Fact sheet: UK 2-18 years Growth Chart:

This chart is mainly intended to assess the growth of school age children and young people. It combines data from the UK 1990 growth reference for children at birth and from 4-18 years\(^1\), with the WHO growth standard for children aged 2-weeks to 4 years\(^2\). The growth of children less than 2 years of age should be plotted on the more detailed UK-WHO 0-4 year growth charts.

The chart includes a number of new features to help plotting an interpretation:

- A birth centiles plotting scale
- A familial height scale to predict adult height and mid parental centile
- BMI lookup and plotting grid
- A new guide to assessing puberty

**Measuring techniques**

**Height**

A correctly installed stadiometer or approved portable measuring device is the only equipment that can be reliably used to measure height and recorded to the nearest millimetre. Accurate measurement is essential and shoes must be removed for all measurements. The child should stand with their heels, back and back of head against the backboard or wall, looking straight ahead, making sure the chin is not tipped up (see illustration). The height measurement is taken after asking the child to breathe in and out after applying gentle upward pressure to the mastoid processes – the bony protrusions behind the ear\(^3\). Experienced measurers usually stretch the child while taking the measurement, but for less experienced staff and where a child may be measured by different staff at each visit, stretching then letting go just before the reading runs less risk of big differences between measurers\(^4\).

If a child cannot stand, measure length lying down with a Dunmow measure and plot as for height.

**Weight**

Remove heavy clothing and shoes and weigh using class III clinical electronic scales in the metric setting.

**Plotting**

Plot each measurement by placing a small dot where a vertical line through the child’s age crosses a horizontal line through the measured value. The lettering on the charts (‘weight’, ‘height’ etc.) sits on the 50th centile, providing orientation for ease of plotting.
Birth centiles plotting scale

The chart only starts at age 2 years, so there is a plotting scale on left of the chart where birth weight (and length, if measured,) for children born at term (after 37 completed weeks) can be plotted, to allow comparison of the birth centile with later growth.

What do the centiles mean?

These charts indicate a child’s size compared with children of the same age and maturity. The centile lines show the range of heights and weights for age and the number of children in the population expected to fall below a particular line (e.g. 50% below the 50th, 91% below the 91st). Children come in all shapes and sizes, but 99 out of 100 children who are growing optimally will be between the two outer lines (0.4th and 99.6th centiles); half will lie between the 25th and 75th centile lines.

When is a measurement abnormal?

There is no single threshold below which a child’s weight or height is definitely abnormal, but only 1 in 250 children are expected to have weight or height below the 0.4th centile, so these children should be assessed further, if not already fully investigated when younger. If weight is above 99.6th centile or if weight and height centiles differ, the BMI centile should be calculated (see below). If a plot falls within the shaded area on the height chart between 8 and 13 years, pubertal assessment will be required (see below).

Growth patterns before puberty

Before puberty, from around age 4 to 8 years, heights usually track fairly close to the same centile line, with only 5-10% shifting centile position by more than 1 centile space\(^5\) most commonly because of measurement or plotting error\(^6\). Successive height measurements can show wide variation, because it is difficult to measure height accurately. If there are concerns it is useful to measure on a few occasions over time.

When do individual children need further assessment of growth?

1. Where weight or height or BMI is below the 0.4th centile, unless already fully investigated at an earlier age.
2. If the height centile is more than 3 centile spaces below the mid-parental centile.
3. A drop in height centile position of more than 2 centile spaces, as long as measurement error has been excluded.
4. Smaller centile falls or discrepancies between child’s centile and parents’, if seen in combination, or if associated with possible underlying disease.
5. If there are any other concerns about the child’s growth.
Adult Height Predictor

This allows you to estimate the child’s adult height based on their current height, but with a regression adjustment to allow for the tendency of very tall and short children to be less extreme in height as adults. Four children out of five will have a final adult height within ±6 cm of the 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 from the right hand scale
- 80% of children will be within ±6 cm of this value
- Scale also shown in feet and inches on left

The Mid-parental Centile Comparator

The Mid-parental Centile Comparator is on the flap to the right of the height centile chart. It is desirable and more accurate to use measured parents’ heights rather than reported heights. The ‘mid-parental centile’ is the average adult height centile to be expected for all children of these parents. It incorporates a regression adjustment to allow for the tendency of very tall and short parents to have children with less extreme heights. This means that children of very short or tall parents will have mid parental centiles nearer to average, than one might expect.

- 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

Comparing this to the child’s current height centile can help assess whether the child’s growth is proceeding as expected. The larger the discrepancy between the two, the more likely it is that the child has some sort of growth disorder.

