

Coaching Applications

An Update on the Age of National-level American Swimmers

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Abstract

Our study was an analysis of participant age at the United States Long Course Swimming National Championships from 1969 to 2016. We found that the age of all participants as well as the age of the top-performing swimmers increased for both sexes during this time, but to a greater extent for women. We then provided evidence that these increases in age were the result of increased opportunities and incentives to participate in the sport. The purpose of this companion piece to our manuscript was to use our findings to reconcile past and current views regarding the age at which elite-level female swimmers reach peak performance. Not long ago, elite-level female swimmers were believed to reach peak performance during middle to late adolescence whereas now it's generally accepted that the performance peak occurs years later. The early estimates for the age at peak swim performance were based on the age of the best swimmers at the time, which tended to be in the middle to late teens. But this was largely due to the fact that there weren't many opportunities available for women to continue in the sport beyond adolescence. Opportunities and incentives to participate in high school, collegiate, and post-collegiate swimming began increasing in the years following Title IX in 1972, and they have continued to increase to the present day. And as opportunities and incentives to continue swim participation increased, we've observed elite-level female swimmers attaining personal best performances into their 20's.

Our study is a historical analysis of participant age at the United States Long Course Swimming National Championships from 1969 to 2016. We found that the mean age of the participants at these competitions increased for both sexes throughout this time period, but to a greater extent for women (from 15.8 to 19.3 years) than for men (from 18.3 to 20.3 years) (see Figure 1). But we weren't satisfied with only determining age for the national-level swim population as a whole; we also wanted to track the age of the best performers within this population. We did this by calculating the mean age of the swimmers who qualified for a championship final heat during these competitions. Similar to what we saw with all the participants, we found that the mean age of the finalists increased for both sexes over time, but to a greater extent for women (from 16.6 to 20.6 years) than for men (from 18.8 to 22.15) (see Figure 2). When we compared the mean age for the finalists and all the participants, we found that the finalists, as a group, were older than all participants, as a group. And this age difference between the finalists and all the participants increased from less than half a year throughout

the 1970's and 1980's to about a year and a half in more recent years (see Figure 3). Our general explanation for these findings is that socio-environmental factors – such as opportunities, motivations, and incentives to continue training and competing – changed from 1969 to 2016, and contributed to an older national-level swim population as well as to an older sub-population of top-performing swimmers.

