

## Removing Maturation Influences from Female Youth Swimming: The Application of Corrective Adjustment Procedures

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**Abstract :** Introduction: Common annual age-group competition structures unintentionally introduce participation inequalities, performance (dis)advantages and selection biases due to the effect of maturational variation between youth swimmers. On this basis, there are implications for improving performance evaluation strategies. Therefore the aim was to: (1) To determine maturity timing distributions in female youth swimming; (2) quantify the relationship between maturation status and 100-m FC performance; (3) apply Maturation-based Corrective Adjustment Procedures (Mat-CAPs) for removal of maturational status performance influences. Methods: (1) Cross-sectional analysis of 663 female (10-15 years) swimmers who underwent assessment of anthropometrics (mass, height and sitting height) and estimations of maturity timing and offset. (2) 100-m front-crawl performance (seconds) was assessed at Australian regional, state, and national-level competitions between 2016-2020. To determine the relationship between maturation status and 100-m front-crawl performance, MO was plotted against 100-m FC performance time. The expected maturity status - performance relationship for females aged 10-15 years of age was obtained through a quadratic function ( $y = ax^2 + bx + c$ ) from unstandardized coefficients. The regression equation was subsequently used for Mat-CAPs. (3) Participants aged 10-13 years were categorised into maturity-offset categories. Maturity offset distributions for Raw ('All', 'Top 50%' & 'Top 25%') and Correctively Adjusted swim times were examined. Chi-square, Cramer's V and ORs determined the occurrence of maturation biases for each age group and selection level. Results—: (1) Maturity timing distributions illustrated overrepresentation of 'normative' maturing swimmers ( $11.82 \pm 0.40$  years), with a descriptive shift toward the early maturing relative to the normative population. (2) A curvilinear relationship between maturity-offset and swim performance was identified ( $R^2 = 0.53$ ,  $P < 0.001$ ) and subsequently utilised for Mat-CAPs. (3) Raw maturity offset categories identified partial maturation status skewing towards biologically older swimmers at 10/11 and 12 years, with effect magnitudes increasing in the 'Top 50%' and '25%' of performance times. Following Mat-CAPs application, maturity offset biases were removed in similar age groups and selection levels. When adjusting performance times for maturity offset, Mat-CAPs was successful in mitigating against maturational biases until approximately 1-year post Peak Height Velocity. The overrepresentation of 'normative' maturing female swimmers contrasted with the substantial overrepresentation of 'early' maturing male swimmers found previously in 100-m front-crawl. These findings suggest early maturational timing is not advantageous in females, but findings associated with Aim 2, highlight how advanced maturational status remained beneficial to performance. Observed differences between female and male maturational biases may relate to the differential impact of physiological development during pubertal years. Females experience greater increases of fat mass and potentially differing changes in body shape which can negatively affect swim performance. Conclusions: Transient maturation status-based participation and performance advantages were apparent within a large sample of Australian female youth 100-m FC swimmers. By removing maturity status performance biases within female youth swimming, Mat-CAPs could help improve participation experiences and the accuracy of identifying genuinely skilled female youth swimmers.

**Keywords :** athlete development, long-term sport participation, performance evaluation, talent identification, youth competition

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