Supporting female swimmers – a multidisciplinary perspective

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Introduction

The difference between coaching male and female athletes has long been the subject of speculation, debate and discussion. There is evidence to suggest coaching and support for female participants is still currently being delivered in a manner that assumes gender neutrality (female and male participants being treated as though their needs are the same). There are a number of well-documented physical, physiological and psychological differences between males and females which would indicate that this in the wrong approach. Within swimming, recent analysis of the performances of swimmers at the British Summer Championships, reveals that the performances (relative to their qualifying time) of female swimmers were significantly worse than males (Figure 1). This implies that the support and

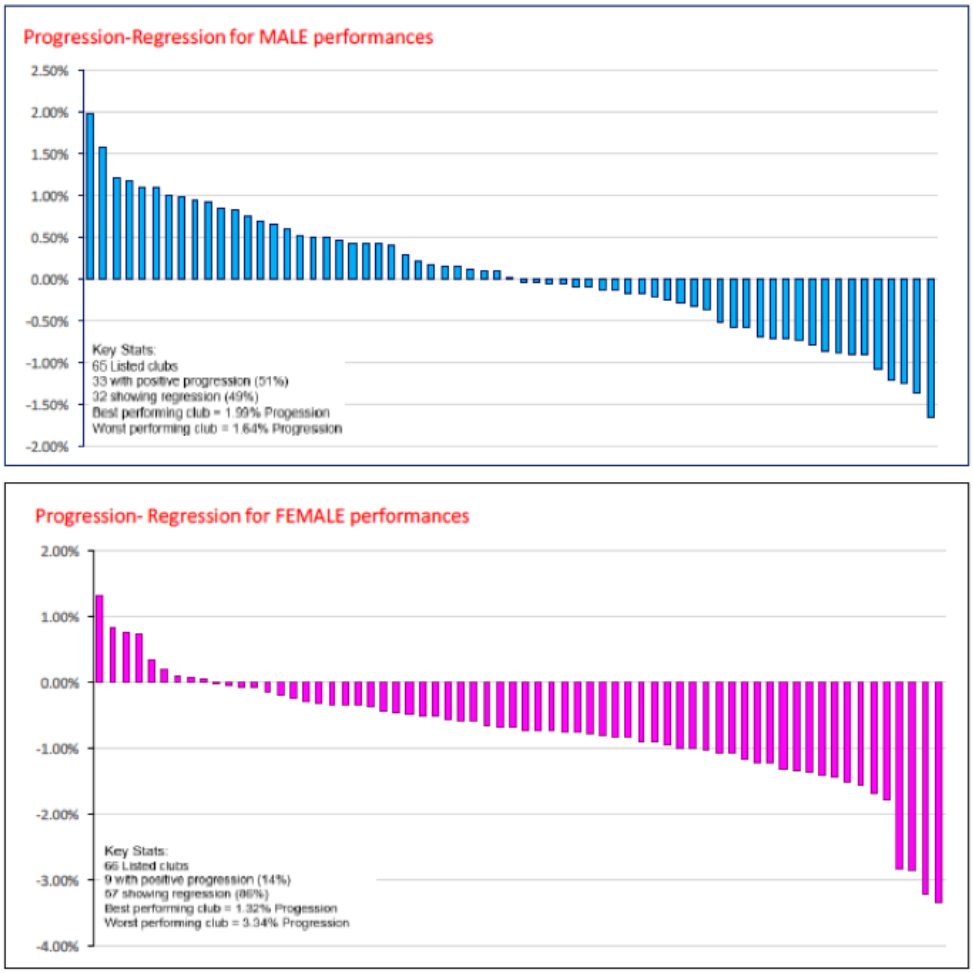


Figure 1 – Performance progression since qualifying of male and female swimmers at the British Summer Championships 2017. (From 2017 British Championships enhanced data for public - reproduced with permission.)

preparation structures available within swimming are better suited for male swimmers rather than their females counterparts. In order to address this problem, Swim England's Sports Science and Medicine team has summarised a number of multidisciplinary issues related to female athlete performance as well as providing a range of practical recommendations for coaches and swim clubs to close the gap in support and provision for these swimmers.

