception may have a negative impact in aerobic endurance decreasing it by as much as 11% under laboratory conditions but it does not impact on strength.

In the next session you will find out about how issues with pelvic floor muscles can impact on active females and most importantly, what can be done about this.

You can now go to Session 4.

Session 4: Pelvic floor muscles: out of sight and often overlooked

Introduction

Pelvic floor dysfunction is a common and often debilitating set of symptoms that can result in many issues for women.

(Gillian Leng, Chief Executive of NICE)

Every woman has a pelvic floor, yet many people know very little about it. Pelvic floor issues are finally starting to get attention from the media and within sport. Generally speaking, the pelvic floor muscles are usually only discussed in relation to childbirth and ageing, but physical activity can also be a contributing factor to developing pelvic floor dysfunction.

Physical activity brings many physical, social and psychological benefits but pelvic floor health may be the only area of the body where the positive effect of physical activity can be questioned (Bo and Nygaard, 2020). Pelvic floor dysfunction is associated with urinary incontinence (UI), or leakage of urine, and this can be a source of embarrassment and discomfort in the active female. This does not mean that women should stop exercising, far from it, but we can't ignore pelvic floor issues as they are impacting on the female experience of sport.

In this session the often overlooked pelvic floor will be brought into focus, and you will develop an understanding of what the pelvic floor consists of, its role in health and exercise, the factors that affects its function, and how it can be trained and strengthened.

By the end of this session, you should be able to:

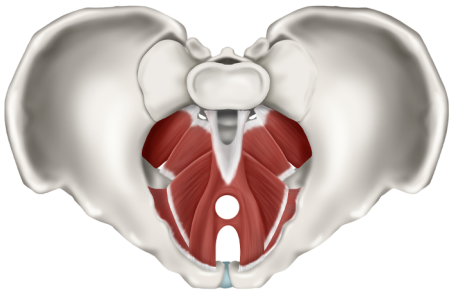
- identify the location and function of the pelvic floor muscles

- understand the impact of pelvic floor dysfunction
- apply the principles of pelvic floor training.

1 What does pelvic floor dysfunction look like?

In the figure below you can see some example quotations from women when asked about their pelvic floor.

2 Introducing the pelvic floor and its muscles



Understanding where the pelvic floor is and its purpose is of key importance when it comes to working with athletes. By having this knowledge coaches, trainers and athletes are able to understand the causes of dysfunction and be proactive with their programming to help the women they are supporting.

You'll start with a video to introduce you to the pelvic floor.

Activity 1 What is the pelvic floor and what should it be doing?

Allow about 20 minutes

Watch the video below where Baz Moffat of The Well HQ introduces the pelvic floor, explains its purpose and the signs that it's not functioning properly to look out for.

Then answer the following questions:

1. What role does a healthy pelvic floor play?
2. What are the signs that the pelvic floor is not functioning correctly?

Video content is not available in this format.

Provide your answer...

Discussion

1. The role of the pelvic floor is to keep us dry by preventing any leakage of urine, while we are doing whatever activity we want to do. The pelvic floor should also be able to withstand the increase in abdominal pressure caused by laughing, coughing and sneezing. Running and jumping also increase abdominal pressure and should be able to be performed without urine leakage.
2. The main sign of pelvic floor dysfunction is leakage, or urinary incontinence, when laughing, coughing, sneezing, or taking part in exercise. However, urge incontinence, where you suddenly need to go and cannot hold on, and pelvic pain are also signs. Fortunately, in most cases dysfunction can be treated or improved through specific exercises.

Urinary incontinence (UI) is also referred to as stress incontinence (SI) due to it being caused by increased stress on the pelvic floor muscles.

3 Which muscles are we talking about?

The pelvic floor is situated inside the pelvis and consists of a group of muscles and ligaments. Because we can't see them as they are surrounded by larger global muscles around the hips, they seem to get less attention from coaches and trainers. They are also complex in structure as they consist of three layers of muscles that are attached to and integrated with other body systems.

Figure 1 shows the key structures of the pelvis and the pelvic floor.

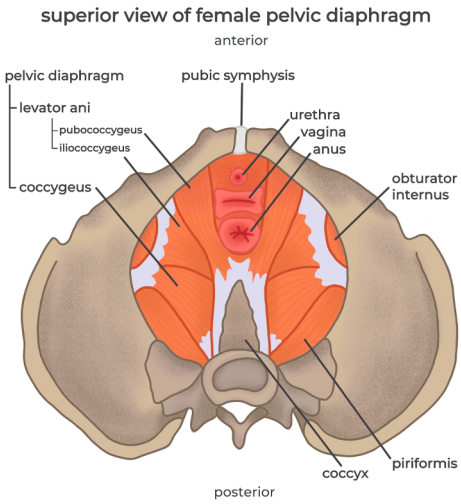


Figure 1 The key structures of the pelvis and the pelvic floor.

The main pelvic floor muscles are the levator ani and the coccygeus. The purpose of these muscles is to keep us dry by avoiding urine, wind or faecal leakage, they allow us to fully empty our bladders and bowels, and they facilitate sexual function and pleasure.

The pelvic floor has to contract, relax and respond to changes in pressure. In sport, common movements, such as jumping and quickly changing direction, place additional stress on the pelvic floor muscles. Thus gymnasts, trampolinists, basketball and volleyball players are most at risk of pelvic floor dysfunction.

Sometimes when we are lifting heavy weights, we need to use the Valsalva manoeuvre (i.e. exercise is performed while holding the breath). This is necessary to stabilise the body's core, but it can damage the pelvic floor muscles. This is due to the increased pressure in the abdomen and thus places additional stress onto the pelvic floor muscles. As a result lifting heavy weights can cause stress incontinence or pelvic organ prolapse. A pelvic organ prolapse is when one or more organs within the pelvis moves from their natural position to form a bulge in the vagina.

4 Athletic performance and pelvic floor dysfunction?

Most women will have a pelvic floor that is strong enough for their daily activities; however, it is not uncommon for athletic females to experience problems due to dysfunction of their pelvic floor muscles. This can have serious consequences.

Teixeira *et al*. (2018) identified that urinary incontinence (UI) can impact on social and mental wellbeing and as a result can cause problems, such as social isolation, low self-esteem, depression and a lower quality of life. They also reported that 20% of women had given up playing sport due to UI. In addition to this there are several risk factors for pelvic floor dysfunction, and these are older age, obesity, childbirth, menopause and exercise (Teixeira *et al*., 2018). Activity 2 introduces the problems athletes may face around pelvic floor dysfunction.

Activity 2 Pelvic floor health and athletes

Watch the animation below that gives more detail about the pelvic floor, why athletes are prone to pelvic floor dysfunction, and what can be done to restore function to these muscles.

Video content is not available in this format.

Then answer the following True/False questions.

1. Due to their strong pelvic floor athletes are less likely to experience urinary incontinence.

- ○ False
- ○ True

Discussion

False. Athletes are more likely to experience UI as their pelvic floors can be weakened by high intensity exercise or their overtight pelvic floors can affect their function negatively.

2. Pelvic floor muscles run across the pelvis from pubic bone to coccyx.

- ○ False
- ○ True

Discussion

True. The muscles of the pelvic floor run across the pelvis.

3. In both males and females there are two openings in the pelvic floor.

- ○ True
- ○ False

Discussion

3. False. Males have two opening in the pelvic floor for the urethra and the anus, but females have an additional opening for the vagina.

4. Exercising, sneezing, and coughing will all strengthen the pelvic floor muscles.

- ○ False
- ○ True

Discussion

False. All these activities can add to increase pressure on the pelvic floor and cause UI.

5 What does the research on athletes say?

Pelvic floor dysfunction is predominantly a problem in 'high impact' sports which are sports that involve running and jumping. This is because they increase intra-abdominal pressure and exert forces directly onto the pelvic floor (Reis *et al*., 2011).

How many female athletes experience pelvic floor dysfunction?

36% of female athletes experience urinary incontinence

44% experience stress incontinence

Athletes and active females have up to three times higher rates of urinary incontinence than sedentary women.

(Teixeira *et al*., 2018)

This figure of 36% may look high, but in reality it is hiding a far worse problem. This figure is taken from research across all sports, whereas actually in some sports figures report that around 80% of female athletes in that sport experience urinary incontinence.

Who is at risk?

Athletes in the following sports reported the highest incidences of urinary incontinence:

- Gymnastics
- Badminton
- Basketball
- Tennis
- Hockey
- Track and field athletics
- Aerobics

(Teixeira *et al*., 2018)

Bo and Nygaard (2020) proposed the two opposing theories, as introduced in Activity 2, as to why athletes have a higher prevalence of pelvic floor dysfunction:

1. Exercise stretches and weakens the pelvic floor because the muscle fibres and ligaments become damaged due to the forces applied on the pelvic floor and the repeated increases in intra-abdominal pressure.
2. Exercise causes the pelvic floor muscles to become too strong. These muscles experience hypertrophy (increase in size) and become shorter and tighter. These changes may mean that the muscles no longer have the flexibility required to respond to changes in pressure. Not being able to resist pressure as effectively can lead to an increase prevalence in leaking.

Currently there is insufficient evidence to conclude that a functioning pelvic floor will improve performance; however we can categorically say that a dysfunctional pelvic floor is an unwelcome distraction for athletes and may even stop them from doing the sport or activity they love.

6 Strong to the core: training the pelvic floor

One of the challenges many women encounter when doing any pelvic floor exercises is that it's not obvious where they are, or what exercises they should be doing.

In Activity 3 Baz Moffat of The Well HQ, who has taught thousands of women to train their pelvic floor muscles, will instruct you on how you should approach them.

Activity 3 A little effort for a big gain

Allow about 20 minutes

Watch the video below where Baz Moffat will help you to locate your pelvic floor muscles and then show you how to train the muscles for strength and endurance.

Once you have watched the video write down your early impressions of completing these exercises.

Video content is not available in this format.

Provide your answer...

Discussion

Your initial impression might be that it can be surprising how difficult the exercises are to do correctly because they involve subtle, small movements. As Baz says there is a tendency to just contract everything and even screw up your face with the effort involved, but it is essential not to engage other muscles. It was important that Baz stressed that they should be done every day and at least 10 lifts to be done slowly and 10 lifts to be done quickly. This will ensure all muscle fibres are worked as the pelvic floor contain both slow twitch muscle fibres (for endurance) and fast twitch muscle fibres (for strength and power).

It is important to reinforce the message from Baz that locating the pelvic floor muscles by practicing stopping the flow of urine or from stopping yourself breaking wind must only be used as a technique to reassure yourself that you are using the correct muscles.

The reason that we should not use this technique regularly is that our pelvic floors are designed to relax while emptying our bowels and bladder. If we do the opposite of relaxing the muscles by contracting them it can confuse the neural pathways between the brain and the bladder and bowels. This can lead to problems in the future, such as an inability to completely empty your bladder that can increase your risk of a urinary tract infection.

7 From the pelvic floor to the gym floor

In the 1940s Dr Arnold Kegel, who was a pioneer in pelvic floor health and exercise, developed a set of exercises which have come to be known as 'Kegels exercises'. Kegels exercises are associated with the times before and after childbirth but are applicable to any female who has a pelvic floor. They should not be seen as being only relevant to those who are experiencing symptoms of pelvic floor dysfunction. However, as you've heard, locating and training the pelvic floor requires a lot of skill and control, and the exercises are very rarely done correctly.

Pelvic floor training can be done in two ways. The exercises can be done in isolation where you focus solely on the pelvic floor muscles, or they can be incorporated into exercises you do in training. This would involve activating the pelvic floor before completing an exercise and focusing on them during the movement.

