Coaching Applications

Maturational Timing and Swim Performance in Collegiate Female Swimmers

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Abstract

National governing bodies in swimming are beginning to encourage their coaches to embrace a long-term developmental process when working with younger swimmers. The thought is that it's inappropriate to emphasize short-term success for children and early adolescents because of a long-suggested, but previously untested, hypothesis: that early-maturing swimmers perform better than late-maturing swimmers during late childhood and early adolescence, but the late-maturing swimmers improve more during early adolescence, and actually surpass the early maturers by middle adolescence. Our goal was to test this hypothesis using longitudinal swim performance data. We started by determining age at menarche (AaM) for 273 collegiate swimmers, and then assigned the youngest 33% and oldest 33% of our sample at menarche to early- and late-maturing groups, respectively. We then used the USA Swimming performance database to record the best swim performance for these swimmers as 12-year-olds (early adolescence), 15-year-olds (middle adolescence), and 18-year-olds (late adolescence). We didn't find a difference in swim performance between the early- and late-maturing swimmers during early adolescence, but late-maturing swimmers improved more than the early-maturing swimmers throughout early adolescence. And as a result, the late-maturing swimmers gained a performance advantage over the early-maturing swimmers during middle adolescence, and then retained the advantage during late adolescence. Based on these findings, we recommend that national governing bodies in the sport (i) educate their coaches about the relationship between maturational timing and swim performance and (ii) endorse swimmer development models that emphasize long-term outcomes rather than short-term success.

In this issue of the Journal of Swimming Research, we wrote about our study on maturational timing and collegiate swim performance. We recently presented preliminary findings from a related project on maturational timing and adolescent swim performance at the American College of Sports Medicine National Conference. In this coaching application piece, we'll discuss the latter rather than the former because it has far more relevance for most swim coaches.

There is often an over-emphasis on immediate results and short-term success in age-group swim programs. But more and more, national governing bodies in

swimming – such as USA Swimming, Swimming Canada, and Swimming Australia – are encouraging their coaches and administrators to adopt a long-term approach. This certainly seems appropriate, but it's not entirely clear what it would involve. We can get a sense of what it might include, though, from Swimming Canada, which recommends that its coaches consider maturity status when developing young swimmers because "early maturers have a physical size advantage and often perform better than late maturers" early in adolescence but the "late maturers often catch up to or exceed the performance of early maturers by the mid-teen years" (4, p. 14). While this recommendation is consistent with our own observations, it's important to note that the relationship between maturational timing and swim performance throughout adolescence hasn't been tested in competitive swimmers to any real extent.

One of the major reasons this relationship hasn't been tested is because of the inherent difficulty in obtaining valid and reliable measures for maturational timing and swim performance throughout adolescence. Maturational timing has traditionally been easier to acquire; it can be quantified by determining the age at which a specific maturational event occurs. While there are several maturational events that can be used to quantify maturational timing, perhaps the most common is age at menarche (AaM), the age at which a girl experiences her first menstrual cycle. Even as adults, women are typically able to recall the timing of this maturational milestone within a couple months of the actual day (2). This means that we could get a retrospective – or after-the-fact – measure of maturational timing for swimmers after they've completed adolescence. And we actually did this in our study. We used an online questionnaire to determine AaM for 273 collegiate swimmers. We then used the AaM values to assign the youngest 33% and oldest 33% of swimmers at menarche to early- and late-maturing groups, respectively. This brought us closer to assessing the relationship between maturational timing and adolescent swim performance, but we still needed to find a way to obtain *adolescent* swim performance data for the *collegiate* swimmers in our early- and late-maturing groups.

