Does Relative Age and Biological Maturation Affect Performance Profiling Outcomes in Youth Football?

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Introduction

Performance Profiling:

- Physical profiling is routinely used within youth academies to support development and enhance talent identification. However, differences in chronological age (CA) and biological maturation may influence performance outcomes.

Relative Age:

- Players are grouped by chronological age using annual selection cut-off dates. Consequently, players in the same squad may differ in age by almost 12 months, creating developmental and selection advantages for relatively older players (Hill et al. 2020).

Biological Maturation

- Players of the same chronological age can also differ substantially in biological maturity. More mature players are commonly taller, heavier, faster and more powerful, which may bias performance profiling outcomes and selection decisions (Hill et al. 2020).

Aim:

To determine whether relative age and biological maturation have an influence on performance profiling outcomes in youth football.

Methods

Design and participants:

- Retrospective analysis of routinely collected performance profiling data across 12-months, from 88 highly trained (McKay *et al.*, 2021) male footballers (14.0 ± 1.2 years, 165.9 ± 11.8cm, 55.7 ± 12.0kg).

Player classification and performance profiling:

Relative Age	Biological Maturation			Performance Tests
Birth Quarters	Pre-PHV <88.0% PAH	Circa-PHV 88.0-95.9% PAH	Post-PHV ≥96.0% PAH	5m Sprint - Acceleration
Q1 (1st Jan - 31st Mar)	PHV Status (Khamis and Roche, 1994)			20m Sprint - Speed
Q2 (1st Apr - 30th Jun)	Late <-0.5 BA-CA	On-Time -0.5-0.5 BA-CA	Early >0.5 BA-CA	5-0-5 - CoD
Q3 (1st Jul - 30th Sep)	Maturity Timing (Curnyn et al., 2025)			CMJ - Relative Peak Power
Q4 (1st Oct - 31st Dec)				Yo-Yo IRL1/L2 - VO2 Max

Statistical Analysis:

- Linear mixed models examined the effects of birth quarter, PHV status and maturity timing on performance tests, with CA added as a continuous covariate. Bonferroni-adjusted comparisons examined significant group differences. Missing data (9.33%) was addressed using multiple imputation by chained equations.

Results

Relative Age

- Consistent Relative Age Effect (RAE) present within the youth academy.
- Medium (ηp^2 = 0.11) significant effect of birth quarter for VO2 Max (p=0.015) between **Q1** & **Q3.** No other significant effects on performance.

PHV Status

- Greater effect on performance than relative age – likely due to pubertal growth.
- Small (ηp^2 = 0.02-0.03) significant effect on 20m Sprint (p=0.014) and Relative Peak Power (RPP) (p=0.049) between **Pre-PHV** & **Post-PHV** players.

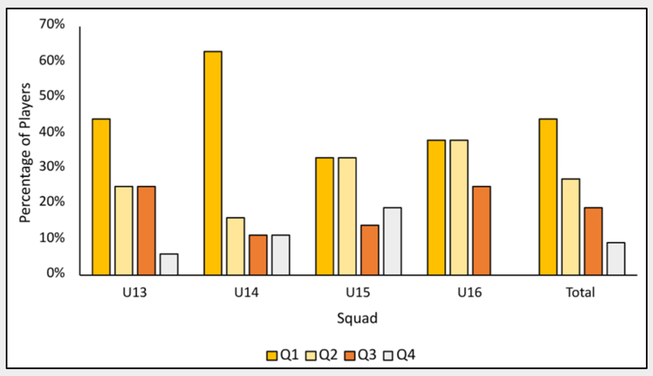


Figure 1. Birth Quarter distribution across youth academy football squads. Bars represent the percentage of players born Q1-Q4: Q1(1st Jan - 31st Mar), Q2(1st Apr - 30th Jun), Q3(1st Jul - 30th Sep), Q4(1st Oct - 31st Dec).