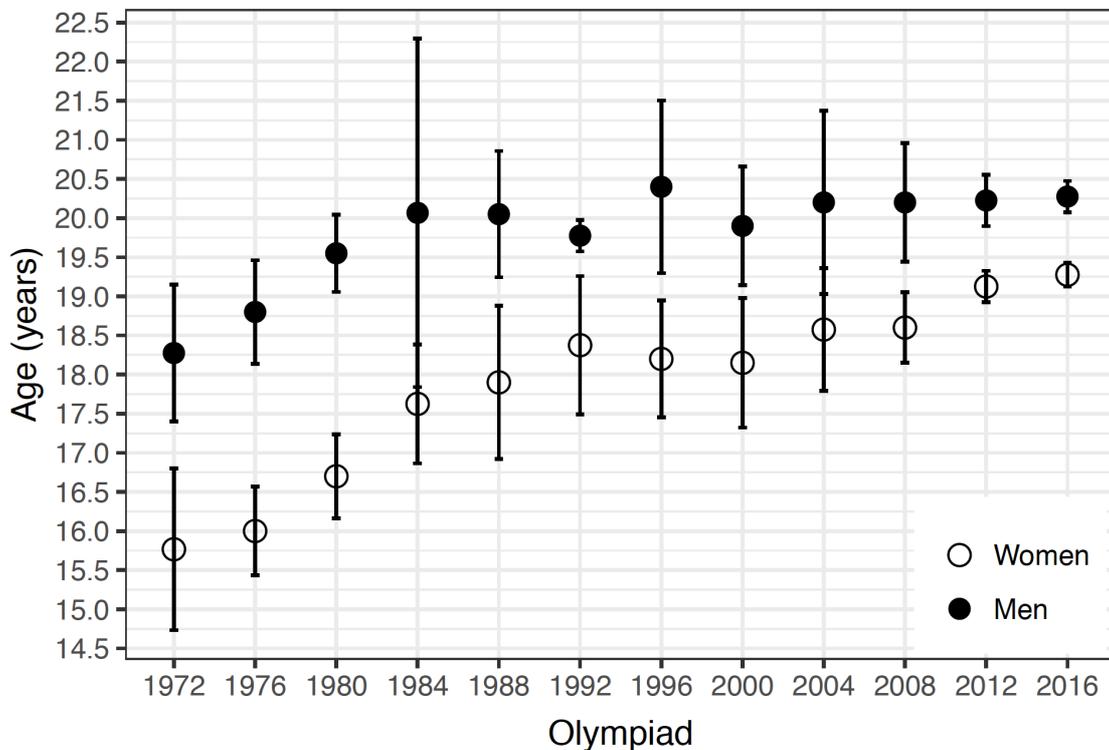


Figure 1. The mean age of competitors at the United States Long Course Swimming National Championships (ALL ENTRANTS) from 1969 to 2016 as a function of Olympiad and sex. There were significant main effects for Olympiad and sex as well as a significant Olympiad by sex interaction. Error bars represent the 95% confidence interval.

For a more detailed description of our methods and results or a more exhaustive explanation of our findings, please read our full manuscript, which can be accessed on the journal's website. In this short companion piece to our manuscript, we'll attempt to apply what we learned from our historical analysis of the age of national-level swimmers in an effort to better understand past positions regarding the age at which elite-level female swimmers attain peak performance. And we begin nearly three decades ago with a Time magazine preview of the 1988 Olympic swim competition. The preview was geared towards the general public, and consequently, was fairly mundane for close followers of the sport such as ourselves. But there was one statement in particular that really caught our attention: "women swimmers peak between the ages of 15 and 17" (2). The statement caught our attention because we assumed – perhaps incorrectly – that the statement was suggesting a physiological peak, despite a lack of evidence to support such a claim. Upon further reflection, we reasoned that the statement might not be referring specifically to a physiological peak, but rather to a performance one. And this seemed more reasonable. Swim performance is influenced by innumerable physiological, psychological, biomechanical, and socio-

environmental factors, so we would expect for peak swim performance to occur at the age at which there is the most beneficial combination of these variables. This would mean, then, that a female swimmer could reach her performance peak before her physiological one, or vice versa. For instance, let's say a hypothetical swimmer reached her physiological peak at 25 years of age, but from a lack of motivation and opportunity, she stopped training and competing around 18 years of age when she graduated from high school. As a result, she likely would have attained her best swim performances around that age, well before she would have reached her physiological peak. If she had had the opportunity and desire to continue in the sport, then she might have achieved her best performances years later. Again, this is just a hypothetical example, but it helps to demonstrate the ambiguity in the statement about female swimmers peaking between 15 and 17 years of age. We wanted to clear up some of the confusion regarding the performance potential of female swimmers, so we did a literature search in an effort to find research on this topic.

