Understanding growth and puberty using the RCPCH UK 2-18 growth charts
Why measure school aged children?

• Growth as best indicator of health
• Normality by age and puberty
• Identifying disorders
• Assessing obesity
Key questions

• Is a child too short or tall for their age – could there be a problem?
• Has puberty started and is it progressing normally?
• Is growth normal for puberty?
• Is this child overweight or obese?
The UK 2-18 charts will help you answer these questions

• Developed and published by RCPCH
• Based on updated UK 1990 growth references
• New design features that need explaining
Working with the UK 2-18 charts

• Updating of UK90 with puberty studies
• Easier way of assessing puberty
• Help you identify growth, puberty and obesity problems more easily
• New features
  • Puberty Phases
  • BMI lookup and plotting grid
  • Parental height comparator
  • Adult height prediction
RCPCH UK 2-18 Growth chart

- UK90 reference after age 4
- WHO standards until age 4
- Birth centiles
- Mid parental centile scale
- Predicted adult height scale
Predicted Adult Height

Use an X to mark the child’s most recent height centile in the centre line.
Read off the child’s estimated adult height form right scale.
80% of children will be within ±6 cm of this value.
Scale also shown in feet and inches on left.
Mid-parental Centile comparator

Mark mother’s height on the left hand scale and father’s height on the right scale using arrows. Draw a line between arrowheads and read off mid-parental centile where this crosses the central line. Regression adjustment means that children of very short or tall parents have mid parental centile nearer to average than expected.

Mid parental Centile = 75th
Mid-Parental Centile comparator

Compare the mid-parental centile to the child’s current height centile (x)

Nine out of ten children’s height centiles are within ±two centile spaces of the mid-parental centile.
Interpretation of the mid-parental centile (MPHC)

- Average centile for all children of these parents
- Compare to child’s actual height centile
- Most children are within ±two centile spaces of the mid-parental centile
- Only 1 percent more than three centile spaces below
  - Most have no treatable cause for their short stature,
  - Investigate further if other concerns about the child’s growth
- NB a child growing abnormally may still be within mid parental height range
Body Mass Index (BMI) lookup

- Read weight and height centiles from the growth chart.
- Plot weight centile (left axis) against the height centile (bottom axis).
- Read off the corresponding BMI centile from the slanting lines.
- Record centile on grid at top of chart.
- Accurate to ¼ centile space.
BMI centile grid: plotting example

Only shows 0.4th, 2nd, 91st, 98th, 99.6th

No need to plot if between 2nd and 91st
BMI Interpretation

- A child whose weight is average for their height will have a BMI between the 25th and 75th centiles
- >91st centile suggests overweight
- >98th centile is very overweight (clinically obese)
- < 2nd centile may reflect undernutrition, but may simply reflect a small frame or low muscle mass

But

- BMI often varies from one measurement to the next due to measurement error
- Compare BMI to weight and height centiles using BMI plotting grid at top of chart
Pre-puberty ONLY

Puberty starting before 8 is precocious

Growth during Puberty

Plotting pubertal children on the UK 2-18 Growth charts
Puberty section of New 2-18 Chart

- **Puberty Lines** mark boundaries of normal pubertal development
- Shaded zone marks area where 0.4<sup>th</sup> centile varies with *phase* of puberty

Most healthy children start puberty between these ages

Most healthy children complete puberty between these ages
## The 3 Phases of Puberty

<table>
<thead>
<tr>
<th></th>
<th>Pre-puberty (Tanner stage 1)</th>
<th>In Puberty (Tanner stage 2-3)</th>
<th>Completing Puberty (Tanner stage 4-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Girls</strong></td>
<td>If all of the following:</td>
<td>If any of the following:</td>
<td>If all of the following:</td>
</tr>
<tr>
<td></td>
<td>• No signs of nipple or breast development&lt;br&gt; • No pubic hair</td>
<td>• Any breast enlargement so long as nipples also enlarged&lt;br&gt; • Any pubic or axillary (armpit) hair growth</td>
<td>Started periods (menarche) with breast, pubic and axillary hair development</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td>If all of the following:</td>
<td>If any of the following:</td>
<td>If any of the following:</td>
</tr>
<tr>
<td></td>
<td>• High voice&lt;br&gt; • No growth of testes or penis&lt;br&gt; • No pubic hair</td>
<td>• Slight voice deepening&lt;br&gt; • Reddening of scrotum with growth of the testes&lt;br&gt; • Early testicular or penile enlargement&lt;br&gt; • Early pubic or axillary hair growth</td>
<td>• Voice fully changed (broken)&lt;br&gt; • Adult size of penis with pubic and axillary hair growth&lt;br&gt; • Moustache and early facial hair growth</td>
</tr>
</tbody>
</table>
Shaded Puberty Zone