To complete pelvic floor exercises National Association for Continence and The Mayo Clinic recommend the following:

- Locate the right muscles and practice contracting and relaxing them.
- Start by contracting the muscles for 5 seconds and then relax them for 5 seconds. Gradually work up to contracting and relaxing for 10 seconds.
- To give a full work out complete 10 quick contractions and relaxations, holding for 1-2 seconds and then 10 long hold contractions where you hold for 10 seconds and relax for 10 seconds. This ensures both fast and slow twitch muscle fibres are worked.
- This full work out should initially be completed at least once a day, with the aim being to work up to 3 times a day.
- Athletes should integrate pelvic floor exercises into their core training and strength and conditioning sessions.

There are also pelvic floor trainers available to buy, but the best advice is always to learn how to do your exercises correctly. If you need devices to help keep you motivated, then they may be useful, but they won't necessarily be any more effective than using your own exercises. There's also a very useful app called squeezy app, which is NHS recommended and is useful to ensure that the exercises are done regularly.

Finally, if after three to four weeks of diligently doing pelvic floor exercises daily the athlete has noticed that they are making no progress, it is advised that they check in with a specialist women's health physiotherapist. This can be done via the directory in the squeezy app. This medical help is important so a physiotherapist can make an assessment of what might be preventing the progress, and then individualise a training programme and offer support.

Also, as an active female, if your pelvic floor is overactive and too strong it is advised that you consult a physiotherapist who specialises in pelvic floor health.

8 This session’s quiz

Now it’s time to complete the Session 4 badged quiz. It’s similar to previous quizzes, but this time instead of answering five questions there will be fifteen.

Session 4 compulsory badge quiz

Remember, this quiz counts towards your badge. If you’re not successful the first time, you can attempt the quiz again in 24 hours.

Open the quiz in a new or window and come back here when you have finished.

9 Summary of Session 4

You should now have an understanding of the anatomy of the female pelvic floor, its purpose, and the impact it can have when it does not function correctly. You should also have an understanding of how training can improve its function and why athletes may be more at risk of pelvic floor dysfunction.

The main learning points of this fourth session are:

- The pelvic floor consists of a group of muscles and ligaments that cover the floor of the pelvis between the coccyx and pubic bone.
- Pelvic floor dysfunction can cause urinary incontinence, urge incontinence and pelvic pain.
- Urine leakage can occur when exercise places increased pressure on the pelvic floor and when sneezing, laughing or coughing.
- Exercising females are up to three times more likely to experience urinary incontinence.
- Athletes in sports involving running, jumping and quick changes in direction are most likely to experience urinary incontinence.
- Active females may experience pelvic floor dysfunction due to the increases in the forces applied to the pelvic floor during training or because the pelvic floor muscles become too strong and inflexible.
- Pelvic floor exercises should be done at least once a day by all women and more if you're experiencing symptons.
- Pelvic floor exercises should involve slow and fast movements to activate all muscle fibre types.

You are now halfway through the course. The Open University would really appreciate your feedback and suggestions for future improvement in our optional end-of-course survey, which you will also have an opportunity to complete at the end of Session 8. Participation will be completely confidential and we will not pass on your details to others.

In the next session, you will explore breast health and the importance of finding correctly fitting breast support.

You can now go to Session 5.

Session 5: Breast health and choosing the correct breast support

Introduction

Everyone feeling comfortable out there on the pitch and in themselves is incredibly important, both as a female in general, but also as a female in sport.

(Hannah Martin, GB hockey)

If I forgot my sports bra, forget it, I just wouldn't compete. That's how integral it is to my performance.

(Goldie Sayers, Javelin)

The need for coaches to better understand the female body is now being recognised, and as the quotes above indicate, the issue of breast health can be a significant factor in sport and exercise participation for women. This session will give an overview of the importance of coaches and trainers in understanding breast health, and will explore the challenges women face and the solutions available.

By the end of this session, you should be able to:

- build coaches' and trainers' confidence to address issues of breast health with athletes
- recognise the challenges female athletes face with breast support
- understand breast anatomy and breast biomechanics
- identify breast support needs for different women and different sports.

1 Why is breast health important?

Experiencing breast pain can deter women from participating in sport and exercise, which can be due to discomfort or embarrassment. For example, in a study with 2,000 girls aged 11–17 years, 46% reported that their breasts had some effect on their participation in sports and exercise.

Breast concerns were high with 73% reporting more than one breast-specific concern in sports; with breast bounce being most prevalent (38%) (Scurr *et al*., 2016). The evidence suggests that many suffer from breast pain and discomfort. For example, Brown *et al*. (2014) found that 32% of marathon runners experienced breast pain and for 17% of them, it impacted how much training they could do. Finally, poor breast support can impact upon performance. Studies by the Research Group in Breast Health at Portsmouth University have demonstrated that running with insufficient breast support can make exercise feel harder, increase the risk of injuries to the lower limbs, and decrease stride length by 4cm and make running mechanics less economical, which means more energy is used for a given intensity and that can accelerate the onset of fatigue (Research Group in Breast Health, 2021).

Activity 1 What is the problem?

Allow about 15 minutes

Watch the animation below which explains some of the key issues around breast health then answer the questions below.

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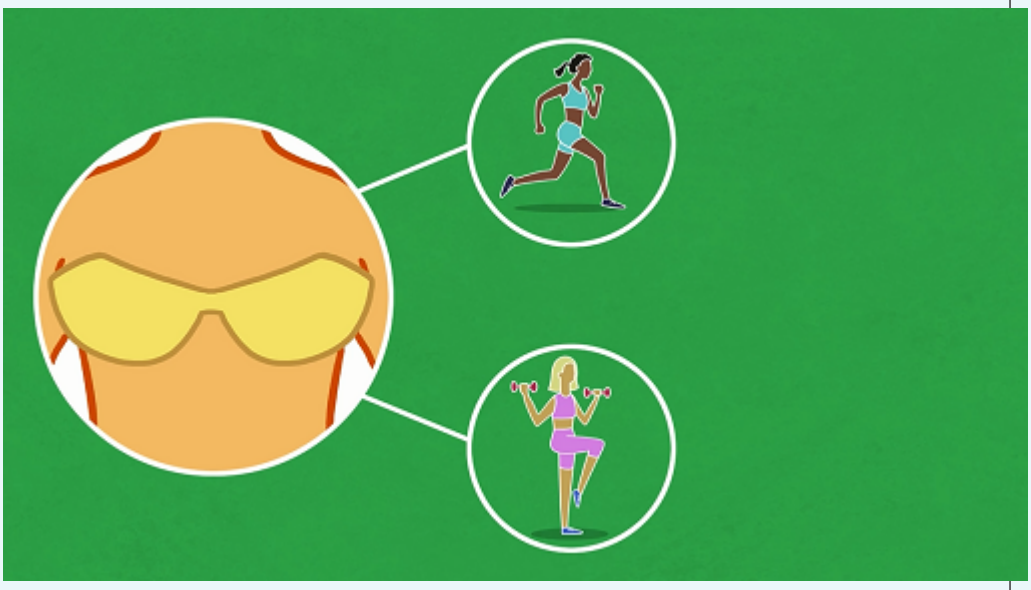

1. There are muscles within the breasts that offer natural support.

- ○ False
- ○ True

Discussion

False. The only support to the breast is provided by the Cooper's ligaments and the skin.

2. Women with larger breasts often experience more discomfort and breast pain.

- ○ True
- ○ False

Discussion

True. Due to their weight, larger breasts place more stress on the supporting structures and can potentially cause more pain.

3. Intense exercise without the appropriate support can cause permanent damage to the breasts.

- ○ True
- ○ False

Discussion

True. Repeated high impact forces without appropriate support can cause irreparable damage to the ligaments and skin that support the breasts.

Good breast support has the potential to positively influence both participation and performance in sport and exercise, yet education around breast health and breast support is currently very poor (Brown *et al*., 2018). By empowering girls and women with knowledge and awareness of breast health and bra fit there are several positive outcomes: body confidence, health and participation in physical activity can all be significantly improved.

2 Breast anatomy and natural support

To further your understanding of the issues surrounding breast health and breast pain it is important to first become familiar with the anatomy of the breast (see Figure 1). Essentially the breast is a mass made up mostly of fatty tissue, with some connective tissue that provides it with a limited support from the inside. This connective tissue is called the Coopers ligaments, although 'ligaments' is a very a misleading label. Elsewhere in the body, ligaments attach bone to bone, however Coopers ligaments are not 'real' ligaments, but connective tissue that provides some support for the breast mass (Page and Steele, 1999). The third component of the breast is glands, and this is the part that has a job to do. This glandular tissue is the milk glands and ducts which are used for breastfeeding.

The breast is held in place on the chest wall by the skin. Breast sag happens when the skin supporting the breast tissue stretches. This can happen as a result of age, as our skin becomes less elastic, and also as a result of how much the breast moves.

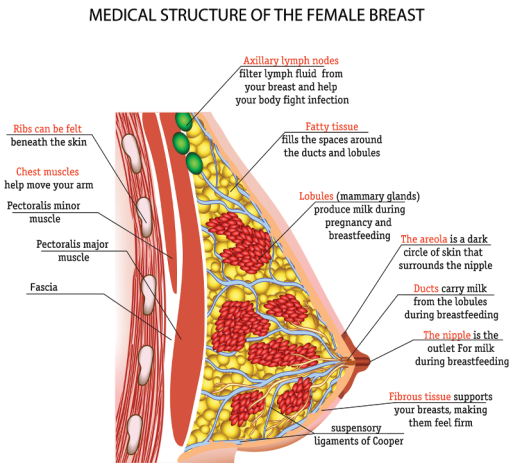

Figure 1 Anatomy of the breast.

3 Breast biomechanics

Now that you know the anatomy of the breast you can start to understand how a breast moves when participating in different activities. With limited internal support and the skin as the only external support the breasts move when the body moves, whether it's walking, running, cycling or dancing, and breasts move most when the activity is high impact, like running and jumping. Each breast itself is, on average, about half a kilogram, and movement of the breast mass during exercise can cause the skin to stretch beyond its natural elastic range and cause permanent damage. Wearing a good fitting sports bra can reduce breast movement by up to 74% when compared to a bare breasted condition (Norris *et al*., 2021).

Activity 2 How do breasts move during exercise?

Allow about 10 minutes

Watch the video which shows the science used by the Research Group in Breast Health at Portsmouth University to establish the exact movement of the breast during exercise. Then answer the following questions:

1. What are the three types of breast movement?
2. Which exercise elicits movement in all three dimensions?
3. What are some of the negative effects of not wearing the right level of support?

Video content is not available in this format.

Provide your answer...

Discussion

1. In the video Professor Wakefield-Scurr explains how the breast moves in three dimensions: forwards and backwards, side to side and up and down.
2. Performing a star jump can cause the breast to move in all three dimensions throughout the movement.
3. Performing exercise without the correct support can cause stretching of up to 93% in the breast as well as causing damage to the ligaments that hold up the breast (Cooper's ligaments).

The way the breast moves and the implications of different movements on the breast can influence the type of support that is required. In the next section you'll look at the implications of not meeting these requirements for support during sport and exercise.

4 The impact of poor breast support on sports performance

Poor breast support during sport and exercise not only influences breast health but it may also have a negative effect on performance. Breast support requirements will differ depending on the type of sporting activity you are performing, and across a woman's life as the breast size changes during adolescence, through pregnancy, and into menopause. Being aware of the requirements for different sports, as well as individual requirements and preferences, is key in maintaining good breast health and optimal breast support.

Activity 3 What impact does poor breast support have on performance?

Listen to the section of the podcast 'Bounce' where the panel discuss the impact of breast health and breast support for a variety of sports.

Then watch the animation which identifies the impact that poor breast support can have on performance.

