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Centile charts and assessing growth

What is a centile chart?

Current UK child centile charts (the UK growth charts) are available from the Royal College of Paediatrics and Child Health. There are charts for 0–4 years and 2–18 years.^[1] ^[2] ^[3]

Centile charts show the position of a measured parameter within a statistical distribution. They do not show if that parameter is normal or abnormal. They merely show how it compares with that measurement in other individuals.

They are called *centiles* and not *per centiles*. If a parameter such as height is on the 9th centile, this means that for every 100 children of that age, 9 would be expected to be shorter and 91 taller. On the 25th centile, 25 would be shorter and 75 taller.

Centile charts are very useful for plotting changing parameters such as assessing a child's height or weight over time, or head circumference of an infant or fetus. They may also be used in public health. For example, Clinical Commissioning Groups (CCGs) may show their index for coronary heart disease (CHD) or cancer as a centile to demonstrate how the local prevalence compares with the country as a whole.

Because centile charts are usually used to assess a parameter over time, they are normally presented graphically. The parameter such as height, weight or head circumference is shown on the y axis and the age or gestation on the x axis. The graph shows a number of lines representing important centiles. All paediatric growth charts now have 9 centile lines which are 0.4th, 2nd, 9th, 25th, 50th, 75th, 91st, 98th and 99.6th centiles. These charts are purely to illustrate that presentation. Note that there are different charts for boys and for girls.

Interpretation of centiles

It is dangerous to take an arbitrary figure such as the 2nd centile and to declare that anything below that is abnormal. Not only does this automatically label 2% of the population as 'abnormal' but some cases of abnormality will be missed. What matters is not so much an isolated value as changes with time.

For example, If an infant's weight stays on the same centile, they are maintaining the status quo. If their weight rises but slower than expected so that it starts to fall towards the lower centile then this is cause for concern, as there is [faltering growth](#).

Recognising childhood obesity

A child may be brought to the consultation with a complaint of being overweight. However, more often this is noticed during the consultation.

The UK Growth Charts incorporate look-up charts that can calculate the BMI centile from the height and weight centiles. A BMI above the 91st centile suggests overweight. A BMI above the 98th centile is very overweight (clinically obese). BMI below the 2nd centile may suggest a small build or may be indicative of undernutrition.^[2] ^[3]

For children of school age who are at the extremes of the normal range, various other charts are available at specialist clinics.

Management

See also the separate [Obesity in Children](#) article.

Inadequate growth^[4]

See also the separate [Faltering Growth in Children](#) article.

A child may be brought with a complaint that they are too small. Note any medical history that may suggest a cause:

- Ask about diet and eating habits and weigh and measure the child.

- Again, look at the centile charts; if the child is on a lower centile for weight than for height this may suggest poor nutrition, but a more accurate picture would be gained by more than one measurement, taken over a period of time..
- Ask the height of the parents; tall parents can expect to have tall children and short parents to have short children.

It may be that there is insufficient cause for concern to justify immediate referral to a paediatrician and a period of observation is required:

- Make serial recordings of height and weight and plot them on centile charts. If the child continues along the same centile, this is probably just constitutional smallness.
- He/she may catch up and show some rise through the centiles.
- If the child falls further through the centiles, even if gaining height and weight, this is a cause for concern and a reason to refer.

Overweight or underweight?

A child may be brought with complaints that they are overweight or underweight.

- It may be appropriate to ask the child how they feel about body size but as a clinician you should use your discretion as to whether this is appropriate.
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- Again record height and weight and check centile charts. Height and weight do not have to be on exactly the same centiles but so long as they are in the same order of magnitude, this is reassuring.
- Parents may be trying to overfeed the child but also eating disorders can start young.
- Ask the child about any teasing about weight at school.

Do not be afraid to express your opinion about whether the ratio of the child's height to weight is concerning, or whether there is no problem.

Creating centile charts

Centile charts are supposed to demonstrate the statistical scatter of the normal population. Therefore, a great many individuals must have the relevant parameter measured so that the sample size is large enough to be statistically rigorous. They are supposed to represent the normal population and so those with obvious pathology should be excluded from the data to produce the charts. This may include children with a syndrome such as [Down's syndrome](#), [Turner syndrome](#) or [achondroplasia](#). It may include those with diseases that lead to malnutrition or recurrent infection, including [coeliac disease](#) or [cystic fibrosis](#) or cyanotic [congenital heart disease](#).

Problems using centile charts

- If centile charts are based on the normal population and they are being used mostly for children with disease, who are not part of the normal population, are they valid? The answer is probably that they are the best available tool but their limitations must be remembered. There are specific reference charts for Down's syndrome and Turner syndrome.
- Very low-birth-weight babies are plotted on UK World Health Organization (WHO) Neonatal and Infant Growth Monitoring Charts. These require careful interpretation.^[5] They feature low lines to monitor unusually short or underweight children and the date box system for gestational correction.^[1]
- Are they applicable if based on one race but used in another? Variations within races are greater than variations between races and so they are probably applicable but with the usual caveats, including asking about the height of parents.

- Until 2006, growth charts were based on children with mixed feeding patterns, predominantly bottle-fed but evidence from various studies suggested that exclusively breast-fed infants gain weight differently: [6]
- The worry has been that misinterpretation of growth charts could lead to breast-fed babies being given unnecessary supplements of formula.
- This led the WHO to develop new charts for all children from 0-4 years.
- Using the new charts, normal UK infants risk being diagnosed as being on a trajectory towards childhood obesity. National estimates of obesity will have to be recalculated for previous years to allow longitudinal comparison. The use of the 91st or 98th centile on the new charts will identify many more infants as being at risk than the same centiles on the old UK90 charts. [7]
- It is now accepted that adequate training is required for the accurate interpretation of the new charts. [8]

Further reading

- [Growth reference data for 5-19 years](#); World Health Organization
- [Moon JS](#); Reappraisal of Regional Growth Charts in the Era of WHO Growth Standards. *Pediatr Gastroenterol Hepatol Nutr.* 2013 Sep;16(3):137-142. Epub 2013 Sep 30.

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Authored by:	Peer Reviewed by: Dr Colin Tidy, MRCGP	
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