Should Females Train Differently Than Males in Swimming

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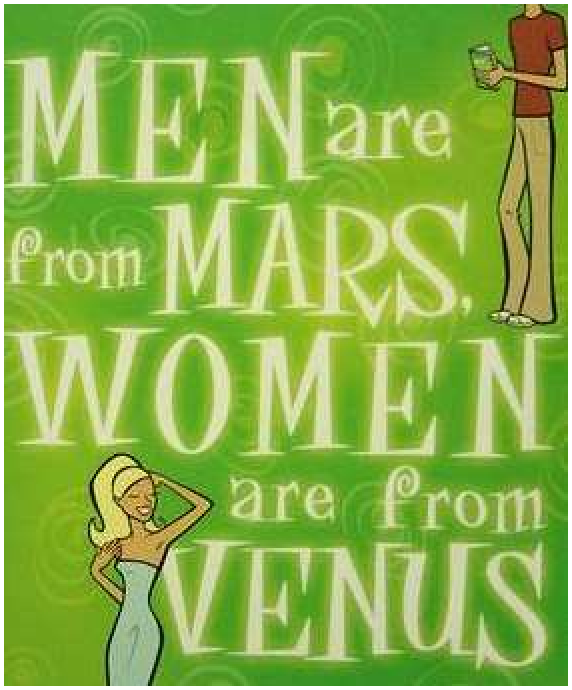
Part I: Should Females Train Differently Than Males in Swimming

Swimming is a unique sport in which female performances can approach and even exceed the men with regularity. Even compared to running (another sport with high female participation), gender performances in swimming are more closely aligned, particularly as event duration increases (Tanaka 1997). In swimming, males and females with similar fitness often train alongside each other; almost in equal proportion at the early age group and masters environments. If you're a guy who can't take losing to girls, age group and masters swimming are the wrong places for you! In this article, we'll address physiological and training differences between genders in post-adolescence. The physiological differences can be profound during the teen years and merit a separate article.



We have many options for establishing training groups. At one extreme we have one program for an entire team. At the other extreme we have individual programs for every single swimmer. Most teams meet somewhere in the middle. Can inherent gender differences help refine our training approaches to make the best group training compromises? In general, both lab experiments and race results indicate female athletes are relatively more resistant to fatigue, when fatigue is measured as the ability to sustain a workload at a given percentage of max effort. As event distance increases, females close the gap to males. In fact, some of the best times in open water challenges belong to female swimmers (Tanaka 1997).

But while comparing performances is interesting, it doesn't give us all the information we need to assess training implications. Different athletes, whether male or female, can respond to training stimuli differently even if fitness levels are similar. Some variables are difficult to isolate in the field, though gender is a fairly easy one to identify!

While females generally demonstrate better fatigue resistance, this condition is not absolute. Avin (2010) observed that gender differences in fatigue resistance are task and muscle dependent. In isometric contractions to failure at 50% of max capability, women were more fatigue resistant than men at the elbow but not at the ankle. However, men produced greater peak torque values at both joints. Peak pain, rate of pain increase, peak exertion, EMG, and baseline physical activity did not differ between sexes.

Perhaps the most critical implication of gender differences is recovery. One corollary to increased fatigue resistance is rapid recovery, though the two conditions aren't always linked. Recovery differences are clear in literature of both strength and energy production. Judge (2010) compared recovery times of males and females after a series of 5RM (rep max) bench press efforts, which were used to establish 1RM. Subjects performed bench press tests over three weeks with varying recovery periods : 4, 24 or 48 hours. Males demonstrated significant strength loss in all but the 48 hour recovery period. Females did not experience strength loss at any rest interval.

Hakkinen (1993) noted similar results in a muscular endurance test, a 20RM squat. Within first hour post-test, females lost significantly less strength compared to males, but at subsequent checkpoints (2 hours, one day, two days) the recovery rate was similar. Despite these differences, it does not follow that female dryland training should focus on endurance. In fact, many suggest that females have a greater need to train for strength and power.