- Marks area where 0.4th centile varies with **phase** of puberty
- Heights in the shaded area below the 0.4th centile:
  - **Pre**-puberty: if within 2 centiles of Mid Parental Height
    = **within** the normal range
  - **In** or **Completing** puberty
    = **below** normal range
Delayed Puberty

New charts can detect delayed **ONSET**

*E.G. in girls puberty not started by age 13 years (14 years in boys)*

and

**PROGRESS**

*E.G. in girls puberty not completing by age 16 years (17 years in boys)*
Exercises
Angela’s mother has expressed concern that she is not growing and looks pale.

She was born at term with IUGR (birth weight 2.1kg) and at school entry her height was just below 0.4th centile. Now she is 11 years 4 months old with 24kg in weight and 125cm in height.

She has not yet started her periods and has no pubic or axillary hair or breast development.

• How does her height centile change once you allow for her current phase of puberty?
Angela

- Height centile <0.4th
- Weight centile <0.4th
- Pre puberty
- >0.4th once you allow for her current phase of puberty
Bobbi’s mother has expressed concern that she is not growing and looks pale. She was born at term (birth weight was 3.5kg) and at school entry her height was just below 0.4th centile. Now she is shorter than all her peers. She is 11 years 4 months old with 21kg in weight and 125cm in height.

Bobbi has not yet started her periods but has some pubic and axillary hair and breast development.

- How does her height centile change once you allow for her current phase of puberty?
Bobbi

- Height centile <0.4th
- Weight centile <0.4th
- In puberty
- Still <0.4th once you allow for her current phase of puberty
CHELSEA

• Chelsea aged 14 has been measured at her GP and told that she is very overweight and needs to do something about it. Her mother thinks she is a healthy weight and does not agree that she needs to lose weight.
• Her current weight is 83kg
• Her current height is 166 cm
• What is her BMI?
• Is Mum right?
CHELSEA

- Height centile: 75-91st
- Weight centile: >99.6th
- BMI centile: >99.6th
- Very overweight (clinically obese)
DONNA

• Donna aged 13 has been measured at her GP and told that she is very overweight and needs to do something about it. Her mother thinks she is a healthy weight and does not agree that she needs to lose weight.

• Her current weight is 77kg
• Her current height is 175 cm
• What is her BMI?
• Is Mum right?
DONNA

- Height centile? >99.6th
- Weight centile? >99.6th
- BMI centile? 91-98th
- Overweight but not obese
Elinor
Aged 8, parents worried that she is not growing. Her current height is 116 cm (2nd percentile). Her father’s height is 174 cm and her mother’s height 167 cm
• What is her predicted adult height?
• What is her mid parental centile?
• How much does her current centile differ from her mid parental centile?
• How common is for a child to be this different from their parents?
Elinor

- Predicted adult height
  156cm (5’ 1’’)

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Elinor

• Mid parental centile 50th
• Child’s centile 2nd
• 3 spaces difference
• 1% or fewer children will be this different
Faryl

Aged 8, parents worried that she is not growing.
Her current height is 120.5 cm (9th centile). Her father’s height is 170 cm, her mother’s 163.5 cm
• What is her predicted adult height?
• What is her mid parental centile?
• How much does her current centile differ from her mid parental centile?
• How common is for a child to be this different from their parents?
Faryl

• Predicted adult height
  158.5cm (5’2”)

Faryl

- Mid parental centile 25-50th
- Child’s centile 9th
- 1.5 spaces difference
- More than 5% children will be this different
What you have learnt about

• The phases of puberty and how to use them to interpret growth charts
• How to predict adult height and relate a child’s height to the parents’ height
• How to assess BMI without a calculator