For the past 15 years, USA Swimming has collected performance data from sanctioned swim meets throughout the country, and stored the data in their performance database. It's possible to search the database for a particular swimmer on the USA Swimming website and get the swimmer's complete performance history. As it turns out, USA Swimming started the performance database around the same time that most of the collegiate swimmers in our study began swimming competitively. So our study participants could have performance data available in the database from late childhood (9-11 years of age), early adolescence (12-13 years of age), middle adolescence (14-16 years of age), late adolescence (17-18 years of age), and/or early adulthood (19-22 years of age). We were particularly interested in adolescent performance for this study so we searched the database for swimmers with performance data available during (i) early adolescence (as a 12-year-old), (ii) middle adolescence (as a 15-year-old), and (iii) late adolescence (as an 18-year-old). Sixty-two early-maturing swimmers and 53 late-maturing swimmers showed up in the database during each of the three adolescent periods. We recorded the best performance for each swimmer at each adolescent age, defining the best performance as the performance with the highest HY-TEK Power Point Score (PPS) – a standardized score given to all

performances in the database. Once we had this performance data, we were finally able to determine if, as was suggested by Swimming Canada, early maturers perform better than late maturers early in adolescence but the late maturers catch up to or surpass the early maturers by the mid-teen years.

When we analyzed the data, we found that PPS (i) was not different between early- and late-maturing swimmers during early adolescence, but (ii) was higher for late-maturing swimmers than for early-maturing swimmers during middle and late adolescence (see Figure 1). Because higher PPSs correspond to faster swim times, we interpreted our findings to mean that there was no difference in swim performance between early- and late-maturing swimmers during early adolescence, but the late-maturing swimmers performed better during middle and late adolescence. We also found that the percent improvement in PPS (i) was greater for the late-maturing swimmers than the early-maturing swimmers from early to middle adolescence, but (ii) was not different between early- and late-maturing swimmers from middle to late adolescence (see Figure 2).

The mean PPS for the early-maturing group was a little bit higher than the mean PPS for the late-maturing group, but statistically speaking, we can't say that there was a difference between the groups during early adolescence. The difference between the means was too small in relation to the variability – i.e., the size of the error bars. One possible reason we didn't find a performance difference between the early- and late-maturing swimmers during early adolescence is related to anthropometric differences between the two groups. The fact that early-maturing girls are taller and stronger than late-maturing girls during early adolescence (1, 3) suggests better performances from early-maturing swimmers during this adolescent period. However, it's important to note that late-maturing girls have less body mass per height than early-maturing girls during early adolescence (3). And less body mass per height would likely mean less form drag while swimming and less body mass to move through the water per unit of height. So the lower body mass per height could be an advantage for the late-maturing swimmers, and possibly offset the height and strength advantages that the early-maturing swimmers possess during early adolescence. We can't know for sure if this is correct with the information we have, but if it is, then the reason we didn't detect a performance difference between early- and late-maturing swimmers during early adolescence is because there wasn't one to detect.

An alternative possibility is that there actually is a performance difference between the groups during early adolescence, but we failed to detect it. There are a number of factors that could contribute to us failing to detect the effect if it does in fact exist, and an important one deals with our sample. We chose to study the relationship between maturational timing and adolescent performance *for collegiate swimmers*. Or to put it another way, we studied the relationship for swimmers that continued in the sport, and didn't drop out. We don't have maturational timing or performance data for the swimmers that did drop out. Our