What were the key considerations of breast movement for marathon runners, tennis players and javelin throwers and the type of support required?

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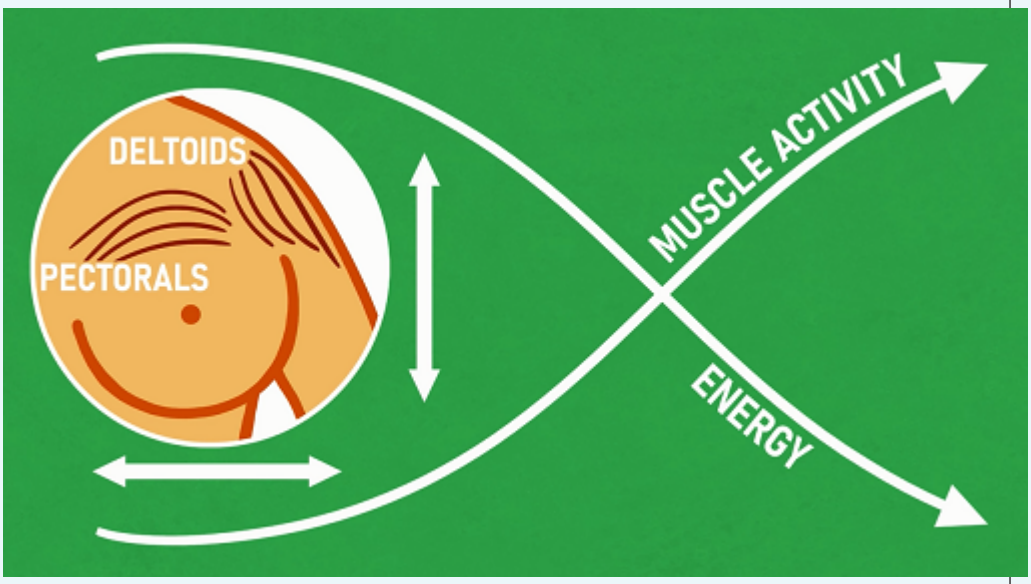
Video content is not available in this format.



Provide your answer...

Discussion

Scientific analysis of running has shown breasts to move in a figure of 8 and over a third experienced breast pain which impacted their training. Breast pain can be due to movement but also related to hormonal changes linked to the menstrual cycle.

In tennis, the upper body rotation causes a lot of lateral movement from side to side and so a suitable sports bra is one that supports the breast during this type of movement.

For javelin a key concern is the range of arm movement and, therefore, the design of the shoulder straps of the sports bra are of great importance to provide support, without restricting any movement.

Additional considerations are, in some sports, also given to the aesthetics of the breast support, for example, in gymnastics or figure skating the underwear must not be visible or interrupt the silhouette of the leotard. The next section looks at the type of bras and breast support available.

5 Bras and breast support available

Research indicates that over 80% of women wear ill-fitting bras (Research Group in Breast Health, 2021) and when it comes to sports bras many women don't even own one, with 50% of 11–18-year-olds not wearing a sports bra for PE or sport. Yet, wearing inadequate breast support, such as an everyday bra, to participate in sport and exercise can cause permanent damage and negatively impact performance. The importance of the sports bra as essential sports kit has been cited by many sportswomen and was demonstrated in the move by the England Institute for Sport (EIS) to provide GB athletes with bespoke bras for the 2020 Tokyo Olympic and Paralympic games (EIS, 2021). The crucial element here was that athletes were professionally fitted for the right size bra, but also to ensure the athlete wore the right style of sports bra to suit their breast size and sporting movement.

Activity 4 How to select the right sports bra

Allow about 15 minutes

Watch the animation which explores the benefits of a good sports bra and then watch the video showing an experiment involving the three types of sports bra.

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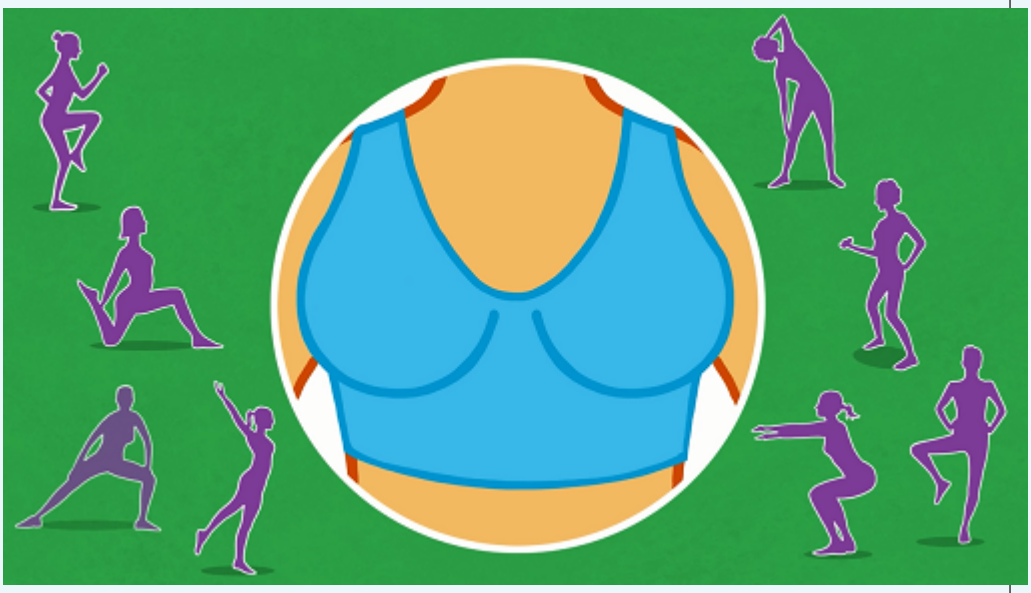

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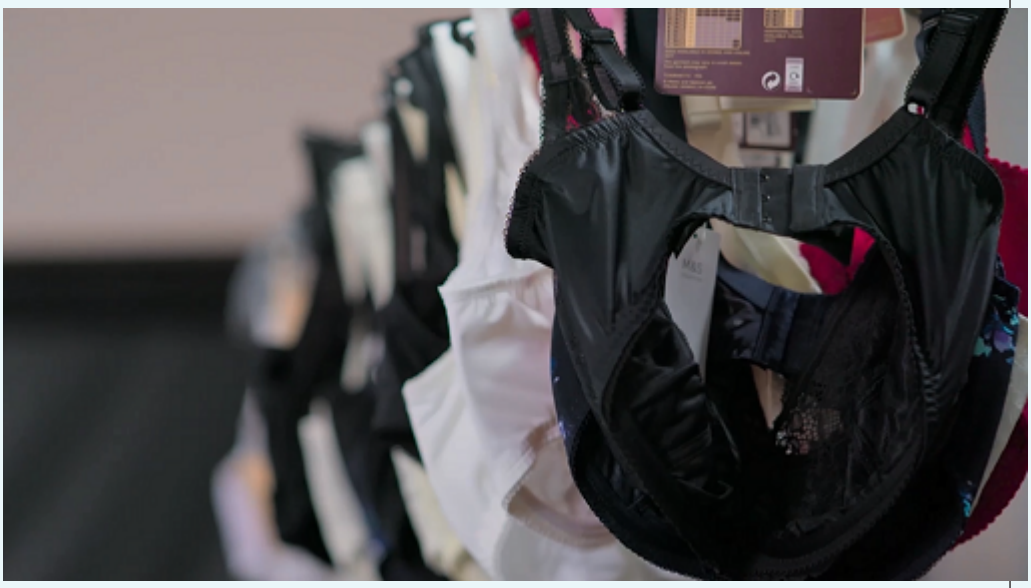


Then complete the table below to evaluate each type of sports bra:

Type of sports bra	Features	Advantages	Disadvantages	Movement reduction
Compression bra	Crop top style which pulls over the head and compresses breast tissue	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*

	against chest wall. Suitable for smaller breasted females.			
Encapsulation bra	Separates to provide support to each breast individually. Centre part sits flat against chest wall. Beneficial for larger breasted women.	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
Combination bra	Combines features of compression and encapsulation bras. Supports the breasts separately but also compresses them against the chest wall.	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*

Discussion

Type of Sports bra	Features	Advantages	Disadvantages	Movement Reduction
Compression	Crop top style which pulls over the head and compresses breast tissue against chest wall. Suitable for smaller breasted females.	Comfortable, suitable for more low impact activities such as yoga.	As it has to be stretchy enough to fit over the shoulder there is a limit to their capability to reduce movement.	Up to 55%.

Encapsulation bra	Separates to provide support to each breast individually. Centre part sits flat against chest wall. Beneficial for larger breasted women.	Offers greater support and reduces movement in all directions. Vital for high impact activities.	Structured form and rigid material can be less comfortable than soft, stretchy fabric used in compression bras.	Up to 73%.
Combination bra	Combines features of compression and encapsulation bras. Supports the breasts separately but also compresses them against the chest wall.	Offers good support but may not control movement during high impact activities, such as running, as well as the encapsulation bra.	It may be less comfortable for females with larger breasts.	Not stated in the video but more than the compression bra and less than the encapsulation bra.

As the animation and video show there are typically three types of sports bra for women to choose from and they should select the bra that is most appropriate for them in terms of how it fits, what they are going to wear it for and how comfortable it feels. It is important to be fitted for a sports bra and ensure that it provides the support that you need.

In addition to the three common types of sports bras there are also different features of a sports bra that can impact the effectiveness of the support it provides. A study by Norris *et al*. (2021) into the characteristics that impacted the effectiveness of sports bras revealed that there were five key features that contributed to greater support:

1. an encapsulation style (separates the breasts)
2. padded cups
3. made from Nylon
4. an adjustable under band
5. a high neckline.

A summary of their study of how to choose the most effective sports bra for yourself is provided in Figure 2.

Figure 2 Tips on how to choose the most effective sports bra.

6 Getting the right fit

The University of Portsmouth Breast Health Research Group recommends using a five-point fit technique to evaluate whether the fit of a sports bra is optimal (see Figure 3 below). Using bra size can be misleading since the same size bra can actually come up as different sizes across varying styles and brands. It is much better to establish whether the bra has a good fit, rather than focusing on whether it is a certain size. If you wish to find out more the following video explains the five-point fit guide: Does your bra fit correctly?.

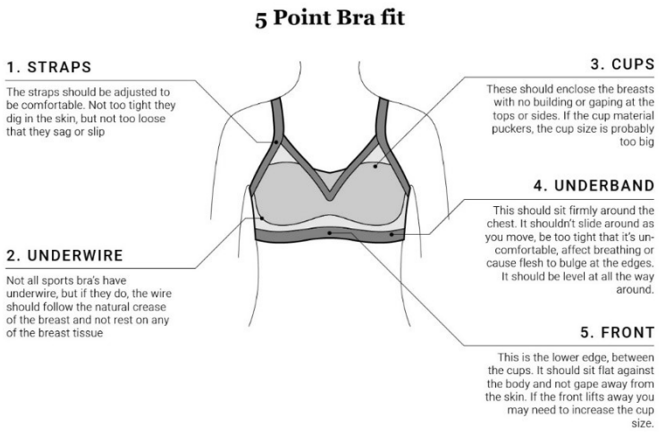


Figure 3 The five-point bra fit guide.

7 Case study: Equestrian sports

You want the whole focus to be on you and your horse. Constantly worrying that your bra straps are falling down is not helpful. I don't think young girls are aware of breast issues. It could be very, very bad for me if I did ride in a normal bra and I wasn't aware of that as a young girl.