Fundamental differences between male and female athletes

A useful tool for describing or understanding any athlete is the bio-psychosocial model of human development (Engel, 1977 – figure 2). Simply put, this model would describe a person from three independent factors namely; physical capabilities (biological), the way they think (psychological) and their interactions with other people (social). It also aims to describe the way in which these factors interact, for example, a person may behave shyly (social) when talking with a person who is much larger than them (physical) because they feel intimidated (psychological).

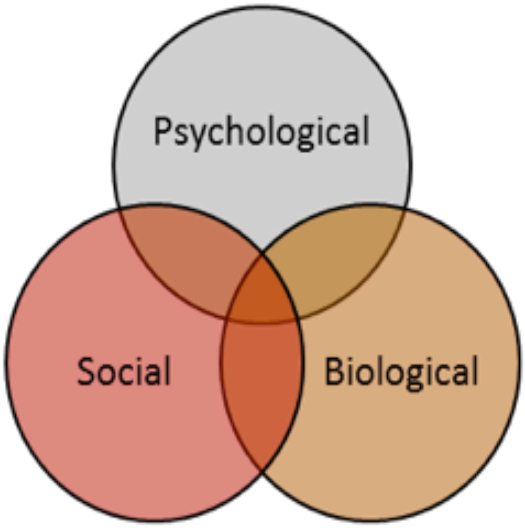


Figure 2 – Bio-psycho-social development model (Engle, 1977)

From a biological point of view, many of the apparent differences between males and females are mediated by the effects of the predominant sex hormones; testosterone and oestrogen. As a result of the influence of these hormones, males tend to have a greater overall muscle mass, while females tend to retain a greater percentage of body fat. In addition, men tend to have longer bones, which creates a mechanical advantage in some sports. The net result of these factors is that in absolute terms, females tend to display about 66% of the strength of a weight-matched male counterpart. In highly trained individuals, this difference is smaller, with a difference of approximately 10% in world record performances for males and females in running and swimming. Interestingly, females are more resilient to fatigue than males. Females fatigue more slowly than males in both running and weight lifting tasks, and recover faster.

One of the key differences between male and females is in the onset of physical maturity (Figure 3). Typically, females start the adolescent growth spurt and onset of sexual maturity one to two years before males. This maturation process initiates the onset menstruation (discussed in detail later), and triggers the development of many of the sex-specific differences discussed previously (e.g. increased fat mass). In what is a relatively short space of time, female swimmers no longer have a childlike body structure and will have developed adult female features such as higher body fat, wider hips and breasts. This can be a sensitive time with such big changes happening that are out of the individual's control.

The psycho-social differences between male and female athletes are far less clear cut because the range of individual variation is huge! Despite this, some broad generalizations can be made. In general, females are more empathetic, and more concerned with people and relationships than their male counterparts.

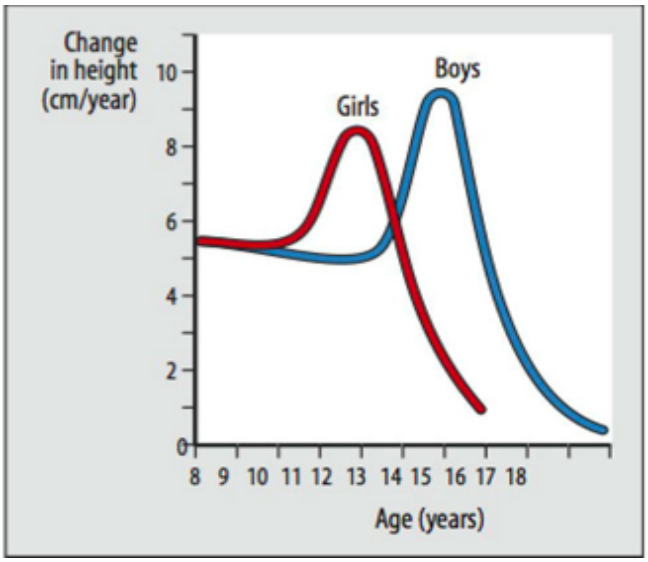


Figure 3 – Growth rates of male and female swimmers during adolescence.