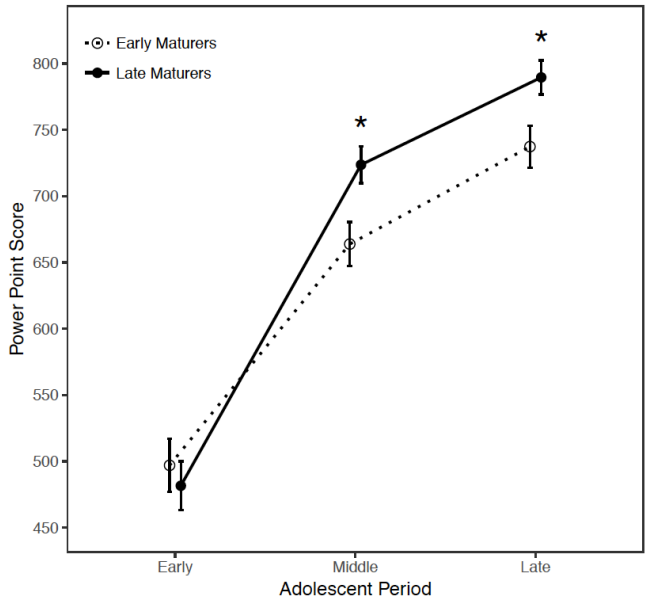

Figure 1. Mean (± 1 standard error) HY-TEK Power Point Score (PPS) for early- and late-maturing collegiate female swimmers during early (as a 12-year-old), middle (as a 15-year-old), and late (as an 18-year-old) adolescence. *Note*: PPSs are standardized performance scores that allow for comparison across events. Higher PPS values correspond to better swim performances. All adolescent PPSs were converted to adult PPSs. * indicates that PPS was significantly greater for late-maturing swimmers than for early-maturing swimmers during a particular adolescent period.

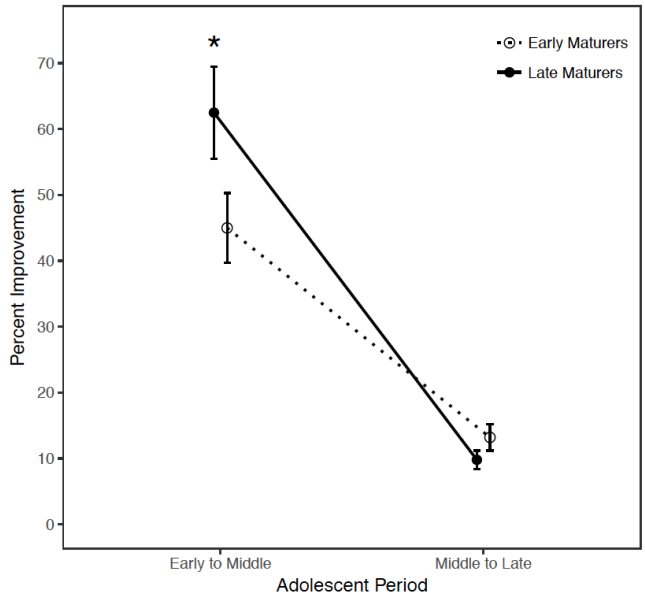

Figure 2. Mean (± 1 standard error) percent improvement in HY-TEK Power Point Score (PPS) for early- and late-maturing collegiate female swimmers from early (as a 12-years-old) to middle (as a 15-year-old) adolescence and from middle to late (as an 18-year-old) adolescence. *Note*: PPSs are standardized performance scores that allow for comparison across events. * indicates that percent improvement was significantly greater for late-maturing swimmers than for early-maturing swimmers from one adolescent period to the next.

hypothesis is that the earliest-maturing swimmers are both (i) the most likely to drop out of the sport during adolescence and (ii) the most likely to gain a

performance advantage during early adolescence on the basis of their maturity status. If this hypothesis is correct, then it would mean that the earliest-maturing swimmers are disproportionately leaving the sport during adolescence, and are under-represented in our collegiate swimming sample. This would bias the performance comparison between early- and late-maturing swimmers during early adolescence in favor of the late maturers. Once again, we can't know for sure if this is the case with the information we have. So the bottom line is, we need to do more research to better understand the relationship between maturational timing and swim performance during early adolescence.