(Natasha Baker, Paralympic equestrian rider)

Different activities will require different support for the breast and horse riding is an energetic and dynamic activity that can cause excessive breast movement. Despite this, research into breast support and horse riding by Burbage and Cameron (2017) reported that only 35% of women regularly ride in a sports bra. The study also indicated that riders with larger breasts experienced greater breast pain, as did those with higher body mass. Overall, 21% of riders said that breast issues negatively impacted on their performance. One of the aims of this course is to build awareness and education of these issues as a positive step to help women find effective breast support solutions.

Activity 5 Selecting a sports specific sports bra

Allow about 15 minutes

Listen to another section of the podcast 'Bounce' where the panel discuss breast health and horse riding with Natasha Baker, a paralympic equestrian rider. Then read the information booklet 'The Horse Rider's Guide to Bras' and consider the benefits of wearing a sports bra for women when riding.

Audio content is not available in this format.

Provide your answer...

Discussion

Wearing a sports bra appropriate for riding is crucial due to the high impact nature of the activity, not only to maintain breast health but also to aid performance. As Natasha described, a poorly fitted sports bra can remove the focus from competition and the task at hand, which can negatively impact on performance. When competing it is important not to have any external distractions such as falling bra straps or breast movement or pain. Comfort is also key in a sports bra, as when comfortable you can focus purely on performance. A correctly fitting sports bra can also aid posture which is another important factor when riding.

8 Practical recommendations for coaches and athletes

The key word that appears in many research articles and literature surrounding breast health is ‘education’. It is vital that young girls and women recognise the importance of appropriate breast support when participating in sport and exercise and that it is not considered a taboo or embarrassing subject. Instead, the sports bra should be considered as an essential piece of sports kit featured on a kit list, just like a gum shield or shin guards. Ideally, coaches need to feel confident having conversations about breast support with their athletes.

Activity 6 Advice and guidance

Allow about 15 minutes

Listen to the following section of the podcast ‘Bounce’ where the panel offers some key tips about how to choose appropriate breast support.

Note down any advice you would give to girls, parents and coaches around breast health.

Audio content is not available in this format.

Provide your answer...

Discussion

Advice to girls and women should include the importance of wearing a properly fitting sports bra, either by getting a professional fitting, or having the right understanding to evaluate fit yourself. Girls should be discouraged from wearing two bras, as it is a myth that this offers better support, and a properly fitted sports bra should be sufficient.

Also, girls should receive in-school education on sports bras, as with dance and PE forming part of the curriculum, all girls need a sports bra. If all girls are required to wear one as essential PE kit this could alleviate the embarrassment and self-consciousness that some girls experience.

> Educating and empowering girls when they are younger is especially important, as girls going through puberty will experience physical changes to their body shape, and breast development. This can be an especially sensitive and vulnerable time for girls in terms of body confidence, and embarrassment about breast development is one reason why girls might not want to engage in physical activity.

Education materials for use in schools are freely available through 'Treasure your Chest', a collaborative research group, who have made resources available to empower girls and young women to know more about their breasts.

Parents or guardians have a role to play in educating their daughters and are typically responsible for taking their daughter for a bra fitting. If going for a fitting, parents/ guardians should discuss with their daughter what is likely to happen during a fitting to lessen any anxiety or worry. The panel in Activity 5 suggested that when taking their daughter for their first bra they should include fitting for a sports bra. However, it should also be noted that teaching girls how to fit a bra for themselves is really important.

Parents, teachers and coaches can all play an important role in helping girls understand the importance of breast support.

9 This session’s quiz

Well done – you have reached the end of Session 5. You can now check what you’ve learned this session by taking the end-of-session quiz.

Session 5 practice quiz

Open the quiz in a new or window and come back here when you have finished.

10 Summary of Session 5

This session has provided an introduction to the topic of breast health in sport and exercise participation. It has demonstrated that while breast pain and discomfort is commonly thought of as a barrier to sport and exercise, increasing the knowledge and understanding around solutions to these issues can eliminate or reduce their impact.

The main learning points of this fifth session are:

- Breast issues can deter women from participating in sport and exercise.
- Breast pain and discomfort is common, and for women participating in sport and exercise settings it can impact on performance.
- Learning more about breast anatomy and movement of the breast and educating women, coaches and athletes can encourage more women to seek the right support.
- There are three types of sports bra, each suited to different levels of activity, and women should be fitted for the correct type of bra for their needs.
- Getting the right fit of bra is the most important factor in breast support. Education for girls and women should include what elements are important to consider when evaluating bra fit.

In the next session, you will explore the injuries that female athletes are particulary prone to and how to manage the risks of these injuries.

You can now go to Session 6.

Session 6: Injuries and the female athlete

Introduction

As the number of females participating in sport and fitness has increased, trends have been identified in the types of injuries that occur more frequently in female athletes than male athletes. At the start of this session you will hear from Dr Emma Ross, of The Well HQ, explaining which injuries are most common in females and what can be done to help prevent them.

In this session you will be exploring these injuries in more detail and assess their causes as well as what a coach or fitness trainer can do to make the athlete less susceptible to such injuries.

By the end of this session, you should be able to:

- understand why female athletes are more susceptible to specific injuries than male athletes
- appreciate how changes in hormone levels may impact on injury prevalence
- improve awareness of how coaches and trainers can help female athletes to reduce the risk of injury.

There are anatomical, physiological and hormonal factors that can predispose male and female athletes to different types of injuries and varieties in the severity of symptoms. These factors start with hormonal changes that occur at puberty where males experience increases in testosterone that strengthen muscles and make them more effective at supporting joints.

In females the rises in oestrogen levels at puberty cause muscles to become more flexible and joints less stable, increasing the risk of injuries from this stage onwards (Bompa and Carrera, 2015). At the other end of the lifecycle, females experience the menopause where oestrogen levels decline. Since oestrogen plays a role in muscle repair and regeneration (including maintaining bone density), injury risk presents differently in females across their lifespan (Enns and Tiidus, 2010).

1 Female athletes and their susceptibility to specific injuries

While the nature and severity of injuries are dependent on a range of factors, such as the type of activity, playing surfaces, equipment and individual fitness level, there are statistics that indicate that sex is an additional factor as active females are more susceptible to specific injuries. This is explained by Dr Emma Ross from The Well HQ in Activity 1.

Activity 1 Sports injuries and the female athlete

Allow about 15 minutes

Watch the video below where Dr Emma Ross explains which injuries female athletes are most susceptible to, some of the factors that increase the likelihood of these injuries occurring and strategies that can be employed to reduce the risk of sustaining an injury. Then answer the following questions:

1. Which injuries are more common in female athletes than in males?
2. What role may the menstrual cycle play in increasing the likelihood of injury?
3. What strategies may help manage the risk of injury?

Video content is not available in this format.

Provide your answer...

Discussion

1. Joint injuries to the ankle and shoulder are more common in female athletes as they have looser joints (joint laxity), which might also be influenced by the menstrual cycle, and also less muscle around these joints. Injuries to the anterior cruciate ligament (ACL) in the knee that are not caused by physical contact with another player are around 4.5 times more likely in female athletes due to the female skeleton, muscle imbalances and poor movement techniques. Female athletes also show higher incidences of concussion, have worse concussion symptoms and take longer to return to play than males. Females may also experience more stress fractures.
2. Emma makes the key point that injuries are rarely due to one factor, and it is often when several risk factors align at a given moment to make an injury more likely. In a well-conditioned athlete, we can reduce injury risk, even in light of factors beyond our control, such as the menstrual cycle. However, higher levels of oestrogen, as found just before ovulation, can interfere with the collagen of ligaments making joints looser and less stable with an increased range for movement. This might contribute to injury risk.
3. Through cycle tracking, if an athlete develops awareness that there are times in their cycle when they experience pain or injuries, they can develop strategies to proactively manage this risk, such as a more thorough warm up or discussing taping with a physiotherapist.

2 Why are there so many ACL injuries in female sport?

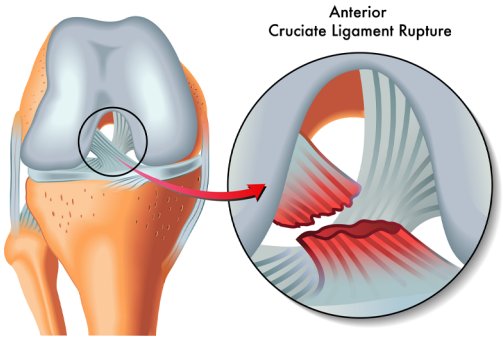


Figure 1 Knee ligaments and ACL tear.

The anterior cruciate ligament (ACL) is one of two ligaments in the centre of the knee joint that help provide stability (see Figure 1). The ACL goes from the back of the femur (thigh bone) to the front of the tibia (shin bone) and limits the forwards movement of the femur. The second ligament, the posterior cruciate ligament (PCL), goes from the front of the tibia to the back of the femur and prevents the knee from bending backwards excessively (hyperextension). They form a cross shape, and this gives them their name ‘cruciate’.

The reasons why female athletes may experience more ACL injuries are complex, but they can partly be explained by changes that happen at puberty.

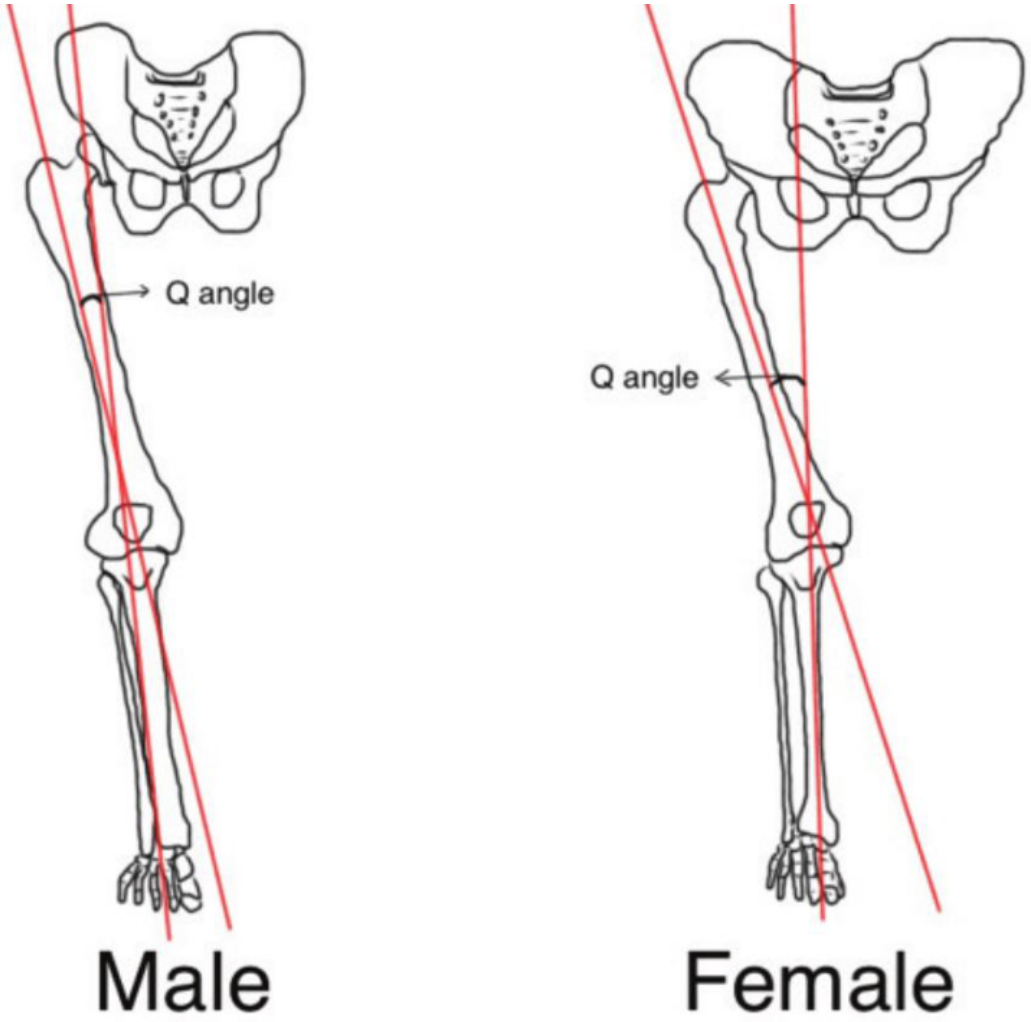


Figure 2 Differing Q-angles in males and females.