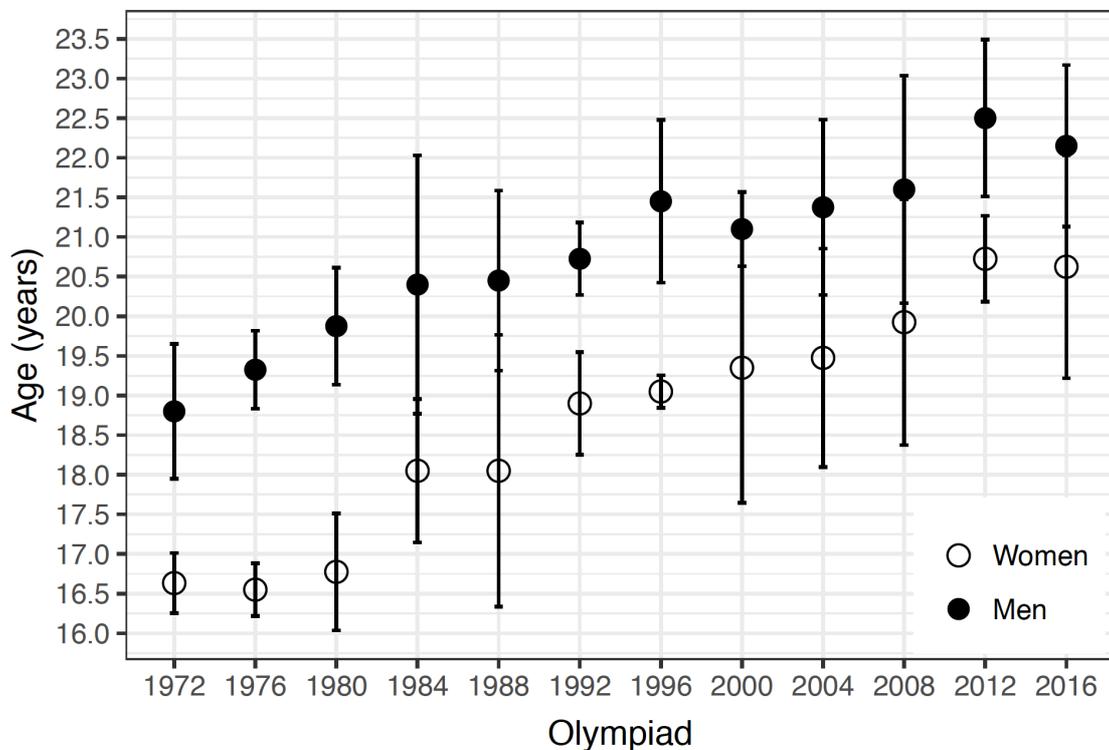


Figure 2. The mean age of the top eight finishers in each event at the United States Long Course Swimming National Championships (FINALISTS) from 1969 to 2016 as a function of Olympiad and sex. There were significant main effects for Olympiad and sex as well as a significant Olympiad by sex interaction. Error bars represent the 95% confidence interval.

And as it turned out, an article on the topic had been published shortly before the Time magazine preview. The study was an analysis of the age of Olympic gold medalists from 1896 through 1980 in a variety of sports, including swimming (3). The methods used in the study pertaining to female swimmers were straightforward; Schulz and Curnow, the study authors, simply used an almanac to record the age of gold-medal-winning freestylers in the 100-m, 400-m, and 800-m events throughout Olympic history. The most frequent age for the gold medalists in these events was 17, 16, and 15 years, respectively, while the mean

age for gold medalists in these events was 19.4, 17.6, and 16.0 years, respectively (3). Schulz and Curnow concluded from their findings that the age at which female swimmers reach their performance peak must occur during the middle to late teenage years. And, because the ages remained relatively constant throughout the course of Olympic history, they reasoned that the “limiting factor for peak performance [at this age] is physiological as opposed to motivational or behavioral” (p. 113; 3). So Schulz and Curnow actually concluded from their evidence that elite female swimmers reach peak performance levels during the middle to late teenage years, similar to what was stated in the Time magazine preview. But they also went a step further by suggesting the performance peak was the result of physiological limitation.