Although formal research is limited as to recovery differences in the water, we can glean valuable information from metabolic studies on land. Esbjörnsson-Liljedahl (1999) compared females and males in a single 30 second sprint test. Females demonstrated lower blood lactate production but there was no difference ATP, creatatine phosphate, and glycogen loss in Type II (fast twitch) fibers. However, women lost less glycogen than men in Type I (slow twitch) fibers. During a repeated sprint task, Esbjörnsson-Liljedahl (2002) also found that females had smaller reduction and faster recovery of ATP.

One mechanism behind the results discussed above may be that added growth hormone release promotes faster regeneration. Both continuous exercise and repeated sprint exercise have been shown to induce a greater growth hormone release in females. Pritzlaff-Roy (2002) conducted graded treadmill testing and noted that each increase in exercise intensity resulted in a greater incremental increase of growth hormone in women as compared to men. Similarly, Esbjörnsson (2009) observed that both growth hormone and insulin response were greater in females after repeated sprint exercise.

Another factor to explain performance differences is economy, which is simply the energy cost exercise. Females generally are more economical in the water, due in part to having less overall lean body mass and possibly more adipose tissue (fat mass). Increased muscle mass offers greater power production but comes at a higher energy cost. The differences in swimming economy are greater as compared to land-based activity due to the added buoyancy by having a lower percentage of lean body mass. Pendergrast (1977) noted the following:

"[T]he energy cost of swimming the freestyle has been shown to be significantly higher (i.e., lower economy) for men than for women performing similar training programs. This means that the energy cost of swimming one unit distance per unit SA for the male Olympic swimmers was 1.29 greater than that for their fe male colleagues…The higher economy of women has been attributed to smaller body size (resulting in smaller body drag), smaller body density, and greater fat percent and shorter legs (resulting in a more horizontal and streamlined position)"

Conclusion

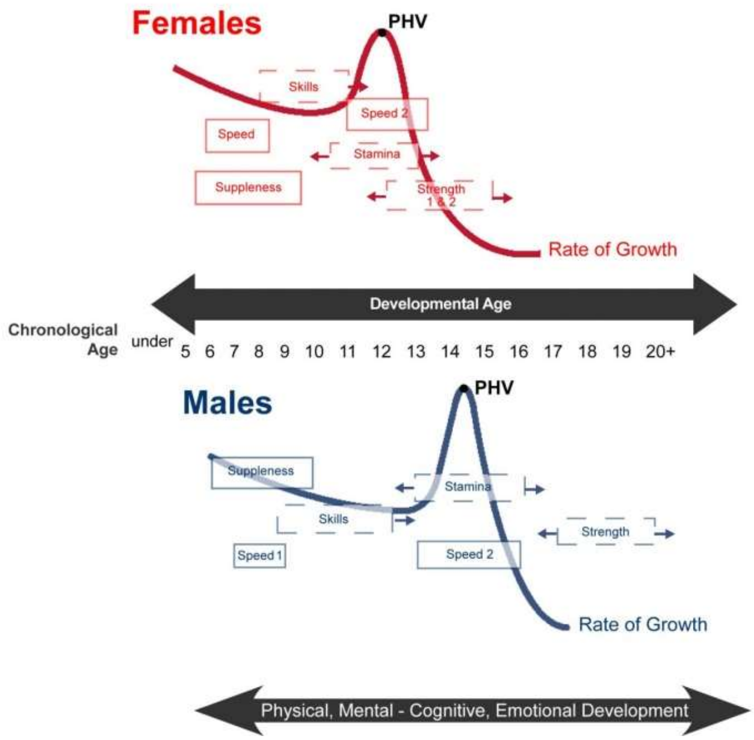
The question remains…should females train differently than males of similar ability? It's a tough question to answer due to the multitude of variables to consider, especially during early development. Developmental differences may be a topic for a future post. Though gender alone should not drive training decisions in mature athletes, gender differences may explain different responses to training and may help guide further interventions for a particular athlete or group of similar athletes.