This may manifest in increased levels of role-strain/conflict for female athletes as they struggle to balance their identities; as family members, students, athletes as well as within various social groups. A further key psycho-social issue for female athletes relates to social pressures surrounding body image. In the sections that follow we will summarise how these key differences in male and female participants may affect training and performance, and will provide practical recommendations for how swimmers can be best supported.

Menstrual cycle

Females from the ages of 13 to ~50 years will experience regular variation in their ovarian hormones over a period of 23 to 38 days. This cycle is traditionally split into two main phases, the follicular phase (days 1 to 14) and the luteal phase (days 15 to 28), with ovulation occurring between (Figure 4). Menstrual bleeding, typically referred to as a 'period' happens at the start of the follicular phase marking day 1 of the cycle and lasts 3 to 7 days on average. The sex hormones oestrogen and progesterone are primarily responsible for driving the changes that take place.

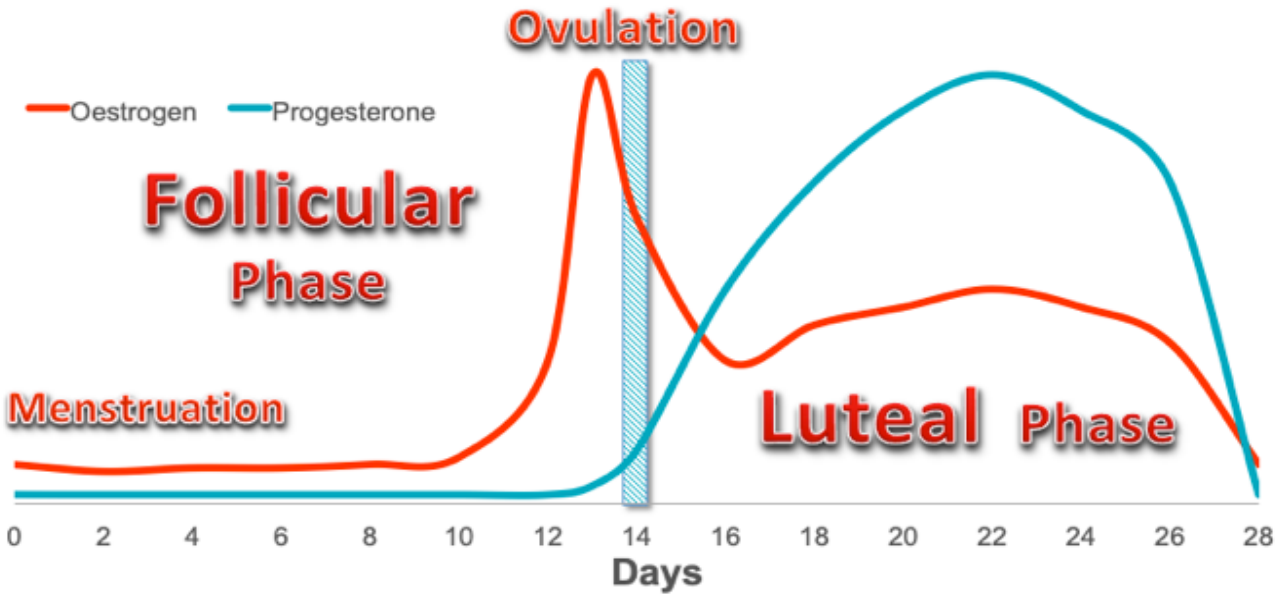


Figure 4. The average menstrual cycle (Lasting 28 days) and its phases.

