

Growth Monitoring Guidelines for Children with Chronic Kidney Disease

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The scope of the guideline extends to both specialist renal units and shared care centres, including those where children are seen by non-specialist paediatricians. This guideline provides guidance on the monitoring of growth in children with CKD. Where this monitoring indicates concerns regarding growth, clinicians should manage and refer cases according to their local or regional clinical referral pathways.

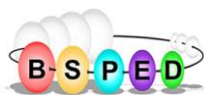
Background: Growth retardation is well recognised in children with CKD^{1,2,9,11}, even in children with mild-moderate chronic renal insufficiency^{2,11}. Short stature is associated with increased morbidity and mortality^{3,4}. A combination of regular anthropometric measurements, clinical assessment of growth and a nutritional assessment is an essential part of treatment in these children^{8,15}.

There is no direct gold standard evidence or specific UK or European consensus guidelines for monitoring the growth of children with moderate to severe renal disease. This document therefore aims to define minimum standards for measuring and monitoring growth in children with CKD, based on local expert opinion, international committee reports, and indirectly supportive peer-reviewed clinical trials and reviews. Multiple measures are necessary^{15,19} to give a broad and reliable picture of growth and nutrition, and the frequency of measurement will depend on the child's age and stage of CKD (see appendix 1). Children displaying growth delay or unstable medical or nutritional status will require more frequent monitoring²⁰, as will those with more complex social or medical problems.

The rationale for the guideline is that whilst growth is documented in a proportion of those receiving renal replacement therapy (published in the UK Renal Registry report) there is scope for improving identification of growth failure in children at an earlier stage. Identification and treatment of nutritional deficiencies and metabolic abnormalities should be aggressively pursued with respect to linear growth. Recombinant human growth hormone (rhGH) should be considered if there is growth failure despite the treatment of nutritional deficiencies and metabolic abnormalities²⁰. Supporting evidence states that response to growth hormone (rhGH) therapy is better if commenced at a younger age and lesser severity of CKD (eg stage 3 rather than end stage 4-5). The use of human growth hormone is approved by the National Institute of Health and Clinical Excellence (NICE) for children with growth failure as a result of Chronic Renal Insufficiency (also known as CKD). There are other international guidelines on growth monitoring in children with CKD (US and Australia^{13,20}). This guideline is the first UK guideline for growth monitoring in this population group of children with CKD.

The evidence base for this guideline was reviewed using the following search strategy: MeSH terms for Kidney and kidney disease were combined with MeSH terms for Children and Growth and Nutrition assessment on 11th May 2010. The Cochrane database was also searched for articles with the search terms 'kidney', 'children' and 'growth'.

These guidelines have been endorsed by The British Society for Paediatric Endocrinology and Diabetes (BSPED), The British Association for Paediatric Nephrology (BAPN) and The Paediatric Renal Interest Nutrition Group (PRING).



Growth Monitoring Guidelines for Children with Chronic Kidney Disease

GFR ml/min 1.73m ²	CKD Stage	MEASUREMENT	FREQUENCY	ACTION
> 90	Stage 1	Normal childhood growth monitoring	Royal College of Paediatrics & Child Health (RCPCH) guidelines Appendix 2	Measure [†] and plot on growth chart* Appendix 3
60-89	Stage 2	Length/height and weight	Annually ²⁰	Measure [†] and plot on growth chart*
GFR ml/min 1.73m ²	CKD Stage 3-5	MEASUREMENT	FREQUENCY (minimum recommended)	ACTION
≤ 59	All these items for Children with greater severity CKD i.e. Stages 3 - 5	Euvolaemic (normal fluid status) weight for age ^{8,10,11,13,20}	Every clinic visit	Measure [†] and plot on growth chart*
		Head circumference for age ^{10,11,20}	Every 2 months if < 1 yr	Measure and plot on standard head circumference curve on growth chart*
			Every 3 months if 1-2 yrs	
			If > 2 yrs measure only if concerns from earlier measurements	Use specific head circumference chart**
		Length/Height for age ^{8,10,11,13,20}	Every 2 months if 0-1 yr	Measure supine length if <2 years on validated length mat such as a rollametre or kiddimetre. Measure standing height if >2 years on wall-mounted stadiometer ¹¹ . Then plot on growth chart*. Sitting height, knee height or total leg length can be used as height proxies ^{5,7}
			Every 3 months if > 1 yr	
		Assess Pubertal Stage	Annually if ≥ 12 years. i.e. during the older half of the normal age range of onset of puberty in girls 8-13 years, boys 9-14 years.	Consider whether growth and development progress as expected or whether concern of pubertal delay.
Body Mass Index (BMI) ^{8,11,17,19,20}	Only applicable if > 2 years, then do so every 6 months ^{11, 19}	Calculate and plot on BMI chart*** against chronological age ²¹ or calculate BMI standard deviation score.		
Mid-parental height (or estimates such as short/medium/tall) and range	As soon after referral as possible if patient's height < 9 th centile or if height falls through 2 or more centiles	Record in case notes and/or plot on growth chart		

Notes

[†]nude for infants and in light clothing without shoes for older children. *measurements should be plotted on UK WHO 2006 growth charts for those born in or after May 2009 and on the UK 1990 growth reference charts for all born before this date (Use corrected age up to 1 year for patients born 32-37 weeks gestation. Use corrected age up to 2 years for patients born earlier than 32 weeks gestation.) **UK 1990 Head circumference chart 0-18 years. ***UK BMI Charts 0-20 years featuring healthy BMI range 2003.