Post-puberty the male and female pelvis will differ as females will develop a broader pelvis to facilitate potential childbearing. This results in an increased angle where the femur connects at the knee joint with the tibia. This is referred to as the Q-angle and is around 16 degrees in females and 11 degrees in males. As well as affecting the way that forces travel through the leg to the knee and ankle it can cause a difference in the way the patella (kneecap) moves during exercise, and as a result females can experience more knee pain than males (Roush and Bay, 2012). This increased Q-angle can make it more difficult to prevent the knee from falling inwards when landing from a jump or turning quickly. If you examine Figure 2 you can see why this might be so.

Stability of the knee is provided by ligaments, such as the ACL, but it is also dependent on the strength of the muscles that control the knee. This includes the quadriceps at the front of the upper leg and hamstrings at the back, but also the gluteal muscles that control the hip. A weakness in gluteal muscles at the hip can result in the knee taking all the strain to prevent its increased range of movement.

There are some other factors that predispose female athletes to ACL injuries:

- Quadriceps dominance – female athletes are more likely to use their quadriceps to control the knee joint than male athletes. Male athletes tend to use strength in the hamstrings and gluteals, as well as the quadriceps, to share the load. The hamstrings will pull the tibia (in the lower leg) backwards to protect the ACL, while the

stronger quadriceps in female athletes push the tibia forwards and place additional stress on the ACL (Greene, in Tomas and Whyatt, 2020).

- Ligament dominance – relative to male athletes the female athlete will have less musculature around the knee joint to stabilise it. As a result the ligaments have to take on more stability work and absorb forces placed on the knee joint. This increased load on the ligaments make them more susceptible to injury (Greene, in Tomas and Whyatt, 2020).

3 What can be done to protect female athletes against ACL injuries?

Firstly, in Activity 1 Dr Emma Ross explained why it is important for female athletes to track their menstrual cycle so they can identify the times in their cycle when oestrogen levels are higher, usually around days 9–14 of a typical 28-day cycle, and injury may be more likely. Then the athlete can be prepared and make adaptations to their training or competition schedule if required.

Emma referred to non-contact ACL injuries which is where the force is not applied from an external source, such as during a tackle, or where an external force is placed on the knee joint. ACL injuries in females are most prevalent in sports involving multidirectional movement, such as football, rugby, basketball, hockey and netball, where they may land in risky positions or have to twist and turn quickly (Zumwalt, 2019).

In Activity 2 you will examine whether the increased prevalence of ACL injuries is due more to social or physical factors that determine the physical conditioning of male and females

Activity 2 Are ACL injuries due to social or physical factors?

Allow about 10 minutes

Listen to a section of the podcast at the following link. Listen from 14:25 (‘In a nutshell, why do you think there are so many ACL injuries in women’s football …’) to 16:50 (‘… the biggest thing is the strengthening’):
Injury and the female athlete: Injury risk and prevention, impact of the menstrual cycle, removing psychological fear and the consequences of playing catch up (buzzsprout.com)

Listen to the audio clip where Dr Nicole Surdyka, who is a physical therapist working in the rehabilitation and risk reduction of football injuries, explains why the increased prevalence of ACL injuries in female athletes may be due to social factors as much as physical ones.

To what extent do you agree with Dr Surdyka’s argument that it is social factors that are leading to high levels of ACL injury in female athletes.

Provide your answer...

Discussion

Dr Surdyka attributes the high levels of ACL injuries to increasing numbers of females participating in sport without being exposed to effective strength and conditioning programmes beforehand and the differences in activities performed by boys and girls. Historically boys have been generally taught to be more active, so they were more likely to develop the fundamental movement patterns and strength and conditioning that the body needs to protect against injury. However, this does seem to be changing with young females becoming increasingly active and involved in sports specific schemes and training programmes.

4 Reducing injuries among female athletes

The claim that social factors may be at the heart of the issue helps suggest a strategy that may contribute to reducing injury prevalence. Fox *et al*. (2020) suggest that confining women's injury risk to biological causes (e.g., hormones, anatomy, physiology) misrepresents the root cause of ACL injury, which is likely to be strongly influenced by what they term 'gendered environmental disparities' (different experiences in sport and less access to training facilities). Other causes could include women's teams often being allocated artificial surfaces or poorer grass surfaces than men which can increase ACL injury rates (Braun, Wasterlain and Dragoo, 2013).

Currently not all females are coming to their sport with adequate skill and physical development (Parson, Coen, & Bekker, 2021). This is particularly important in relation to the muscles that support the knee and help to prevent ACL injuries. Improving neuromuscular control, which is teaching the nervous and muscular system to work effectively together, will help muscles to work in groups to move and stabilise joints. In particular it is important to train the neuromuscular system in a way that replicates movement patterns found in any chosen sport and for correct 'landing techniques' so that forces can be shared between muscle groups.

An analysis of studies into training for ACL prevention by Webster and Hewett (2018) showed that ACL prevention training programmes could reduce the number of injuries by 50% and non-contact ACLs by 67%. A good injury prevention programme will incorporate many strategies including, strength and conditioning, learning effective movement patterns, learning safe landing techniques, core conditioning and tracking menstrual cycles.

5 Sport concussions and the female athlete

Concussion is a brain injury that is caused by a blow to the head, or the head being shaken violently. They are particularly prevalent in contact sports such as rugby, hockey and football but are also present in sports where the head can collide with the ground after a fall, such as horse racing and gymnastics.

Research shows that female athletes are almost twice as likely to experience a sport-related concussion than male athletes (Bretzin *et al*., 2021), sustain more serious concussions, have worse symptoms, and take longer to recover (McGroarty, Brown and Mulcahy, 2020). While we are starting to understand why this is the case, research is in its early stages and we are only starting to see a fuller picture.

Activity 3 Introduction to concussions in sport

Allow about 10 minutes

Listen to the audio clip about what causes a concussion, and the short and longer symptoms of concussion. Then answer the following questions:

1. What immediate symptoms may you experience from a blow to the head?
2. What longer term effects might you feel from a concussion?

Audio content is not available in this format.

Provide your answer...

Discussion

1. Concussion injuries are caused by a blow to the head and this blow does not necessarily result in a loss of consciousness. However, it may leave you feeling dazed and confused about where you are and what you are doing. You may also find balancing difficult and be lacking coordination. Because it is the brain tissue that is injured you may not see typical signs of injury, such as bleeding or bruising, but that does not mean that these injuries are potentially very serious.

2. Long-term dizziness and headaches are tell-tale signs of a concussion. Fatigue, memory loss and nausea are also common symptoms.

Further information about signs and symptoms of concussion and what to do about them can be found on the NHS website.

For female athletes, concussions can also cause a disruption to the menstrual cycle, including amenorrhea, which is the loss of periods (McGroarty, Brown and Mulcahy, 2020). This is because the menstrual cycle is controlled by the hypothalamus in the brain and its function is disrupted by head injuries. Earlier research by Wunderle *et al*. (2014) showed that women who experienced concussion during the second half of their menstrual cycle (when progesterone levels are high), suffered worse outcomes than those women experiencing head injury during the first half of their cycle.

These differences are attributed to the disruption to the brain-ovary axis causing progesterone levels to fall rapidly. Research into the menstrual cycle and concussion is still emerging, but tracking when concussions occur in the cycle might be helpful information in the complex evaluation of brain injuries.

6 Why do females fare worse from sport concussions?

The reasons for the differences in how females and males experience concussion are complex. As Dr Emma Ross explained in Activity 1, females have smaller heads and weaker neck musculature for support (up to 47% weaker than males (Sanderson, 2021)). As a result their skulls when hit can be accelerated more quickly, potentially causing more damage to the brain.

Research by Elizabeth Williams, of Swansea University, has shown that more than 50% of the concussions sustained by female rugby players were due to their head making contact with the ground, while only 4% of concussions in male rugby players were caused in this way (Sanderson, 2021).

In football, female players were more likely to injure themselves while heading the ball, while for male players concussions were more likely to be caused by contact with other players (Bretzin *et al*., 2021). While male football and rugby players tend to be larger and may create more force it does not fully explain these significant gender differences, and Activity 4 looks into explanations for them.

Activity 4 Rates of concussion in female sports

Allow about 10 minutes

Watch the video in the link below where Elizabeth Williams presents the findings of her pioneering research into concussion in women's rugby.

Rugby concussion: Swansea University study into protecting women

Then answer the following question:

> What has this research shown and how may it be applied to training for contact sports?

Provide your answer...

Discussion

The research has shown several things. Perhaps most significant is the different ways that females fall to the ground compared to men. This is reinforced by data from the mouthguards that have been developed to measure forces applied to the head.

The implication of this is that training around how to fall more safely can be developed so that players can learn ways to fall that limit potential damage to the brain.

There are also differences in the structure of nerves within male and female brains. When force is applied to the head forces are transmitted deep inside the brain to the neurons and axons (nerves), which can become damaged, causing inflammation and irreparable damage. Females have smaller axons than males (Dollé *et al*., 2018). This makes the axons more prone to damage and affects the outcome of a head trauma.

Coaches of female athletes need to be more vigilant than those of male athletes because concussion resulting from contact between the head and the ground are much harder to see happening than those that occur during head-to-head contact. There is evidence that boys are 1.5 times more likely to be immediately removed from the field of play and return to play 2 days sooner than girls with sport-related concussions (Bretzin *et al*., 2021).

We are continuing to learn more about sport-related concussion in females. It has taken a long time for the consequences of sport related concussion to be taken seriously in men's sports, such as rugby and football. But we can't stop here. Best practise for identifying and treating concussion by sex is the really important next step.

7 This session's quiz

Well done – you have reached the end of Session 6. You can now check what you've learned this week by taking the end-of-session quiz.

Session 6 practice quiz

Open the quiz in a new or window and come back here when you have finished.

8 Summary of Session 6

You should now be aware of the two main types of injuries that female athletes are more susceptible to, why this is the case and what can be done to reduce the risk of these injuries.

The main learning points of this sixth session are:

- Female athletes are 4.5 times more likely to experience ACL injuries than male athletes.
- Female athletes experience almost twice as many sport-related concussions than male athletes, have poorer outcomes and take longer to recover.
- The differences in the type and severity of injuries are due to anatomical and physiological differences between males and females but are also related to changes in hormone levels across the menstrual cycle.
- The higher prevalence of ACL injuries in female athletes is partly due to the larger Q-angle (between pelvis and femur) and also the higher quadriceps and ligament dominance in providing knee stability.
- ACL injury risk can be reduced through a specific strength and conditioning programme that increases the stability of the knee through learning correct movement patterns, safe landing techniques and core conditioning.
- Females experience more sport related concussions due to their potentially weaker neck musculature, differences in the structure of the nerves within the brain and differences in how they fall to the ground.

In the next session you will explore the serious impact that low energy intake, caused by athletes not consuming enough calories to meet the energy needs of training, can have on the female athlete.

You can now go to Session 7.

Session 7: Low energy intake and missed periods: the risks

Introduction

When I was losing weight, I felt like a true athlete.

