Practical Case Study of Assessing Growth and Maturity in the Premier League

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Maturation and measurement

Elite Player Performance Plan (EPPP)

- Long-term strategy to increase number and quality of home-grown players
- Improve coaching provision; implement system of effective measurement and quality assurance
- Collective platform for clubs to share ideas/concerns
Maturation and measurement

Academy concerns

1. Limited understanding of growth and maturation & how to assess & monitor it

2. Assessments, training & competition based upon chronological age groups – blanket approach

3. Selection bias towards males who are advanced in age and/or maturation
Premier League Growth Study: Aims

1. Establish a systematic and shared set of procedures for the measurement of growth & maturation across 29 clubs

2. Educate practitioners on growth, maturation & measurement

3. Adapt existing database (PMA) to capture and present growth and maturation information

4. Help clubs develop strategies to account for individual differences in growth & maturation
Maturation and measurement

PLGS Organizational Structure

Scientific Advisory Group Lead
Dr. Sean Cumming

EPPP
James Bunce

Anthropometrist
Dr. Clare Hencken

Primary Field Site Investigator

Primary Field Site Investigator

Primary Field Site Investigator

Primary Field Site Investigator

Research Asst

Research Asst

Research Asst
### PLGS Scientific Advisory Group

<table>
<thead>
<tr>
<th>Name</th>
<th>University/Institution</th>
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<tbody>
<tr>
<td>Professor Robert Malina</td>
<td>University of Texas</td>
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<td>Professor Adam Baxter-Jones</td>
<td>University of Saskatchewan,</td>
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<td>Professor Joey Eisenmann</td>
<td>Michigan State University</td>
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<tr>
<td>Dr Manuel Coelho e Silva</td>
<td>University of Coimbra</td>
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<tr>
<td>Dr Thomas Dompier</td>
<td>Datalys Center for Sports</td>
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<tr>
<td>Dr Lauren Sherar</td>
<td>University of Loughborough</td>
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<tr>
<td>Dr Amanda Johnson</td>
<td>Aspire Academy</td>
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<td>Dr Marije Elferink-Gemser</td>
<td>Rijksuniversiteit</td>
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<tr>
<td>Dr Roel Vaeyen</td>
<td>Club Brugge K &amp; Ghent University</td>
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</table>
PLGS Measurement protocol

• Baseline player/parent demographic questionnaire

• Anthropometric measurements taken every 3-4 months (or at clubs discretion)

• Non-invasive methods of maturity assessment
Baseline demographics

- Birth history/ethnicity
- Medical history
- Parents heights (meas./self-reported)
- Player history (e.g., position, training age, multi-sport)
Anthropometrics

- Height, weight, seated height, (iliospinale, chest depth)
- Taken every 4 months (or at clubs discretion)
- Repeat measures with 3rd measure if +/- .5 (cm./Kg.)
Quality control

• Competency and reliability of measures assessed

• Intra- and inter-investigator reliability

• Technical Error of Measurement calculated (absolute & relative)
Maturation and measurement

Application of TEM (absolute)

Growth in cm. with TEM (1.2 cm)

Time 1: 145.6
Time 2: 146.2
Maturation and measurement

Application of TEM (cont.)

Growth in cm. with TEM (1.2 cm)
Maturation and measurement

Assessments of maturation

- PMA provides three indices of maturation
  - Khamis-Roche method (% Predicted Adult Height) *
  - Maturity Offset Method (age at/from peak height velocity)
  - Growth velocity curve
Khamis-Roche method *

- Predicts adult stature from age, height, weight, mid-biological parent height (adjusted for overestimation) **
  - Maturity status expressed as percent of adult height attained at measurement (PAH)
  - Maturity timing (early, on-time, late) expressed as age and sex specific Z score

Maturation and measurement

Khamis-Roche Equation

- Predicted Adult height =
  - Intercept + (β₁ x height) + (β₂ x weight) + (β₃ x mid-parent height)
  - Sex and age specific intercepts and coefficients available for imperial (inches, lbs.) and metric (cm./Kg.) measures

A worked example: Bob

Bob
13.5 years
172.5 cm
55.0 Kg.

Adult Bob
187.6 cm
50% CI +2.2 cm.