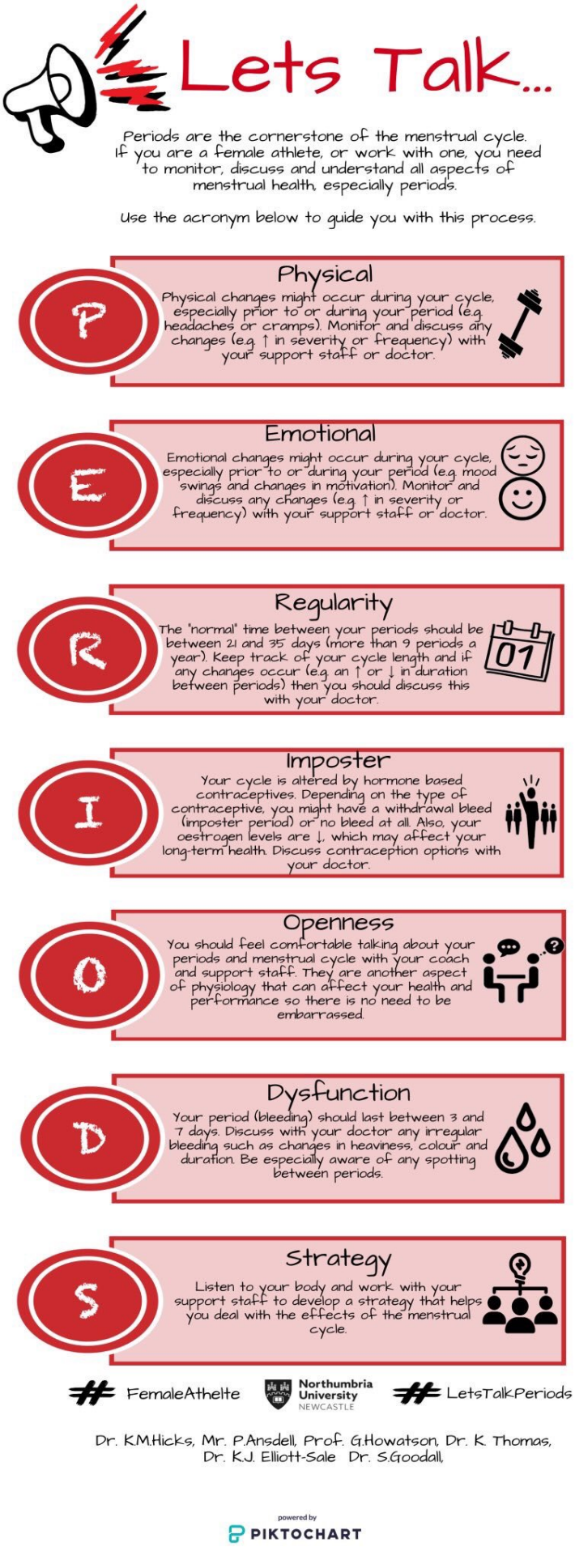
From a physical point of view, there is limited information available on the effects of menstruation on training and competition. It has been suggested that females are more responsive to strength and power type training during the luteal phase, and that endurance performance might be better during the follicular phase. Some athletes report a decrease in performance during the pre-menstrual and menstrual phases, due to abdominal discomfort, nervousness and general fatigue. Disturbances in menstrual cycle or periods missed especially for longer than three consecutive months, can be an indication of underlying health issues. For this reason, the menstrual cycle should be closely monitored within all female athletes.

Many of the challenges related to the menstrual cycle are not physical in nature. When adolescent swimmers first start having periods, this can be very confusing time. Swimmers may feel uncomfortable training during the menstrual period and may also feel uncomfortable discussing the situation with their coach. This may result in lost training time.

Practical recommendations for coaches

- Menstrual effects on training and performance are highly individual. Swimmers should be encouraged to monitor their cycles and document performance effects so that individual training strategies can be devised.

- Taboos around discussing the menstrual cycle and its effects should be removed! Menstruation should be discussed regularly and openly.
- If you are a male coach and don't feel comfortable discussing the menstrual cycle with your swimmers, use female staff, senior swimmers or parents to have these important conversations.



- Encourage swimmers track their cycles. This can be facilitated through the use of practical apps. We recommend the free app FitrWoman to allow them to learn about their cycle with regards to symptoms, physiology, training and nutrition. Other menstrual cycle tracking apps are available such as Clue.
- For those working with young swimmers much of the awkwardness related to the onset of menstruation can be avoided by discussing the implications and management strategies before it actually happens.

Nutrition – Fuel for Female Swimmers

Energy requirements for males and females are relatively similar until they reach puberty. During these periods of growth and development, a busy school life and swimming training cause energy requirements to be high. When physically mature, this need for energy to grow is reduced, but swimmers still need energy rich diets to fuel their extensive training regimes.

Male and female swimmers approach their nutrition very differently. A study by Shaw *et al*. (2014) showed that adult female swimmers consume 1,900-2,600kcal a day, while their male counterparts consumed 3,600-4,800kcal a day. Adult males do have higher energy requirements because typically they have more lean mass, however, what the females were consuming, were far too low. They also saw the males were far better at increasing their calories intake and particularly carbohydrates in line with their harder days of training.