We certainly need to do more research during middle and late adolescence as well, but the relationship between maturational timing and performance is clearer during these adolescent periods. Late-maturing girls experience greater height and body mass gains than the early-maturing girls during early adolescence, and by middle adolescence, late-maturing girls are no longer statistically shorter than the early-maturing girls, although they still have statistically less body mass and less body mass per height (3). Because of the timing of this growth spurt, it has long been hypothesized that late-maturing swimmers improve more during early adolescence than their early-maturing peers. Our findings support this hypothesis. The late-maturing swimmers improved more than the early-maturing swimmers during early adolescence, and actually surpassed them by middle adolescence. The late-maturing swimmers then maintained their performance advantage over the early-maturing swimmers during late adolescence. And from our manuscript on maturational timing and *collegiate* swim performance, we know that the late-maturing swimmers retained their performance advantage into early adulthood as well. In that manuscript, we discuss why the timing of a particular maturational event might be related to swim performance 5-10 years after the fact. For more on that, please read our manuscript, which is available on the JSR website.

Conclusions & Recommendations

Early-maturing girls grow more during late childhood than late-maturing girls, but the late-maturing girls grow more during early adolescence (3). The assumption that often goes along with this is that late-maturing swimmers will improve less than early-maturing swimmers during late childhood, and vice versa during early adolescence. When this is coupled with the fact that the top-performing swimmers during late adolescence and early adulthood tend to be relatively late maturers, it leads to a very specific concern: that the swimmers with the greatest long-term potential – i.e., the late maturers – are the most likely to drop out of the sport from a lack of early success. We would argue, though, that this particular concern is slightly off the mark. The purpose of age-group swimming is to help *all* swimmers realize their full potential. So the real worry should be that any swimmer who truly loves the sport will dropout prematurely due to a maturation-related lack of progress. But is there evidence to suggest that this actually occurs?

The short answer to this question is, no. For us to have evidence for this, we'd need to be able to demonstrate (i) that early- or late-maturing swimmers improve less than their peers during certain adolescent periods, (ii) that early- or late-maturing swimmers are more likely to drop out of the sport during these same periods, and (iii) that the reason the swimmers drop out is because of a relative lack of progress. This study provides

strong evidence that early-maturing swimmers improve less than late-maturing swimmers throughout early adolescence. We don't know if the opposite is true during late childhood, but we're currently working to test this hypothesis. We also don't know about the swimmers that drop out of the sport during childhood and adolescence. Our sample consisted of swimmers that stayed in the sport throughout adolescence, and didn't drop out. So we can't say if late-maturing swimmers are more likely to drop out during late childhood or early-maturing swimmers are more likely to drop out during early adolescence. We hope to pursue this line of inquiry in the future, though. And if we ultimately find that certain swimmers are more likely to drop out at certain times, we'd still need to demonstrate that the reason they're leaving the sport is their lack of progress. The reality is, there are many reasons why swimmers might drop out, and how much they're improving is just one of them. Swimmers also might drop out for various psychosocial reasons – e.g., dislike of tedious practices, uncomfortable wearing a swimsuit, etc. – that are unrelated to their progress. If we can understand these reasons – whatever they may be – then we can turn our focus to the next logical question: is it possible to identify these swimmers and intervene before they actually leave the sport?

Once we have an answer to this question, we'll be better able to make specific, evidence-based recommendations on *how* age-group swim coaches can use maturity status when working with children and adolescents. Until that time, we simply recommend that national governing bodies in swimming double-down on their efforts to (i) educate their coaches about maturational timing and swim performance and (ii) promote long-term athlete development. If the goal is to help all swimmers reach their full potential, then coaches need to understand that all age-group swimmers are likely to encounter periods when they don't improve as much as their peers. These periods might happen at different times for early-, average-, and late-maturing swimmers, but they will happen nonetheless. And an awareness of the relationship between maturational timing and swim performance could help coaches get swimmers through these troubling times. It could also be helpful for coaches to understand that while the best swimmers *tend* to be relatively late maturers, the best swimmers are not *all* relatively late maturers. There were early-, average-, and late-maturing swimmers in our sample that performed at the national, and even international, level. So we can say with certainty that it's possible to be an elite-level swimmer regardless of maturational timing.

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