Most children’s height centiles (nine out of ten) are within ±two centile spaces of the mid-parental centile

Mid-parental target height and family range

This can be obtained by plotting the mid-parental centile on the main chart at age 18 and reading off the corresponding height. Four children out of five will have an adult height within ±7 cm of this target height (‘80% expected range for this family’). However the predicted adult height (above) is usually closer than mid-parental target height to the child’s final height.
**Body Mass Index (BMI) centile look-up and plotting grid**

In a child over 2 years of age the BMI centile is the best indicator of thinness and fatness. The chart below allows you to read off the BMI centile, accurate to a quarter of a centile space. There is a BMI centile grid at the top of the growth chart where this centile can be plotted.

- Note the weight and height centiles from the growth chart.
- Plot the weight centile against the height centile on the chart. If between centiles, read across in this position.
- Read off the corresponding BMI centile from the red slanting lines.
- Plot the centile in the BMI grid at the top of the growth chart at the appropriate age.

**What does a high or low BMI mean?**

Most children will have a BMI between the 25th and 75th centiles, whatever their height centile. A BMI above the 91st centile suggests overweight. A child above the 98th centile is very overweight (clinically obese). BMI below the 2nd centile is unusual and may reflect undernutrition, but may simply reflect a small frame or low muscle mass. BMI can vary a lot over time due to measurement error. If there has been a change it is therefore important to check whether this reflects a real change in weight or inaccurate measurements.
Assessment of puberty using Puberty Phases

A detailed evaluation of the development of puberty may be made using the five Tanner stages, where pre-puberty is Stage 1 and maturity is Stage 5. This staging process requires user experience. A simpler system involves assessing the ‘phase’ of puberty. The Puberty Phase may be evaluated by clinical examination. However, if clinical examination is not possible or desirable, then the Puberty Phase may be ascertained through simple questions about the appearance of secondary sexual characteristics.

### Puberty Phases

<table>
<thead>
<tr>
<th>Girls</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></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</td>
<td>Any breast enlargement so</td>
<td>Started periods (menarche)</td>
</tr>
<tr>
<td></td>
<td>or breast development</td>
<td>as nipples also enlarged</td>
<td>with breast, pubic and axillary</td>
</tr>
<tr>
<td></td>
<td>No pubic hair</td>
<td>Any pubic or axillary</td>
<td>hair development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(armpit) hair growth</td>
<td></td>
</tr>
<tr>
<td>Boys</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</td>
<td>Slight deepening of the</td>
<td>Voice fully changed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>voice</td>
<td>(broken)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reddening of the scrotum</td>
<td>Adult size of penis with pubic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and growth of the testes</td>
<td>and axillary hair growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early testicular or penile</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>enlargement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early pubic or axillary</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(armpit) hair growth</td>
<td></td>
</tr>
</tbody>
</table>

### Is the timing of puberty normal?

Children with measurements plotted on the left hand page of the chart will usually be in the ‘Pre puberty’ phase. Signs of puberty before 8 years in girls and 9 years in boys are precocious and further assessment is necessary. The three vertical black lines (puberty lines) indicate the normal age limits for the phases of puberty described above.

After age 8 years children will be in either ‘Pre puberty’ or ‘In puberty’.

If there are no signs of puberty by 13 years in girls and 14 in boys, then puberty is delayed and further assessment is indicated.

After 13 years in girls and 14 in boys most young people will be either ‘In puberty’ or ‘Completing puberty’.

After 16 years in girls and 17 years in boys most will usually be ‘Completing puberty’. If this is not the case, maturation is delayed and further assessment may be needed.
Growth patterns during puberty

Assessing growth during puberty is complex because of the variation in age when puberty starts and its varying rates of progression. As a result an individual’s centile during puberty will commonly differ from the centile tracked before puberty by up to one centile space, while children with relatively late or early puberty may differ by as much as 1½ centile spaces.

What does a height in the shaded area below the 0.4th centile mean?

This chart provides some extra guidance about the lower limit (0.4th) for height in girls 8-13 years and boys 9-14 years. For young people plotting in the shaded area their mid-parental centile should be assessed.

If they are in puberty or Completing puberty, they are below the 0.4th centile and should be referred.

In most instances a Pre-pubertal young person plotted in this area is growing normally, but comparison with the mid-parental centile and growth trajectory will assist the assessment of whether further investigation is needed.

For more detailed assessment of growth in puberty use the Puberty Phase Specific Chart. These charts provide additional guidance about the range of height and weight in each phase of puberty at any given age.

References

2. www.who.int/childgrowth
4. Voss,L. and Bailey,B., Diurnal variation in stature: is stretching the answer? Archives of Disease in Childhood 77, 319-322, 1997