Parents
Mum = 5’9
Dad = 5’10
Maturation status: (%PAH)

Bob
91.9% PAH
Circa-pubertal
At PHV

0% 89% 95% 100%PAH
Pre-pubertal Puberty Post-Puberty
Maturity timing: Z Score

Z Score for 13.5 years

(91.9 - 89.1) ÷ 3.68 = .76

Z score >+.5 = early
Maturation and relative age

11-12 MONTHS

91.9% PAH

85.3% PAH

92.3% PAH

79.80% PAH

Sept  Oct  Nov  Dec  Jan  Feb  Mar  Apr  May  Jun  Jul  Aug
Maturation and performance

- Allows athlete’s fitness to be judged relative to maturity standards (%PAH) pooled from 29 clubs
- Identifies strengths and weakness from a developmental perspective
### Maturation and measurement

#### Data Sheet

<table>
<thead>
<tr>
<th>Name</th>
<th>Hay, Geoffrey</th>
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<table>
<thead>
<tr>
<th></th>
<th>Absolute</th>
<th>Maturity</th>
<th>Age</th>
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<tbody>
<tr>
<td>Power</td>
<td>11.15</td>
<td>1.20</td>
<td>-1.88</td>
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<tr>
<td>R Power</td>
<td>14.56</td>
<td>0.60</td>
<td>-0.49</td>
</tr>
<tr>
<td>10m Speed</td>
<td>1.88</td>
<td>1.90</td>
<td>-1.83</td>
</tr>
<tr>
<td>Momentum</td>
<td>407.45</td>
<td>0.99</td>
<td>-1.16</td>
</tr>
</tbody>
</table>

#### Current Ht vs Estimated Ht

- Ht Range: 200 to 160
- Bars show current and estimated heights

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**Note:** The table and graph represent data analysis for maturation and measurement purposes. The specific details and units used in the measurements are not specified in this excerpt.
Maturation and measurement

Maturation status and training

<table>
<thead>
<tr>
<th>PHYSICAL QUALITIES</th>
<th>TRAINING STRUCTURE</th>
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<tbody>
<tr>
<td>Mobility</td>
<td>UNSTRUCTURED</td>
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<tr>
<td>Agility</td>
<td>LOW STRUCTURE</td>
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<tr>
<td>Speed</td>
<td>MODERATE STRUCTURE</td>
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<tr>
<td>Power</td>
<td>HIGH STRUCTURE</td>
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<tr>
<td>Strength</td>
<td>VERY HIGH STRUCTURE</td>
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### YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES

<table>
<thead>
<tr>
<th>CHRONOLOGICAL AGE (YEARS)</th>
<th>2</th>
<th>3</th>
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<th>21+</th>
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<tbody>
<tr>
<td>AGE PERIODS</td>
<td>EARLY CHILDHOOD</td>
<td>MIDDLE CHILDHOOD</td>
<td>ADOLESCENCE</td>
<td>ADULTHOOD</td>
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<tr>
<td>GROWTH RATE</td>
<td>RAPID GROWTH</td>
<td>STEADY GROWTH</td>
<td>ADOLESCENT SPURT</td>
<td>DECLINE IN GROWTH RATE</td>
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<tr>
<td>MATURATIONAL STATUS</td>
<td>YEARS PRE-PHV</td>
<td>PHV</td>
<td>YEARS POST-PHV</td>
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<tr>
<td>TRAINING ADAPTATION</td>
<td>PREDOMINANTLY NEURAL (AGE-RELATED)</td>
<td>COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)</td>
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**Figure 1.** The YPD model for males. Font size refers to importance; light blue boxes refer to preadolescent periods of adaptation, dark blue boxes refer to adolescent periods of adaptation. FMS = fundamental movement skills; MC = metabolic conditioning; PHV = peak height velocity; SSS = sport-specific skills; YPD = youth physical development.
Maturation and measurement

Maturation and training (cont.)

Donald
- 13.5 years
- Curr. 165cm
- 89% PAH
- Circa PHV
- Z Score = -0.2
- On time

Craig
- 13.5 years
- Curr. 165cm
- 97% PAH
- Post PHV
- Z Score = 2.2
- Early
Implications for Donald

- Entering pubertal growth spurt; greater risk of epiphyseal injuries
- Closer monitoring of training load, FMS and sport specific skills
- Stay within age group for training/competition

Donald
- 89% adult ht.
- Circa PHV
- Z Score = -0.2
- On time
Implications for Craig

- Post-growth spurt; reduced risk of epiphyseal injury

- Benefits from combined training (neural & structural adaptation)

- Could train/play up an age; if technically / emotionally competent

Craig
- 97% adult ht.
- Post PHV
- Z Score = 2.2
- Very Early
Maturation and measurement

Bio-banding for competition

Under 12s

Under 13s

80-85%

85-90%
Thank You
Any Questions?