Part II: Should Females Train Differently Than Males in Swimming

Last week we discussed gender training differences of post-pubescent athletes. This week we'll explore differences in younger athletes. We'd all agree adolescence is a volatile life stage. Boys and girls develop at different paces and thus can have markedly different responses to training, despite being the same or similar age. In this light, the most important consideration is not always gender but instead recognizing periods of rapid growth and acting appropriately on these changes. Many of the post-growth spurt training accommodations are similar for boys and girls, but girls typically hit their growth spurts sooner.

Early teen years are critical for swimming development, but the least experienced coaches are often the ones in charge young age groups. That's hardly specific to swimming, but coaching age groupers is often "paying your dues" to move up the ranks, as if these ages are unimportant. To the contrary, these years are foundational years and have a profound impact on the rest of a career. It would be presumptuous to call these years "make or break" without definitive evidence, but when you consider the physiology of what occurs during adolescence, certain things happen to the body that will never happen again during the athlete's life. Coaches must be "sensitive enough to know gender-related differences but not so much so that they form incorrect stereotypes and over-generalize" (USA Swimming 1998).

A key concept in discerning gender differences is Peak Height Velocity (PHV). PHV simply represents the main growth spurt. Every individual is different, but on average girls will achieve PHV sooner than boys. Consider the charts below (from Canadian Sport for Life). The vertical axis represents average yearly growth; the horizontal axis represents age.



PHV typically occurs in girls between ages 11 to 13. Boys typically reach PHV between ages 12 to 14. Note the sharp upticks in both curves preceding PHV. Based on PHV timing, a rapidly developing 12 year old girl may be at a similar development stage to a normal 14-15 year old boy. Interestingly, USA Swimming motivational times align closely with these developmental stages as many girls' times in the 11-12 age group are less than a second behind boys for similar performance levels (B, BB, A, etc.), which is closer than any other age group.

Training implications: VO2 max, a measure of aerobic capacity, improves significantly during the most rapid phases of growth: 11 to 13 for girls; 12 to 14 for boys (Geithner 2004). Some believe the growth spurt and concomitant increase in aerobic capacity represents a "sensitive period" with a window of opportunity for aerobic training. Think of this period as a time when aerobic training may net a greater return on investment than investments in other areas, as if comparing a financial investment with 5% return versus one with 10%.

While the concept of sensitive periods is widely recognized by many federations, the training implications are not universally accepted due to the present lack of formal research (Ford 2011). Lack of research doesn't invalidate the concept; it simply means more evidence is needed. Nonetheless, it's a concept with a sound theoretical basis and is certainly a more targeted than throwing everyone into the same workouts based strictly on time and then later guessing why some improve dramatically while others languish behind. At the very least, it is indisputable a 13 year old girl during a growth spurt is in a very different place in life compared to a late maturing 13 year old boy. Some girls may not reach their PHV until later, and some boys may reach it sooner, but on average expect changes to occur at certain ages.

The corollary to exploiting aerobic gains around PHV is the aerobic base prepares swimmers for anaerobic training in the mid-teen years, after the swimmer has added stature. Boys will add muscle mass via testosterone release. However, girls produce estrogen during these years meaning muscle gain often comes with fat gain. The years after PHV can be trying mentally too. Girls may experience rapid progress during their growth spurt, but struggle with their "new" bodies.

No matter how hard they try, maintaining lean body composition can be difficult, not to mention the emotional toll. It can be frustrating for athletes, coaches, and parents when improvement stalls during this phase, but it's important to recognize nature's work and have some patience. Further, if the athlete does not put on weight when expected, it may indicate overtraining or poor diet, both of which require specific interventions.