(Bobby Clay, GB International athlete)

Relative energy deficiency in sport (RED-S) is a condition that occurs when more energy is being used by the body than being taken in over a prolonged period. If you do not have enough energy available for training it can also impact the maintenance of the body's optimal health. Energy deficiency can lead to a disruption, or loss, of menstrual function and the loss of the important menstrual cycle hormone, oestrogen. This can also impact on bone health and RED-S is often not detected until athletes stop having periods or, worse still, start to experience bone fractures.

The terminology RED-S is a relatively new phenomenon in sports science, with the International Olympic Committee (IOC) introducing the term in a consensus paper in 2014. It was a new name to describe the condition previously known as the 'Female Athlete Triad' which linked low energy availability to menstrual cycle disturbances and poor bone health in female athletes. However, knowledge has developed to allow us to understand that relative energy deficiency affects many other aspects including metabolic rate, immunity, protein production, cardiovascular and psychological health. RED-S can affect anyone, not just females.

Athletes in sports that are associated with leanness, such as athletics, gymnastics and figure skating are seen to be more at risk of RED-S (De Souza *et al*., 2014). However, recreational athletes are more likely to experience RED-S than elite athletes as they undergo less health screening, have less support, and may not even be aware they are energy deficient.

In this session, by examining athletes' own experiences, you will better understand what effect RED-S has on the body, what causes it, and the coach's role in guarding against it.

By the end of this session, you should be able to:

- identify the impact of RED-S on body systems
- understand the factors that can cause RED-S
- become more aware of the signs and symptoms of RED-S.

1 Medals or menstruation? What the athletes say

Athletes, either intentionally or unintentionally, can experience RED-S due to a desire to change body composition with the belief that it will improve their performance and increase their chances of success. This is reflected in these quotes from athletes.

Bobby Clay's story

Bobby Clay was a junior international track and field and cross-country runner who won gold at the 2015 European Junior Championships over 1500m. However, aged 19 she started suffering a series of bone fractures.

Watch the following video clip that tells Bobby's story:

I believe I'll be the athlete I once was

Bobby's story may seem shocking to us, and like the quotes in this section she links speed to lightness which in turn caused her to under fuel her training. In what she calls her osteoporosis nightmare she describes how she was part of a female training group where food was perceived as the enemy. Although she says she has never had an eating

disorder she was constantly doing high volumes of training without taking in enough energy through her diet to allow her body to recover, adapt and progress.

In the short term the result of this was low body weight, which she regarded as a competitive advantage. The suppression of her menstrual cycle and the impact of sustained energy deficiency meant that she was physically and psychologically impacted in the long term. This ended her dreams of becoming an internationally successful athlete.

2 What is the problem?

RED-S occurs for several reasons as you shall see, but central to its development is an intentional or unintentional restriction of sufficient energy to effectively fuel training, recovery and health. For some athletes this stems from a belief that restricting the diet and losing weight will improve performance, while for others it is about conforming to socially constructed body image of attractiveness. The third cause is when energy intake restriction happens because of a clinical eating disorder.

But what is the cost of RED-S on the body? In Activity 1 Anna Boniface, an international marathon runner, shares her experiences.

Activity 1 Stress fractures and osteoporosis

Allow about 10 minutes

Listen to the audio clip where Anna Boniface tells her story of how long-term under eating and over training impacted on her body and performance in marathon running.

Then answer the following question:

What impact did Anna's overtraining and undereating have on her skeleton?

Audio content is not available in this format.

Provide your answer...

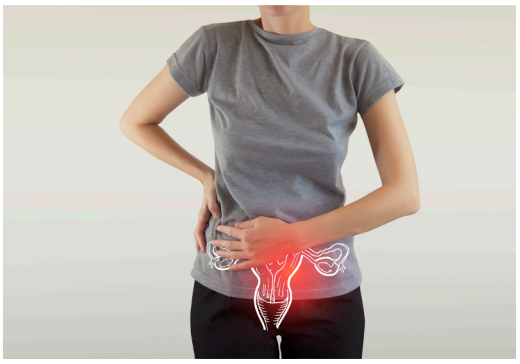
Discussion

Anna says that she had not had a period for about 8 years and identifies the lowering of the hormone oestrogen as damaging to her bone health. As a result she experienced a stress fracture to her ankle due to reduced bone density ('thinning' of the bones). It was also found that she had osteoporosis in her spine which could have led to thinning or fractured vertebrae.

Anna outlines the link between bone health and disruptions to the menstrual cycle. The loss of a regular menstrual cycle (amenorrhea) leads to lower bone mass, less bone strength, and higher rates of fractures among athletes (Elliott-Sale *et al*., 2018).

What is the relationship between low energy availability and the menstrual cycle? You will explore this in the next section.

3 The period is a vital sign of health



The changes in hormones that result from RED-S impact on many systems of the body with bone and reproductive health being particularly at risk. In Activity 2 Dr Emma Ross from The Well HQ explains how and why low energy availability will impact on the menstrual cycle, and the reproductive and skeletal systems.

Activity 2 Loss of periods – a red flag to female athletes

Allow about 15 minutes

Watch the video where Dr Emma Ross explains the 'brain to ovary' link and how it is affected by low energy availability. Then answer the following questions:

1. Why does the brain choose to switch off the menstrual cycle when there is low energy availability?
2. Why is the maintenance of bone health so vital to young female athletes?

Video content is not available in this format.

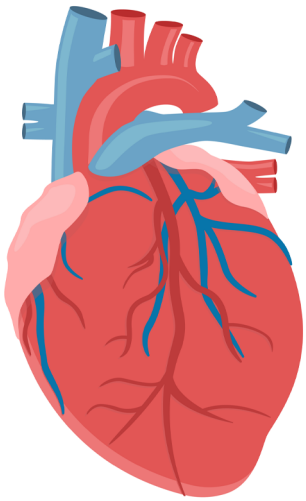
Provide your answer...

Discussion

1. While oestrogen is produced by the ovaries, its production and release are controlled by the brain through the brain to ovary axis. The brain switches off the menstrual cycle to conserve energy for other processes that are vital for life. The reproductive system is the only system a woman can lose without risking their life, and a pregnancy will increase the energy demands of the body. As a result the menstrual cycle is disrupted to prevent a pregnancy that could not be sustained, and the period stops. However, this impacts oestrogen levels, and this is a vital hormone in its role in building and maintaining bone strength.
2. Maintaining long-term bone health is really important for young female athletes, as the teenage years and twenties are times when the female is building bone to achieve peak bone strength, which occurs by around age 30. From this point on bone density will slowly decline across the lifespan. For women in particular, whose bone health can be impacted significantly by the loss of oestrogen after the menopause, building bone strength in the teens and twenties is vital to achieving a high peak bone density, to offset bone loss throughout later life, and to reduce the risk of osteoporosis and bone fractures.

RED-S will affect other body systems as well as the reproductive and skeletal systems. The following figures show the impact of RED-S on other body systems (from Mountjoy *et al*., 2018).

Cardiovascular system (heart and blood vessels)

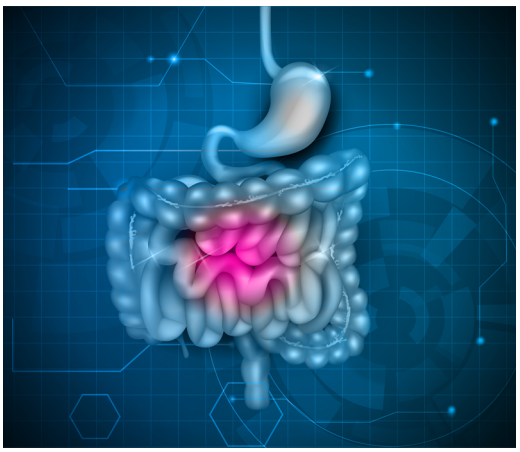


Impact of RED-S:

- Irregular heart beat

- Lower heart rate
- Lower blood pressure
- Low red blood cell count (anaemia)

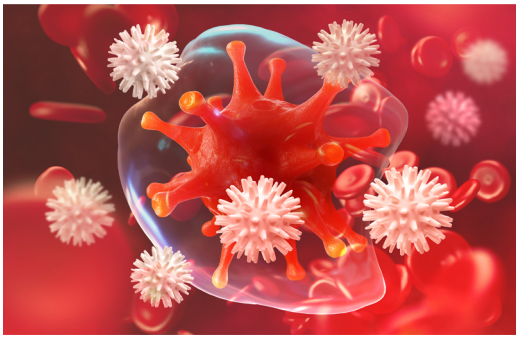
Digestive system



Impact of RED-S:

- Slower digestive speed
- Increased time food spends in intestines
- Constipation

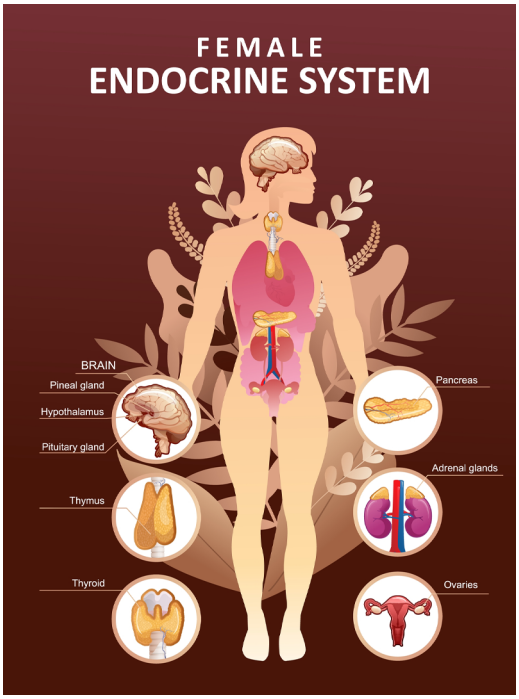
Immune system



Impact of RED-S:

- Increased likelihood of illness
- Increased colds and flu
- Increased body aches
- More headaches

Endocrine system, including the thyroid gland



Impact of RED-S:

- Reduction in rate at which calories are burned
- Increase in the hunger response

As you will see in the next section some of these have a profound impact on physical performance.

4 The impact of RED-S on performance

You have seen in Activity 2 that Anna Boniface had to drop out of a marathon as she developed a stress fracture in her ankle, which highlights the increased risk of injury to the skeletal system. Being lighter, or having low body fat, may decrease the energy expenditure of running or cycling producing a short-term performance benefit.

Having low energy availability interferes with many of the mechanisms needed for optimal performance and impacts on several measures of fitness, as well as psychological measures. This is shown in Figure 2.