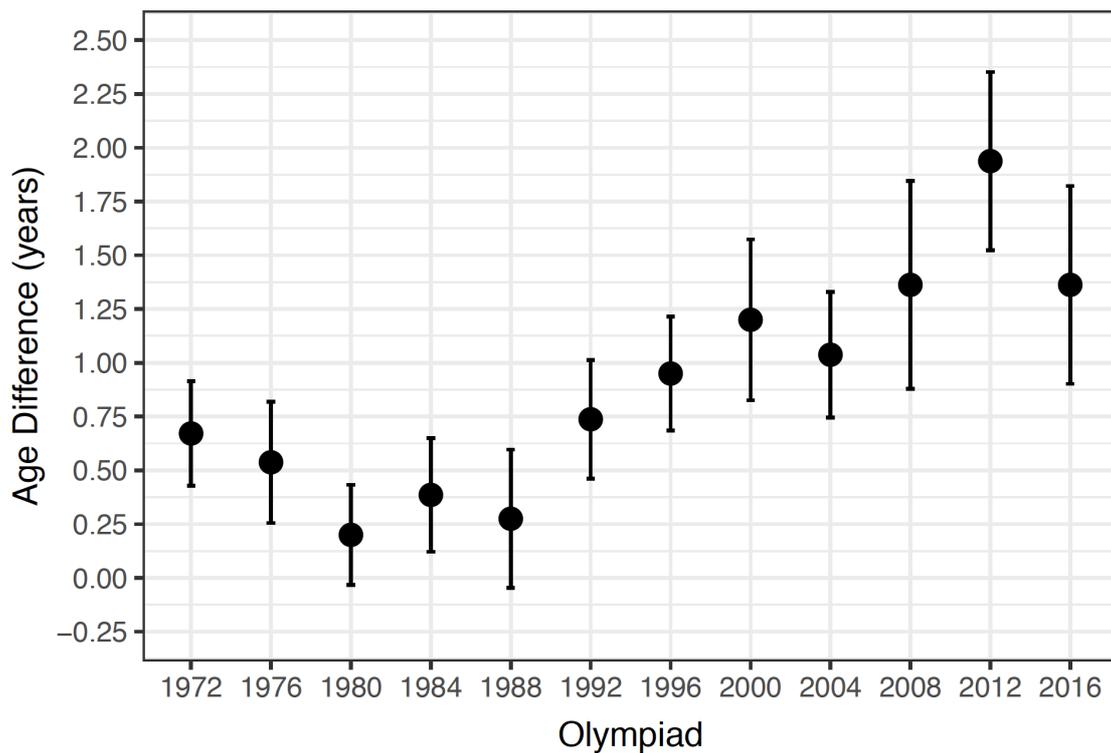


Figure 3. The mean difference between the age of the top eight finishers and the age of all competitors at the United States Long Course Swimming National Championships (DIFFERENCE) from 1969 to 2016 as a function of Olympiad. Olympiad has a significant effect on DIFFERENCE. Error bars represent the 95% confidence interval.

Before we accept Schulz and Curnow’s conclusions, we need to examine a couple of their assumptions. First, they assumed that, if the age of gold-medal-winning swimmers stays constant over time, then it’s indicative of a physiological peak at that age as well as a performance one. But this isn’t necessarily true. It could be that the age of gold-medal-winning female swimmers remained relatively unchanged throughout Olympic history because age was being influenced by a factor other than physiology that also stayed constant during the time period in question. And this is exactly what we think happened. The age of gold-medal-winning swimmers stayed constant over time because certain socio-environmental factors remained relatively unchanged during this period, not because female swimmers reach their physiological peak during the middle to late teenage years. Or to put it another way, opportunities and incentives for women to continue in

the sport beyond adolescence were virtually nonexistent during the time period Schulz and Curnow studied, so of course most of the gold-medal-winning female swimmers were in their middle to late teenage years!

In the 1970's, a trend towards increased opportunities and incentives for women to participate in high school, collegiate, and even post-collegiate swimming began. This trend has continued to the present day to the point where there are now more opportunities and incentives for women to participate in swimming beyond adolescence than ever before. Women quickly began taking advantage of these opportunities in the 1970's, and as they did, we started seeing more and more women reach peak performance levels years beyond when Schulz and Curnow suggested they would. We also saw the age of Olympic-gold-medal-winning swimmers start to go up. In fact, if we look at the age of gold-medal-winning female swimmers at the recent 2016 Olympic swimming competition, similar to what Schulz and Curnow did, we find the mean age to be 22.7 or 22.9 years, depending on if Katie Ledecky and Katinka Hosszu are counted once for the competition or once per gold medal, respectively.