Unfortunately, there is little if any research measuring energy expenditure in swimming, which makes it difficult for us as nutritionists to advise on how much exactly swimmers should be consuming. An old study by Trappe *et al*. (1997) measured energy expenditure on a USA national training camp in their 18-20yr old females during an extremely high training volume period (18,000km and 5-6hrs training per day). They discovered even though they were expending 5,100-6,100kcal per day, the five female swimmers were only eating 2,900-3,500kcal per day. Although the training volume is incredibly high and not that representative of current typical swim training, we can see an example of how much these females were struggling to match their energy requirements.

Sadly, we suspect that many of our female swimmers particularly those, growing and going through puberty are consistently under fuelling. This may be due to fear of gaining body fat and not understanding their nutrition needs as a swimmer, often not wanting to eat more than their friends outside of swimming who don't exercise. The health and performance issues this causes are serious and might not be so visible to the athlete, coach or parent. As a result of under fuelling, our body reduces the energy it spends on basic physiological functions (Figure 5) which has a negative impact on health and consequently performance. This can occur in both male and female swimmers, known as Relative Energy Deficiency in Sports (RED-S). Consequence of RED-S that coaches and support staff may see in the pool includes (but is not limited to) a variety of physical issues such as decreased muscle strength, decreased endurance, increased risk of injury, and is less responsive to training. There is also an increased risk of depression, impairment of judgement, and increased irritability.

In females, any disturbances in menstrual cycle or periods missed especially for longer than three consecutive months, can be an indication that the athlete has RED-S. It's really important that the menstrual cycle is viewed as a healthy part of being female and

not as an inconvenience to a swimmer. It would be a mistake to track changes in body fat alone to indicate if a swimmer was suffering from RED-S, because where we would expect a consistent loss, with a low energy intake we often see a maintenance in body fat where the body may be breaking down or not re-synthesising tissues to use or save. Some of the damage that gets done during low energy availability, can take a long time to recover.

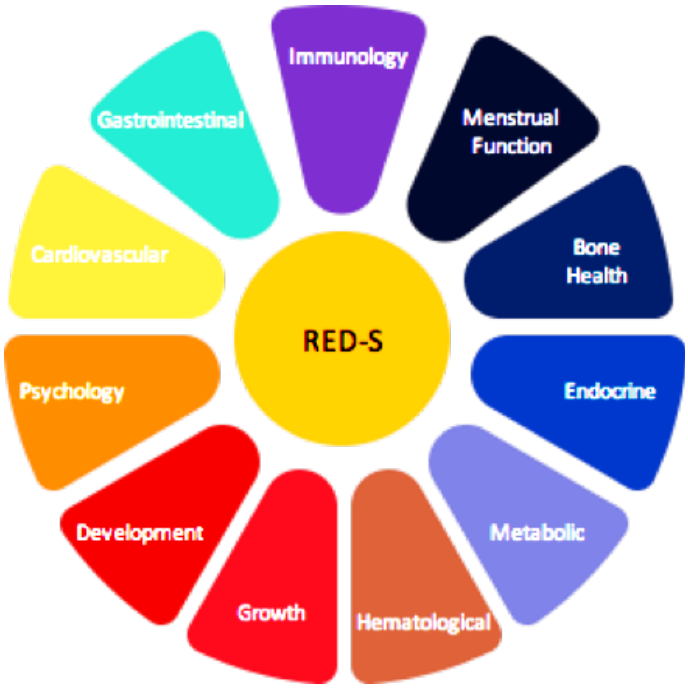


Figure 5 – Health consequences of Relative Energy Deficiency in Sport (RED-S). Redrawn from Mountjoy et al. (2014)

When it comes to treatment of RED-S, increasing energy intake and a reduction of exercise should be considered in conjunction. However, if an athlete refuses to follow a treatment plan that involves increased energy intake and a reduction of exercise then referral to a sport psychologist is indicated. It is important for coaches and support staff to not wait to see dramatic weight loss before talking to a swimmer about their concerns and seeking professional help for that athlete.