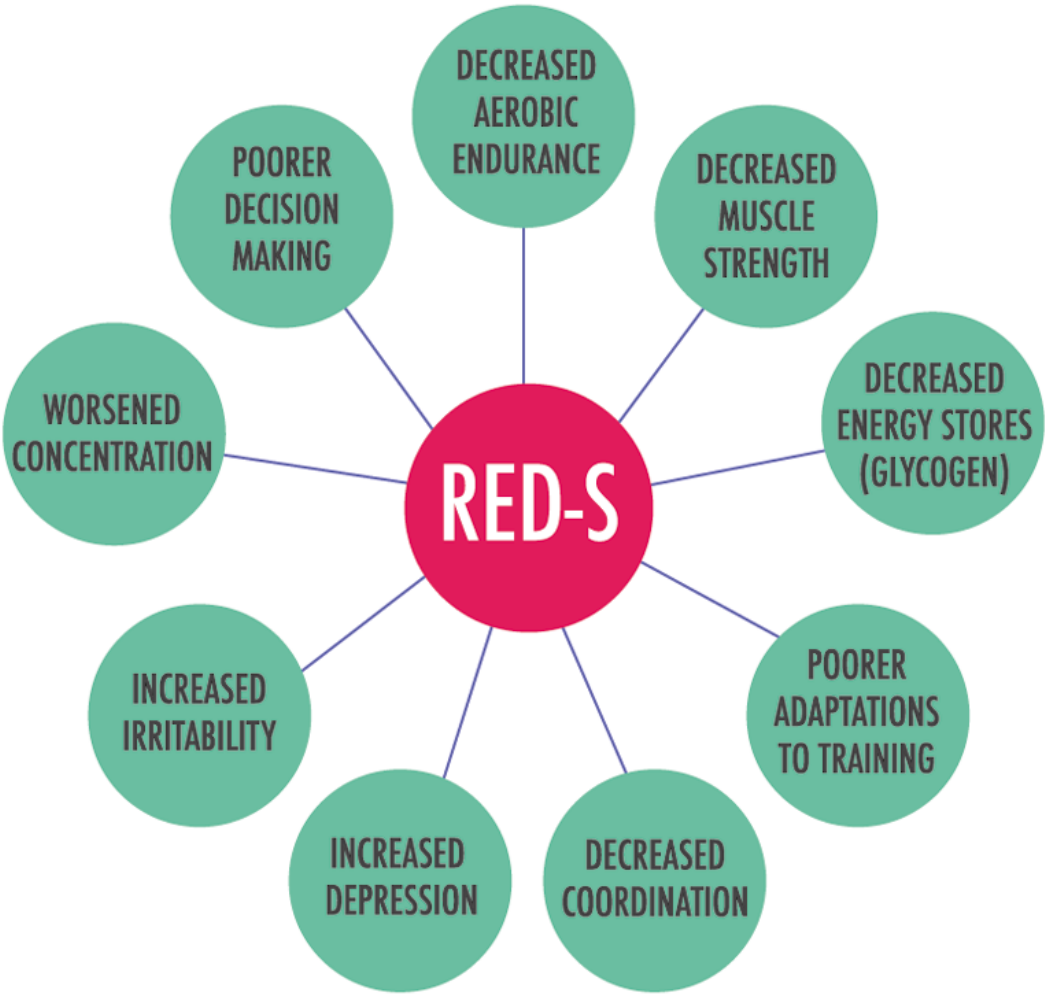


Figure 2 The impact of RED-S.

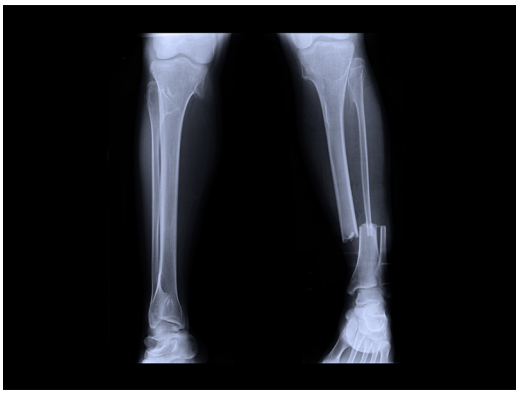
Eating less, or cutting out certain food groups, can lead to the body simply not having enough fuel to sustain itself. For example, endurance activities rely on food in the form of carbohydrates, which provide glycogen to produce energy as well as replenish energy stores afterwards. To build muscle and repair any damage caused by training an individual must consume foods rich in protein. Also fat intake is important as it provides the body with energy, supports cell growth, and helps the body absorb vital nutrients.

Psychological problems, such as depression and irritability, also feature in Figure 2. Mental health issues can be both a contributing cause to RED-S and a result of it. RED-S is not necessarily caused by eating disorders, such as anorexia nervosa, but if an athlete has a high drive for thinness than anorexia can become a contributing factor to its

development (Mountjoy *et al*., 2018). Often RED-S is caused by a poor nutritional strategy where an athlete does not plan their nutrition carefully enough to ensure that they gain enough calories to fuel their training and other daily activities.

Eating disorders, such as anorexia nervosa, can be a contributory factor in low energy availability but it is also a serious mental health problem. It is associated with an intense fear of gaining weight and often a distorted body image where an individual thinks they are overweight no matter how thin they become (NHS, 2021). Beatcharity has resources to help people suffering with eating disorders.

5 Warning signs of RED-S



In the cases of Bobby Clay and Anna Boniface we see that they sustained low fuelling and overtraining for a period of time before experiencing bone fractures. This is partly because the body has stores of fat and glycogen for fuel, and it can break down stored fat and muscle protein to produce additional energy if needed. However, it can only survive in this state for a short time before the body is seriously affected and its systems, particularly the muscular and skeletal systems, become so damaged that they are no longer able to function effectively. This is when injuries start to occur.

The problem for coaches and trainers who support athletes is that they may not have full access to the athletes' nutritional strategies or knowledge of their menstrual cycles. In many cases an exercising female may not have a coach or trainer who oversees their training and recovery, and lack of nutritional knowledge may cause them to become under-fuelled without even being aware of it.

In Activity 2 Emma Ross explained that the coach has an important role to play by ensuring the athlete arrives to training well fuelled and eats the right foods after training.

The coach needs to be aware of the warning signs of RED-S in athletes:

- irregular or absent periods
- difficulty staying warm in the winter and cool in the summer
- low muscle mass
- pre-occupation with food and eating
- increased prevalence of illnesses and injuries
- decrement in performance
- excessive tiredness and lethargy
- poor recovery from training sessions
- poor sleep patterns
- digestive problems such as constipation or bloating
- perfectionist tendencies
- high levels of anxiety
- becoming withdrawn or reclusive.

(Train Brave, 2021)

6 Preventing RED-S in female athletes

RED-S can be prevented by maintaining energy balance where energy intake matches the energy demands of health, training, recovery, and everything else in an athlete's life, which might include their job, studies and socialising. Figure 3 gives 5 top tips for getting the correct energy balance.

Figure 3 Get your energy right.

How can a coach support their female athlete?

A healthy athlete is more successful than a broken one

Telling an athlete to 'eat more' simply won't work as it's about changing behaviour, and sometimes addressing the athlete's dysfunctional or emotional relationships with food.

As a coach you can 'celebrate the power of food'. In conversations with athletes you can talk about the power of food as a fuel for performance. You can use coachable moments at the beginning of the session to ensure everyone has arrived well fuelled by asking 'what did everyone have to fuel up for today' and again at the end of the session 'what is everyone going to eat to refuel'.

Use education to teach athletes about what and how to eat. While eating may seem intuitive, eating to fuel sports performance often isn't and many athletes get it wrong. For example, the timing of energy delivery is just as important as the number of calories consumed. Ensuring that eating matches training volume and that athletes are not training without a pre-training meal or during fasting is important, as is remembering to eat soon after training.

Finally, ensure that athletes stop attaching value to body shape and size. This happens when an athlete looks at another athlete and believes their performance success is directly related to their leanness or believing that leanness will offer them a competitive advantage. It is important to understand that an under fuelled athlete, whilst being lean, is at a competitive disadvantage due to their shortage of energy.

Remarks that a coach or athlete may make, sometimes unconsciously, can serve to fuel a dangerous culture of restricted eating in sport. Athletes come in all shapes and sizes, success isn't simply down to body size, and a healthy athlete is more successful than a broken one.

7 The importance of carbohydrates to female athletes

Energy intake is an important consideration to prevent RED-S and in particular carbohydrates are a particularly important source of energy for females around training for the reasons shown in Figure 4.

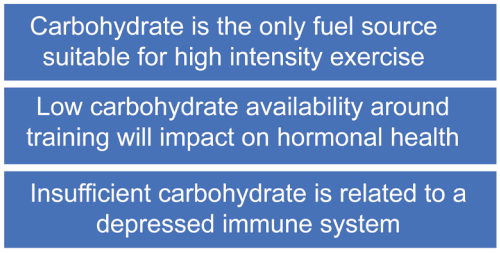


Figure 4 The importance of carbohydrates to the exercising female.

Female hormones are extremely sensitive to nutrient intake and in particular carbohydrates. This is because not providing the body with adequate amounts of carbohydrate can significantly disrupt the production of oestrogen and progesterone (Gastman and Hanan, 2021). As we are aware these hormones are central to the functioning of the menstrual cycle and maintenance of bone health. As such carbohydrate restrictive diets or low carbohydrate high fat (LCHF) diets may not always be suitable for female athletes.

The recommended range for how much carbohydrates an athlete needs is often expressed as a percentage of daily calorie intake, in which case it should be about 55% of total calories but can be up to 75% of total calories for athletes who have a very high training load (Eckerson, 2019). A better way to determine carbohydrate intake need is to calculate it relative to an athlete's weight.

For exercising females their calorie intake should be between 5–7grams of carbohydrate for every kilogram of body mass. For example, for a 65kg woman, her daily carbohydrate requirement would be around 390g. Research by Gibson *et al*. (2011) showed that just over 50% of the female football players studied consumed less than 5g of carbohydrate per kg of body mass per day.

It is beyond the scope of this course to provide full nutritional advice but the free course The science of nutrition and healthy eating covers nutrition in detail.

8 Managing athletes and active females experiencing RED-S

To manage RED-S in athletes it is necessary to address three things – increasing energy intake, reducing training load and allowing adequate recovery time (Scarr, 2019). However, putting interventions in place is harder than it sounds. The athlete will have to be central to the process and be willing and able to change. The coach and fellow athletes can be important when having conversations with the athlete and supporting them.

However, it is likely that professional help will be needed as well. This may be from a doctor or GP who can advise them and ask for blood tests to identify how much damage has occurred to the bones and hormone levels, but more often than not will require input from a sports physician (doctor), a sports nutritionist, and a sport psychologist. Using a team approach to manage RED-S is discussed in Activity 3.

Activity 3 Developing a team approach

Allow about 10 minutes

Listen to the audio clip where Dr Kate Ackerman, a researcher in RED-S, explains an approach to manage RED-S.

Then answer the following question:

> What is Dr Ackerman's top tip for addressing low energy availability?

Clinical tips from Dr. Kathryn Ackerman on how to manage athletes with low energy availability in BJSM (soundcloud.com): listen from 09:00 ('Can you give us some of your tips …') to 10:26 ('… to make them a better athlete').

Provide your answer...

Discussion

Dr Ackerman emphasises the importance of developing a team approach as it is unlikely that a coach will have all the expertise the athlete needs. In particular the team should include a sports nutritionist or dietician and a sport psychologist. The sports nutritionist to advise on how to get sufficient calories back into the body to match how many calories the athlete is using up and the sport psychologist to support them with psychological techniques and manage any stress or anxiety.

Dr Ackerman also stressed it is important to emphasise how lucky the athlete is to have all this support around them to help them become healthy again and back playing the sport they love. This support can include family, friends and fellow athletes as well as the professionals helping them.

9 This session's quiz

Well done – you have reached the end of Session 7. You can now check what you've learned this week by taking the end-of-session quiz.

Session 7 practice quiz

Open the quiz in a new or window and come back here when you have finished.

10 Summary of Session 7

You should now be aware of what RED-S is, how it is caused and its relation to bone fractures and osteoporosis. You should also appreciate the impact of RED-S on the menstrual cycle and the negative impact it has on important systems of the body. You should know what signs of RED-S to look out for and what steps can be taken to support female athletes experiencing RED-S.