We don't want to read too much into the average age of gold-medal-winning female swimmers at the 2016 Olympics, though, because of a second problematic assumption made by Schulz and Curnow. They also assumed that the age of a swimmer at the time of a single performance – albeit an Olympic-gold-medal-winning performance – coincides with the age at which the swimmer is performing at her peak, and that isn't necessarily the case. Katie Ledecky is a recent, obvious example of a swimmer who won a gold medal, but certainly hadn't reached her performance peak at the time of her victory. She won a gold medal in the 800-m freestyle at the 2012 Olympics, and then improved her mark by 10 seconds in route to another gold medal in the same event at the 2016 Olympics. So clearly there are limitations to using the mean age of gold medalists to estimate the age at which elite-level female swimmers reach their performance peak. What, then, is a better method for estimating this age?

In order to gain a better estimate for the age at which peak performance occurs, we'd need to measure swim performance at regular intervals over the course of swimmers' careers. Historically, this has been nearly impossible because of the difficulty in obtaining the necessary performance data. But swimming results are more accessible now than ever before, so it's no longer such a daunting task to gather longitudinal performance data for elite-level swimmers throughout the world. In fact, Allen, Vandenbogaerde, and Hopkins (1) recently did just this. They used the Web to construct career performance trajectories for the annual best times of swimmers who were top 16 in pool events at the 2008 and 2012 Olympics. From this data, they were able to estimate the age at which these Olympic swimmers reached their peak performance, and their estimate came out to be 22.5 years (SD 2.4 years) for the female swimmers in their data set (1). However, it's important to remember that the dependent measure in their study was swim performance, not any specific physiological variable. So it's not necessarily true that elite-level female swimmers reach their physiological peak around 22.5 years. In order to determine that, we'd actually need to complete longitudinal assessment of certain physiological variables for this group of

athletes. Since that hasn't been done yet, the best we can say *for now* is that elite-level female swimmers reach their *performance* peak around 22.5 years. And since performance is influenced by numerous physiological, psychological, biomechanical, and socio-environmental factors, which are subject to change, it's possible that our estimate for the age at which elite-level female swimmers reach their performance peak could change in time as well.

Summary & Conclusions

We provided evidence in our manuscript that the opportunities and incentives for women to participate in high school, collegiate, and post-collegiate swimming increased over the course of the past 50 years. And as the opportunities and incentives increased, we showed that the age of the national-level swim population increased along with it. So in short, changes in socio-environmental factors – i.e., opportunities and incentives to participate – affected the age of the national-level swim population over time. In this companion piece, we discussed how a failure to consider these historical socio-environmental constraints led some to conclude years ago that female swimmers reach their physiological peak during their middle to late teenage years. Now that opportunities and incentives to participate have increased, we commonly see elite-level female swimmers attain personal best performances during their 20's, and in some cases, even beyond that – e.g., Dara Torres. For right now, our best estimate for the age at which elite-level female swimmers reach their performance peak is 22.5 years (1), several years older than the best estimates from decades ago. Whether or not this age estimate will continue to increase in the years to come is difficult to say because the limitations imposed upon swim performance by age are essentially unknown. But if the opportunities and incentives to participate in swimming continue to increase, that might just be what happens.

Note: In our manuscript and in this companion piece to our manuscript, we focused on how socio-environmental factors influenced the age of the national-level American swim population over time. We refrained from discussing how the change in age over the years might have influenced the traits associated with success in the sport. That's certainly not to say that we're not interested in this, though. We're actually very interested, and we've thought a great deal about it. And in our thinking, we've reasoned that the change in age over time has favored late-maturing female swimmers over early-maturing ones. The logic is, when all the swimmers in a group are relatively young – such as the national-level female swim population in the 1960's and earlier – it's an advantage to be an early maturer. However, when all the swimmers in a group are a bit older – such as the present day national-level female swim population – it's an advantage to be a late maturer. This is a particularly difficult hypothesis to test, but in our second manuscript in this issue of the Journal of Swimming Research, we'll begin to do just that. For more on this topic, please read our manuscript on maturational timing and swim performance in collegiate female swimmers, which can be found on the journal's website.

References

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