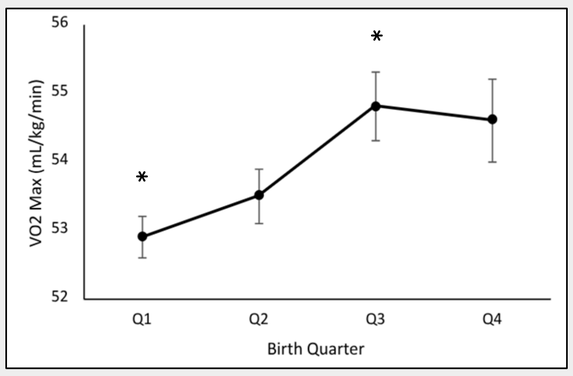


Figure 2. Estimated marginal means (EMM) ± standard error (SE) for VO2 Max in youth academy footballers across Birth Quarter. * denotes significance where p<0.05.

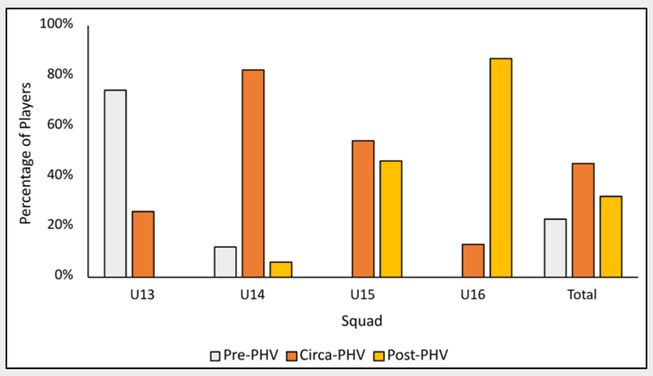


Figure 3. PHV Status distribution across youth academy football squads. Bars represent the percentage of players categorised as: Pre-PHV (<88.0% PAH), Circa-PHV (88.0-95.9% PAH), Post-PHV (>96.0% PAH).

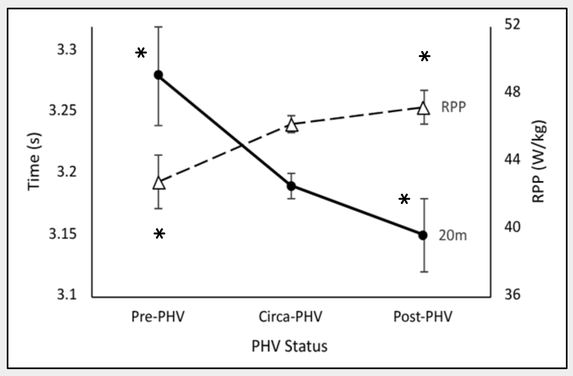


Figure 4. Estimated marginal means (EMM) ± standard error (SE) for 20m Sprint and Relative Peak Power in youth academy footballers across PHV Status. * denotes significance where p<0.05.

Maturity Timing

- Maturation-based selection bias exists within the youth academy.
- Small (ηp^2 = 0.02) significant effect of maturity timing on 20m Sprint (p=0.038) between **On-Time** & **Early** developing players.

Chronological Age

- CA progression remains a primary driver of performance improvement.
- Small-large effects on **all performance outcomes** (ηp^2 = 0.05-0.62) (p<0.05).

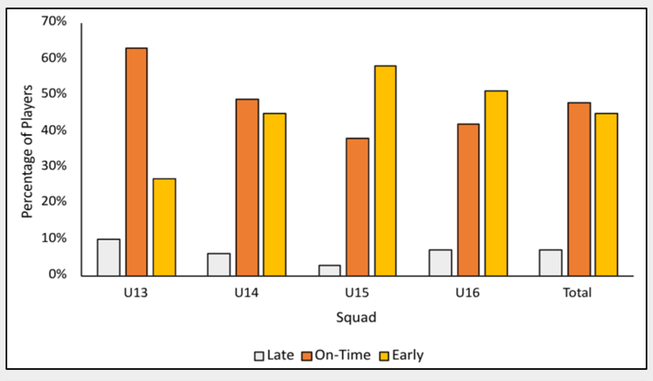


Figure 5. Maturity Timing distribution across youth academy football squads. Bars represent the percentage of players categorised as: Late (BA-CA < -0.5), On-Time (BA-CA -0.5 - 0.5), Early (BA-CA > 0.5).