The main learning points of this seventh session are:

- Relative energy deficiency syndrome (RED-S) occurs when the body uses more energy than is being taken on over a prolonged period of time.
- Low energy availability can lead to a disruption in the menstrual cycle, loss of periods, and eventually bone fractures.
- RED-S can also affect the cardiovascular, immune, digestive and endocrine systems.
- RED-S has a range of causes, but it is closely linked to the belief that being lighter will produce a better performance.
- Low energy availability disrupts the menstrual cycle resulting in less oestrogen production and a shortage of oestrogen can affect bone density.
- Low oestrogen levels in females before their menopause is a major risk factor in developing osteoporosis in later life.
- As well as disruptions to the period, other signs of RED-S are a pre-occupation with food and eating, excessive tiredness, poor recovery and a decline in athletic performance.
- RED-S can be prevented by ensuring energy intake matches the demands of an athlete’s training, recovery, and daily activities.
- The treatment of RED-S requires a team approach, including a doctor, sports nutritionist and sport psychologist.

In the next and final session, you will look at effective ways to communicate with female athletes.

You can now go to Session 8.

Session 8: Effective support of female athletes

Introduction

The inability of male coaches to understand how best to engage with female athletes has been determined to be a key barrier to participation, engagement and progression in this population.

(Norman and French, 2013)

The coach-athlete or parent-athlete relationship is important in supporting athletes. An ideal coach-athlete relationship is one that is successful in terms of achieving the performance required and is effective in terms of the personal growth and wellbeing of the athlete (Jowett, 2007).

At the time of writing, UK Sport suggest that women currently occupy just 10 per cent of coaching positions in Olympic and Paralympic sport. In sport as a whole, from grassroots level to professional levels, just 30 per cent of coaches are female.

As coaching is a male dominated profession, many female athletes will have male coaches. While there are many successful male coaches of female athletes, any gaps in the skillset of males in support roles to understand how to engage with their female athletes can be a significant barrier to a successful relationship (e.g., Norman and French, 2013). The success and wellbeing of an athlete is dependent on this relationship as Jowett (2017, p. 155) says: ‘how one feels, thinks and behaves affects and is affected by how the other feels, thinks and behaves’.

In this session you will be exploring some concepts that are key to an effective relationship between a coach and a female athlete and to help coaches consider how they can best engage with female athletes.

It must be stated here that every athlete, male or female, is an individual and will have their own specific needs for coaching and support. However, some understanding of

general preferences of female athletes for support might help develop communication styles that best suit the female athlete. Research has shown that certain aspects of the coaching environment, like democratic decision making and personalised and positive relationships, are beneficial to improving female athletes' experiences in sport (Norman, 2016).

By the end of this session, you should be able to:

- appreciate the potential differences in preferred coaching between female and male athletes
- explore how coaches may develop effective relationships with female athletes
- increase awareness of how male coaches can effectively support female athletes.

1 ‘Females are just emotional!’

Figure 1 Serena Williams and Naomi Osaka after the 2018 US Open Final.

The belief that women are more emotional than men has been called a ‘master stereotype’, meaning it is a widely held and pervasive view across society. Men and women, older and younger individuals, as well as individuals from a range of cultural backgrounds hold the belief that women are more emotional than men (McRae *et al*., 2008).

The truth is that we are all emotional. Males don’t have ‘fewer’ emotions than females, but the way men and women perceive, process and respond to emotional stimuli can be different.

In the main, women cope with emotions by talking about them. It’s a part of something called ‘emotion focused coping’, where an individual actively does something to manage their emotional response to a stressful situation (Kelly *et al*., 2008). The tendency in females to want to share emotions to help manage them can sometimes be at odds with the way males like to process or cope with stressors. Men tend to use problem-focused coping strategies where they try to address and ‘fix’ the situation itself.

When a female athlete talks through her emotions about the competition that recently didn’t go to plan, a male in a support role might go into problem-focused mode and will try to fix that athlete’s problem. But the athlete may not want a problem fixed; instead she might want to process her emotions so that she can move on. This often creates a mismatch between how female athletes communicate their emotions and male coaches deal with them.

2 Do female athletes prefer certain styles of coaching?

In all relationships there are decisions to be made, and how these decisions are made and who makes them will be central to a relationship's success. There are many different styles of coaching and leadership, but two extremes would be described as autocratic and democratic and expressed in Table 1.

Table 1

Autocratic coaching style 'My way or the highway'	**Democratic coaching style** 'Let's talk about this'
• Coach makes decision without any input from athletes • Their decision is imposed on the athletes • The coach has a vision and expects athletes to conform to this vision and how to achieve it • A win-focused approach	• Coach will seek input from their athletes before coming to a decision • Coach facilitates the process rather than dictating it • Athletes can shape their own goals and how to achieve them • Collaborative approach

In Activity 1 you will explore whether female and male athletes differ in the coaching style that they prefer.

Activity 1 Don't tell me what to do!

Allow about 15 minutes

Watch the video where Dr Emma Ross from The Well HQ explains the coaching style generally preferred by females. Then answer the following questions:

1. What involvement do female athletes tend to prefer to have?
2. Does Emma attribute these preferences to differences in the male and female brain?

Video content is not available in this format.

Provide your answer...

Discussion

1. Emma explains that research shows that female athletes prefer a democratic relationship with their coach where they co-create the coaching process. They like to explore the rationale behind coaching decisions in comparison to males who she claims, are happier to be told and follow instructions.
2. Emma quickly dismisses the view of different male and female brains and explains differences in thoughts and behaviour are shaped by both nature (genetics and biology) and nurture (environment, upbringing, society and education).

It should be said that with regard to the psychology of sport and exercise that males and females have much more in common than differences (Roberts, Ferguson and Mosewich, 2019). However, as a coach it is important to be flexible and understand that female and male athletes perhaps appreciate and respond to different coaching styles, as this can have a significant impact on their performance.

You'll now go back to the coach-athlete relationship and see whether there is a difference in this relationship between male and female athletes.

3 What do female athletes want from their coach?

Each coach-athlete relationship is unique and has a unique balance as to who makes decisions. Gender may play a role in this relationship and also how an athlete selects their coach if they have a choice. This is explored in Activity 2.

Activity 2 Quality not quantity

Allow about 15 minutes

Watch the video where Dr Emma Ross explains some differences in the coach-athlete relationship between males and females. Then answer the following questions:

1. What is claimed to be most valuable to female athletes in the coach-athlete relationship?
2. How does this differ from male athletes?

Video content is not available in this format.

Provide your answer...

Discussion

1. For a female athlete the quality of the relationship is important, and this means that the coach must invest time and effort in developing empathy and rapport. For instance, it would help if the coach should take an interest in their wider life and what they have been doing outside of their sport. Although, this is also often true of effective coaches of men's teams.
2. This is claimed to be different for male athletes who perhaps are more interested in the quality of the coach, how well they have done in the past, and how many high-quality athletes they have supported.

Emma suggests that the female gains motivation and confidence from the relationship with their coach and this link is explored in the next section.

4 What does research say about the psychology of the female athlete?

Research indicates that there are several nuanced gender differences in the psychology of sports performance. Subtle differences in the motivation of female athletes to play sport and how they derive confidence are particularly important in the coach-athlete relationship.

Research summaries

Observations on motivation

- Females generally score high on being motivated by the satisfaction and competence derived from learning new skills and improving their performance (task orientation).
- Males may be more ego-oriented and motivated by competitiveness, and beating other athletes (ego orientation).
- Females tend to define success through self-referenced standards, that is focusing on improving themselves, while males are more likely to use externally referenced standards, that is success in relation to others.

(Roberts, Ferguson and Mosewich, 2019)

This following research into the sources of sport-confidence was conducted on 29 male and 25 female subjects who were active in elite individual sports. These included, for example, karate, judo, badminton, table tennis and cycling. They competed at international level and the age range was between 18 and 51.

Sources of sport-confidence

Female athletes, more so than men, gain self-confidence from an environment that provides:

- opportunities to master skills
- reinforcement from significant others (social support)

- coach's encouragement and positive feedback/reinforcement
- support to feel comfortable in competitive environments.

(Kingston, Lane and Thomas, 2010)

This research did not seek to understand why these differences may exist and acknowledged that some male athletes may gain support from similar sources.

Female athletes also stressed the need for enjoyment in their sport and fitness activities to a greater extent than male athletes (MacKinnon, 2011). Developing environments and relationships that support the motivation and confidence of female athletes can help them to flourish.

5 Final thoughts on coaching female athletes

Sports coaches, athlete management and athlete support currently use male performance as their default position but throughout this course you have focused on how to take into account the different and diverse needs of active females in sport and fitness.

Having a knowledge and understanding of these specific needs should give you the confidence to engage with female athletes and be able to have conversations about important subjects. Understanding what female athletes need out of the coach-athlete relationship will help too. This is particularly important if it is a male coach working with female athletes.

Activity 3 Do not make assumptions!

Allow about 10 minutes

Listen to the audio clip where Dr Caroline Heaney in conversation with Simon Rea discusses the importance of male coaches having conversations with female athletes they coach. Then answer the following question:

> Why is it important that a male coach discusses subjects such as periods with their female athletes?

Audio content is not available in this format.

Provide your answer...

Discussion

Apart from the positive outcomes around performance that can come from these conversations it is part of developing a positive coach-athlete relationship. As Caroline says it is vital for the coach to know everything about their athlete to be able to coach them effectively. Making it an issue that should be dealt with the females in a club could have a negative impact on the coach-athlete relationship.

The final word on this is left to Dr Emma Ross who has supported every session in this course.

Video content is not available in this format.

6 Key learning points from the course

Take a moment to reflect on the image below, which features the key learning points you should take from this course.

7 This session's quiz

It's now time to complete the Session 8 badged quiz. It is similar to the previous quizzes, but this time, instead of answering 5 questions there will be 15, covering Sessions 5–8.

Session 8 compulsory badge quiz

Remember that the quiz counts towards your badge. If you're not successful the first time, you can attempt the quiz again in 24 hours.

8 Summary of Session 8

You should now be aware that while there are more similarities than differences between males and females, women tend to process emotions in different ways to men, prefer different styles of coaching and like different amounts of input into the coaching process.

The main learning points of this eighth session are:

- Sports coaching is a male dominated activity with only 30% of coaches being females; this means female athletes often have male coaches.
- Males and females can process their emotions in different ways as females manage emotions by talking things through while men tend to try and find solutions.
- Female athletes generally prefer democratic coaching styles that enable them to have significant input into the decision-making process while men tend to favour autocratic coaching styles.
- The quality of the coach-athlete is very important to the female athlete while male athletes tend to focus on the quality of the coach.
- Female athletes tend to derive success from self-referenced standards while male athletes tend to use more externally referenced sources for success.
- Female athletes can derive confidence from their coach's encouragement and positive feedback.

Many congratulations on completing this course and we hope you have found some useful knowledge and advice that you can use as an athlete or a coach. This area of study and research is still in its infancy so we would encourage you to keep learning about it through resources that OpenLearn provide and through other sources.

Where next?

If you've enjoyed this course you can find more free resources and courses on OpenLearn.

You might be specifically interested in these other badged courses:

- Communication and working relationships in sport and fitness
- Exploring sport coaching and psychology
- Learning from sport burnout and overtraining
- Coaching others to coach
- The athlete's journey: transitions through sport
- Exploring the psychological aspects of sport injury

There is also a page of sport and fitness courses on OpenLearn as well as a Women in Sport hub where you can explore more resources dedicated to women and get updates on research and knowledge that impacts on females in sport and fitness..

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Tell us what you think

Now you've come to the end of the course, we would appreciate a few minutes of your time to complete this short end-of-course survey (you may have already completed this survey at the end of Session 4). We'd like to find out a bit about your experience of studying the course and what you plan to do next. We will use this information to provide better online experiences for all our learners and to share our findings with others. Participation will be completely confidential and we will not pass on your details to others.

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Session 4

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Session 6

Activity 3: Claudia Hammond investigates concussion in sport and asks, will science stop play? Radio 4, BBC, 2015

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