Managing a team of adolescent personalities is far more art than science, but it helps to understand general personality tendencies. Boys are generally more focused on tangible goals and competition. Think of this as establishing pecking order as in the wild. Girls value learning new skills and the social aspect of sharing activities with friends. If boys want to duke it out and compare times, it's not productive to resist that tendency. However, since only one person can win each race (other than relays), boys should be reminded to compare themselves to their own past performances rather than investing too much into placement. Likewise, girls pursuing athletics merely for social inclusion is not to be confused with disinterest. It simply comes with the territory at that age.

Conclusion

Adolescence is obviously a time for profound physical and emotional changes. Understanding the unique tendencies of both genders can help optimize training stimuli during rapid growth periods. More study is required to validate the energy system implications, but there's no doubt swimmers will vary based on gender-specific changes to their bodies during adolescent years.

Part III: Should Females Train Differently Than Males in Swimming

In Should Female Swimmers Train Differently Than Males: Part I of this series, we explored differences in exercise physiology between males and females. One hypothesis emerging from that discussion was that females might demonstrate greater fatigue resistance. Though it's a tough hypothesis prove due to the myriad of training variables, it's worth considering for interpreting individual adaptations. Last week we discussed differences among youth and adolescents in Should Female Swimmers Train Differently Than Males: Part II. In this post, we'll cover multiple areas, but will mainly focus on stress. Folklore may suggest females would be stressed than males ("drama queens"), but you can find many examples of high stress and low stress athletes in both genders. In truth, many differences lie in the art of coaching more than the science.

Consider this interview excerpt with Coach Anson Dorrance of the University of North Carolina women's soccer team, one of the most successful programs in all of college sports…

Interviewer: Could you elaborate a little bit more on the obvious differences you see in coaching males and females?

Coach Dorrance: Well, it would take me forever because there are so many it'd be hard for me to recount them all. But they're motivated differently. You can't lead women with the intensity of your own personality. A part of what motivates a man is for the coach to actually scream at him during the game to get him going, and that does get him going. And a lot of the times, obviously being a male I understand this, half the time the reason you start playing is you're so irritated at the criticism. And that feeds your adrenaline….

That's totally ineffective with women. What happens when you are that way with a woman, unless you have a very good and close personal relationship with her is that you are going to actually shatter her confidence. And it's a totally ineffective way to lead women athletes. And I know that what's common in sport psychology is we all want to believe the way to motivate everyone is the same way. But I'm here to testify, John, it's not (Silva 2011).

This excerpt is only a snapshot of Coach Dorrance's full answer, but it gives the idea that differences are often more art than science. In terms of science, there's probably not enough evidence to support female specific training, but there is ample evidence in gender differences to refine our explanatory models and understand the nuances of the individual athlete's adaptation.

One area where males and females differ profoundly is in the endocrine system. We discussed how estrogen and testosterone affect adolescent development in the previous installment. Another avenue through which hormones affect performance is the body's stress response. Is there a difference in how females and males react to different stressors, both physical and mental? Again, this isn't something you can ever prove with certainty due to the wide variety of training approaches and individual responses, but some common patterns do emerge.

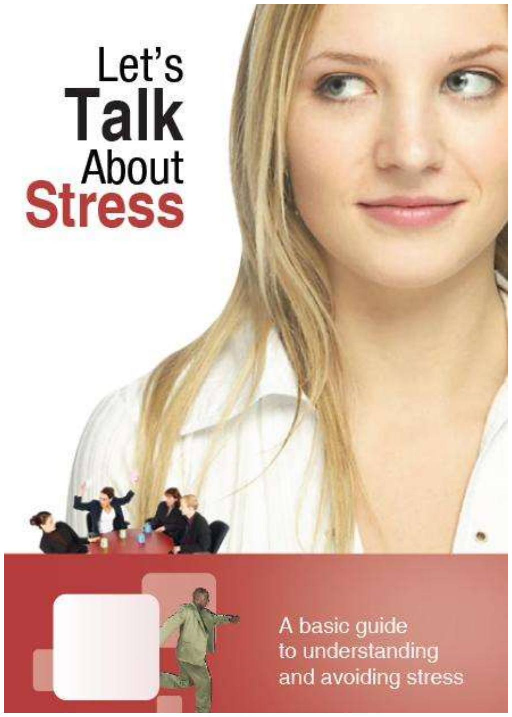
Cortisol levels are a common stress measurement. While cortisol testing requires a lab, you can observe potential signs and symptoms of elevation via observation. In athletics, we're most commonly concerned with training load, but school stress, social stress, and poor nutrition (among other things) can also elevate cortisol. With females, amenorrhea is also tied with cortisol levels (Ding 1988).