In order to avoid the potential consequences of under-fueling, the nutritional focus for younger swimmers should be on developing practical and consistently good nutritional habits. Initially these should focus on nutrition for recovery and fuelling for training to get a bigger improvement in performance and more enjoyment out of their time in the pool. Once these basics are in place more mature swimmers, may benefit from consulting a sports nutritionist if required to optimise their body composition to potentially gain another small improvement in performance. Comments on body shape should be avoided, and a good performance does not necessarily mean a healthy individual. Creating an open and communicative coach-athlete relationship and team culture can allow for athletes who may be suffering from psychological issues related to RED-S to open up before physical symptoms manifest.

Practical recommendations for coaches:

- Remind your swimmers, male and female when they are getting out of the pool to eat carbohydrate in a snack immediately, then shortly again in a meal to refuel.
- Encourage the swimmers to use a practical app to aid education in this area. We recommend the free app FitrWoman to allow swimmers to learn about their cycle with regards to symptoms, physiology, training and nutrition. Other menstrual cycle tracking apps are available such as Clue.
- Give your female swimmers time. They may be physically mature with an adult's body but they are still children with an immature palate and need to get to know their new body and its new energy requirements. The focus at this time should be on nutrition for recovery and nourishing their bodies.

Strength and Conditioning – Fuel for Female Swimmers

The development and maintenance of adequate levels of strength is one of the key performance requirements for female swimmers. Female swimmers develop increased strength when they reach puberty, but at the same time begin to retain a higher percentage of body fat as a result of the presence of oestrogen and progesterone. The result of these body changes is that while absolute strength levels increase during the teenage years, relative to their body mass females may become weaker than they were during pre-adolescence. In order to counteract these effects, strength training has an important role to play, and all competitive female swimmer should consider including regular strength training as part of their training program.

While the benefits of strength training for female athletes are clearly established, from a practical point of view it is often difficult to convince female swimmers to engage in strength training. One of the foremost challenges is conflict between what the swimmer interprets as a desirable figure (often unduly influenced by unrealistic images of women in the media) and the perceived bodybuilding effects of the training they are being asked to do. Female swimmers may avoid strength training altogether, or end up underworking in the gym in an attempt to avoid unwanted muscle growth. This may be difficult for a coach to spot and can become a barrier to productive training and long-term development. The keys to addressing this problem lie in athlete education and effective programming.

Athlete education must make it clear to the swimmer how strength training will directly benefit swimming performance. British swimming have produced a helpful resource, along with benchmark strength performances to help athletes understand this - https://www.britishswimming.org/performance/swimming/training-and-sports-science/strength-and-conditioning/.

Further, swimmers should be educated to understand that not all strength training leads to hypertrophy (increased muscle size), and that in many cases hypertrophy is not desirable. Training can be manipulated to create meaningful gains in strength, without concomitant changes in muscle size (see examples below)

Training structure likely to increase strength as well as muscle size:

- High volume max strength training (E.g. 5 x 5 reps)
- High volume resistance training (E.g. 4 x 10 across multiple exercises)
- Heavy resistance training sets to failure (E.g. pick a weight, complete max reps to failure)

Training structure likely to increase strength with minimal increased muscle size:

- Jump training
- Low volume Olympic weightlifting (E.g. 3 x 3-5 reps)
- Low volume max strength training (E.g. 3 x 3 reps)
- Plyometric training (if deemed appropriate)

While improving athletes' knowledge regarding strength training is a step in the right direction, it should be acknowledged that the social and media pressures that females swimmers are faced with are large. An instant resolution to the issue is unlikely. It is important to avoid becoming frustrated with the swimmers' pre-conceptions and to take a long-term approach to positively influence their relationship with the strength training and body image. With regard to this, a number of thoughtful adjustments can be made within strength training prescription to increase sensitivity to the pressures female athletes face. The language that surrounds the S&C program should be carefully considered

to ensure that it remains attractive for female athletes. For example "big and strong" could be better presented as "lean and athletic", while terms such as "body building" can be replaced with "body strengthening". Wherever possible overtly body building style exercises should be replaced by exercises with a clear functional link to swimming movements.