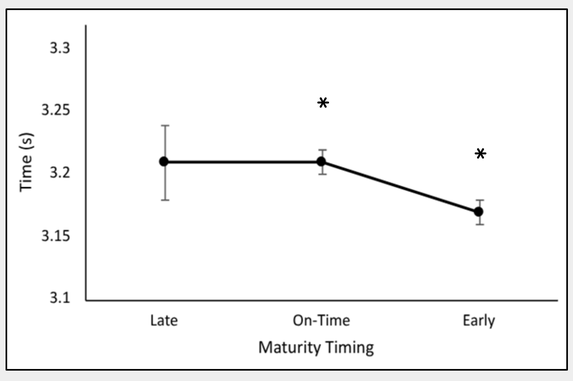


Figure 6. Estimated marginal means (EMM) ± standard error (SE) for 20m sprint in youth academy footballers across Maturity Timing. * denotes significance where p<0.05.

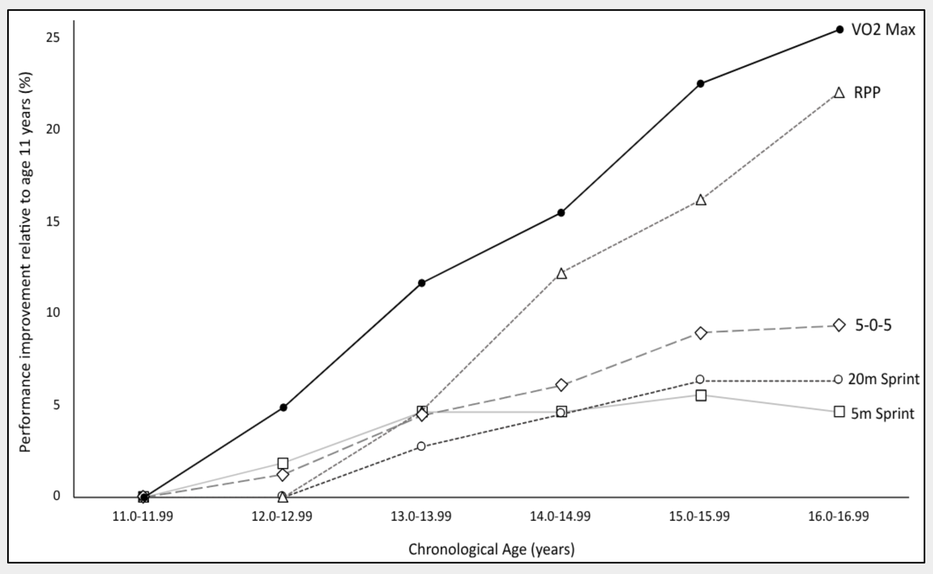


Figure 7. Percentage improvements to performance outcome EMM's across chronological age groups, relative to age 11.0–11.99. Sprint and change of direction improvements represent a reduction in time, whilst RPP and VO2 Max represent increases to performance measures.

Conclusion

- Relative age and maturational selection biases exist within the youth academy, towards early-born and early-developing players.
- When chronological age is controlled, biological maturation has greater effects on performance compared to relative age.
- Academy practitioners should avoid interpreting performance profiling scores in isolation. Outcomes should be considered alongside chronological age, birth quarter and biological maturation to reduce the risk of associating temporary developmental advantages with long-term athletic potential.

References

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