Since we're talking hormones, we'd be remiss to ignore contraceptive use. Yes, it's an off-limits area for many male coaches with their female athletes. But it's important enough to have been studied repeatedly in the literature (Vaiksaar 2011, Reichichi 2008), and fairly recently among swimmers. Reichichi (2012) studied competitive swimmers and found monophasic contraceptive cycle did not impair 200m swim performance, though it may affect blood lactate readings, due to increases in fluid retention, plasma volume, and cellular alkalosis.

As for physical training differences, several studies examine cortisol levels in swimmers and other endurance athletes. Tsai (1991) studied elite male and female endurance athletes over a full competitive season. Athletes were tested three times: preseason, midseason, postseason. Women began their seasons at higher cortisol levels and increased significantly during the season compared to men.

However, after a three day training increase, O'Connor (1991) observed no differences in psychological or physiological responses between males and females. Though cortisol levels are a sign of stress, they are not necessarily a real-time indicator of performance. In fact, in the short term, elevated cortisol may reflect the exact response we're seeking as part of a sympathetic nervous response to peak for racing (the "fight" part of the fight-or-flight dichotomy). It's a greater concern when levels are chronically elevated.

In the O'Connor study eighteen female and twenty two male college swimmers increased daily training volume from 6,800m to 11,200m for the females and from 8,800m to 12,950m for males. Stroke frequency, perceived exertion, fatigue, and muscle soreness all increased. Clearly this was a taxing effort for all, but in the short term, the stress response was the same for both genders.



The results may change for swimmers on dry land. Chatard (2002) studied a mixed gender group of swimmers over a 37 week period. Cortisol increased with volume increases and as the season progressed. Athletes completed sixty eight races during this time frame. Although they observed no link between cortisol and race performance, cortisol was a reliable marker of dryland stress among the females.

"Dryland" is a broad label, and can mean everything from easy stretching to intense lifting. Nevertheless, given the frequent bone density problems of female aquatic athletes, it could be that dryland is more stressful, especially in an elite sample where athletes have spent much of their lives immersed in water for up to 4-5 hours a day. This is just speculation on my part, but it is one possible explanation.

Another explanation could be the heat dynamics of land exercise versus aquatic exercise. Filaire (1996) conducted a female-only study, but compared swimmers to handball players. Handball players had higher cortisol levels, with one theory being the natural cooling provided by water for swimmers.

Training and racing can induce emotional stress too . In a fairly lengthy study, Raglin (1991) followed 84 female and 102 male swimmers over a four-year period to examine psychological stress. Ratings for depression, anger, vigor, fatigue, and confusion all correlated with alterations in training yardage in both genders. Tension was higher in the female swimmers each year and did not abate with yardage reductions.

Kivlighan(2005) studied collegiate male and female rowers and observed that cortisol levels rose in preparation for competition. Levels remained elevated over pre-event baselines and forty minutes post-competition. The sample included both experts and novices in both genders, with the only significant differences in the novice females.

Conclusion

Remember, not all stress is bad, so long as we have appropriate opportunities for adaptation to occur. There's probably not enough evidence to create gender paradigms for all, but knowledge of physiology and reported findings unique to each gender can help individualize based on the athlete's characteristics, whether female or male.

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