Practical recommendations for coaches:

- Body image concerns are likely to influence female swimmers engagement with strength training, and clear, sensitive education and messaging around this issue is required.
- Resistance training should focus on improving strength not increasing muscle size unless clearly indicated.

Reducing injury risk for female swimmers

Female swimmers are faced with a number of challenges that results in an increased risk of injury when compared with their male counterparts. Females have reduced absolute and relative strength levels when compared with males of the same size. In addition, changes in the levels of oestrogen throughout a female athlete's cycle, greatly alters the female's ability to repair, regenerate and adapt to different training types. This can increase a female's fatigue levels during training and possibly lead to an inability to perform at their normal capacity. Increased levels of hormones also alter ligament laxity, which can affect joint biomechanics and movement patterns.

There is a high prevalence of knee injuries amongst female athletes. Females pelvic bones increase in width during puberty, to facilitate the ability to bear children, increasing the Q angle at the hips (figure 6). This angle represents the line of force of the quadriceps and is wider in females than males. This causes an increase in internal rotation at the hip, causing an increased valgus stress at the knee. These valgus stresses place the female athlete at an increased risk of a lower limb injury. For example, ACL tears are 6 times more likely to occur in females than their male counterparts. These risks can be largely overcome through lower limb strength training and targeted exercises that improve landing mechanics, acceleration and deceleration and change of direction.

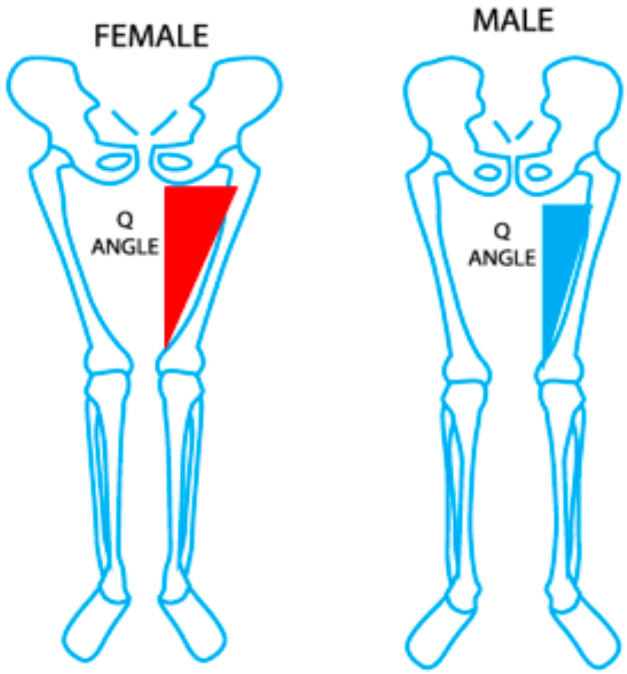


Figure 6 – Female and male Q-angles.

Stress fractures occur more frequently in females than males. Stress fractures are injuries caused by cumulative, repetitive stress that lead to abnormal bone remodelling and long periods of recovery, with possible full removal from sports activity. They are traditionally linked to endurance athletes and athletes suffering from RED-S. Pars Fractures are the most common type of stress fracture in adolescent swimmers. This stress fracture involves a small connecting bone in the lumbar spine, called the pars interarticularis. The Pars bone is a small bone that connects the facet joints that are the chain of joints

found on each side of the spine. They are placed under pressure during activities such as rotating or arching backwards. Due to the repetition of these activities, pressure is exerted on the facet joints and this stress is transmitted to the Pars. The treatment for these is to reduce the exposure to the repetitive load and help the athlete to increase their trunk strength capacity and proprioception. This often means time out of the water for swimmers and an increased focus on their land work.

Practical recommendations for coaches:

- Regular strength training is key to reducing injury risk. For clubs who cannot offer resistance training; by adding body weight strength exercises to pre-pool routines is an effective method of reducing injury risk.
- Emphasis should also be placed on the swimmer's ability to move well on land as well as in the water. A range of movement competencies (squat patterns, lunging, hinging, locomotion and balance) should be regularly screened and evaluated.
- Maintaining joint and muscular flexibility throughout the body can help to reduce the risk of injuries. For swimmers shoulder internal rotation should be above 40 degrees to help reduce the chance of a shoulder injury occurring. Maintaining the latissimus dorsi length in swimmers will help to reduce the amount of lumbar spine arching during streamline, therefore reducing repetitive stresses through the spine.

Dealing with stress infemale swimmers

Pressure is an innate part of sport, which can in some circumstances illicit excellent performances. On the other hand, stress can be detrimental, not only to an athlete's performance but even to his/her long-term mental and physical wellbeing. Research has shown that female swimmers may be more susceptible to the negative effects of stress than their male counterparts. An improved understanding of stress and potential coping strategies is therefore important for supporting female swimmers.

What is stress?

Stress arises from the presence of perceived threats or challenges to the individual, and the perceived ability of the individual to cope with that stress. It is when we do not think we can cope with the threat that a situation shifts from pressure to stress. An athlete's perception of their ability to cope is influenced by the resources available to them. These resources might be previous experience of success, an expectation of success based on coaching and feedback received, or vicarious experience of watching others be successful in similar circumstances.

Coping strategies

Broadly speaking people tend to cope with stress by using one of two different strategies: Emotion Focused Coping (EFC) or Performance Focused Coping (PFC).

- EFC uses strategies to regulate emotional arousal, even if that means the source of threat remains unchanged. It considers how we feel about the threat we are faced with, for example, venting, seeking social support, reinterpreting the event in a more positive light. People who deal with stress by using this strategy report higher levels of somatic symptoms and psychological distress.
- PFC uses cognitive and behavioural efforts to minimise distress by reducing or eliminating the source of the threat and is more effective. People using this strategy evaluate what they

can do about the stress. When it comes to coping women prefer to use EFC, and men prefer PFC.

Stress in female athletes

Our belief that we can cope in a situation is tightly linked to whether or not we feel in control of the situation we find ourselves in. Female athletes report feeling less in control in pressure situations than males. Therefore, it is no surprise that EFC is often used when people feel less in control of the situation. There is an obvious link between feeling in control over a threat and levels of competitive anxiety.

Coaches need to help female athletes feel that they are in control and can therefore cope with the stressful situation at hand. Below are some clearly defined techniques that can help deal with this.

Practical recommendations for coaches:

- Build swimmers ability to cope with stress by providing process rather than outcomes goals. Break down big outcome goals and aspirations into smaller chunks that are easily measurable and attainable day in and day out.Writing these process goals down and ticking them off as they are achieved allows athletes to quantify their preparation for big events. Having process goals related to attendance, technique, and the like, allow athletes to take control of the smaller components of their races, to "control the controllables."

- Help swimmers build portfolios of previous success that they can draw confidence from when faced with stressful situations. Work to build confidence in your swimmers by using evidence of previous success to counteract a negative threat appraisal. For example: "I never perform well under pressure" is a negative threat appraisal, but evidence to counteract that thought would be that a swimmer did well in an exam, or a driving test, or last year's nationals. This type of evidence can be systematically collected and reviewed prior to competitions. Help swimmers build confidence in themselves by increasing self-esteem. This can be done by having your swimmers list ten positive things about themselves or things they have done well each week and have them add new ones to the list each day.

- Use visualization techniques to allow athletes to mentally practice how they will manage both favorable and unfavorable race situations. Get swimmers familiar with their race through the use of imagery—of both good and bad situations. Allow time for swimmers to imagine their pre-race routine as well as their race with as much detail as possible as they prepare of the big day. If they are worried about suits ripping or goggles falling off, have them practice imagery with these scenarios in mind. Get their minds used to knowing they can have plans to cope even when situations go awry before they even arrive for the big event. Help your athletes feel like they are in a familiar environment on race day: look up pictures and videos of previous events so they can get a sense of the pool. Arrive early on the day so that there is time to address any surprises.

Conclusion

This article summarises a number of the important considerations for coaches working with female athletes. The intention of this article is not to identify female swimmers as 'special cases' because they are not males. Instead, the purpose is to recognize that there are a number of important bio-psycho-social differences between male and female athletes and that clubs and organisations that treat males and female athletes the same do not meet athlete needs effectively. Good coaching is responsive to the needs of the individual, and it is hoped that this article will provide increased insight into the needs of female swimmers, and that this will be recognized and responded to by the coaching community.

Swim England