Grading of Recommendations: The modified GRADE system was used to define the strength of recommendation and level of evidence supporting these guidelines²³. This highlighted two features: there was consistent evidence that growth monitoring is required in CKD, with the benefits of this clearly outweighing any risks (1B). However the frequency of measurement we recommend, in our opinion, provides significant benefits but has a weak evidence base due to a general lack of studies in this area (1D).

Appendix 1: Stages of Chronic Kidney Disease (CKD)

Stage	Glomerular Filtration Rate Values are normalized to an average surface area (size) of 1.73m ²	Description	Management
1	90+	Normal Renal Function (but urinalysis, structural abnormalities or genetic factors indicate renal disease)	Observation and control of blood pressure
2	60-89	Mildly reduced renal function (Stage 2 CKD should not be diagnosed on GFR alone - but urinalysis, structural abnormalities or genetic factors indicate renal disease)	Observation, control of blood pressure and cardiovascular risk factors
3a	45-59	Moderate decrease in renal function, with or without other evidence of kidney damage	Observation, control of blood pressure and cardiovascular risk factors
3b	30-44	Moderate decrease in renal function, with or without other evidence of kidney damage	Observation, control of blood pressure and cardiovascular risk factors
4	15-29	Severely reduced renal function	Planning for endstage renal failure
5	<15	Very severe (endstage) renal failure	Transplant / Dialysis

Plotting and assessing infants and toddlers up to age 4 years



This fact sheet covers the plotting and assessment of infants and toddlers from the age of 2 weeks onwards.

Topics in this fact sheet include ...

- ✓ Knowing how often and when to weigh
- ✓ Normal rates and variations of growth or weight gain
- ✓ Length centile changes at 2 years

When to weigh and measure

After the neonatal period and once feeding is established, babies usually need only be weighed at around 8, 12 and 16 weeks and at 1 year; at the time of routine immunisations or checks. If there is concern, weigh more often, but in general weighing at intervals too close together is misleading.

This means that well babies should be weighed *no more than*:

- ✓ once a month before 6 months
 - ✓ once per two months aged 6-12 months
 - ✓ once per 3 months over age one year
- Most children do not need to be weighed this often*

Head Circumference, Length or height should be measured:

- ✓ Whenever there are any worries about a child's weight gain, growth or general health
 - ✓ If the weight is below the 0.4th centile
 - ✓ If there is very rapid weight gain
 - ✓ If the weight is above the 99.6th centile
- For children over two calculate body mass index to help you tell whether the child is relatively over or underweight*

In addition, head circumference should be measured:

- ✓ Around birth, but measurements taken in the first 24-hours are unreliable as the head will have been subjected to moulding
- ✓ At the 8 week check
- ✓ At any time after that if there are any worries about the child's head growth or development

What is a normal rate of weight gain?

As the new charts allow for the normal slower pattern of weight gain up to age 2 weeks, on average, children will be on the same centile at 2 weeks as at birth. This is different from previous charts where children appeared to drop half a centile space between birth and 2 weeks.

After the neonatal period weights usually track within one centile space, but individual measurements often show wide variation. Acute illness may be accompanied by weight loss and weight centile fall. However, a child's weight usually returns to its previous centile within 2 to 3 weeks.

Less than 2% of infants show a sustained drop through two or more weight centile spaces on the new WHO charts. If such a drop occurs, the child should be assessed in more detail.

What is a normal rate of growth?

Length/Height

It is often difficult to get an accurate measurement of length or height in an uncooperative baby or toddler, so successive measurements commonly show wide variation. It is therefore important not to place too much reliance on single measurements or apparent changes in centile position between just two measurements. If there are worries about growth (or weight gain) it is a good idea to measure on a few occasions in order to get a sense of the child's average centile and healthy children will generally show a stable average centile position over time. If after a number of measurements there seems to be a consistent change in centile position by more than one centile space, the child should usually be assessed in more detail. All children below the 0.4th centile should be assessed by a Paediatrician at some stage even if apparently growing steadily.

Head circumference

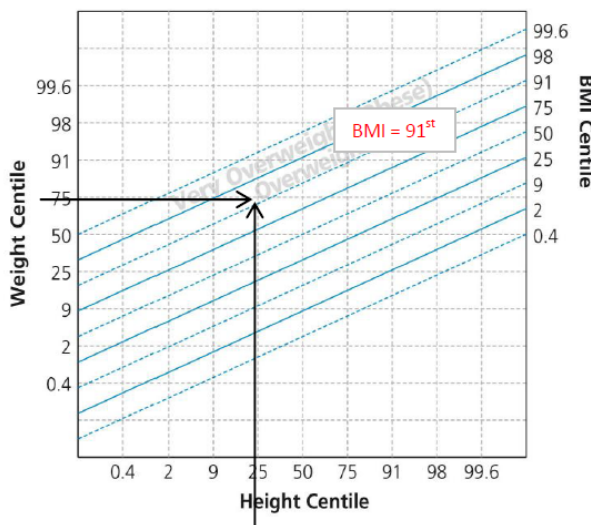
The head circumference centile may show some variation over time, but most measurements track within one centile space and fewer than 1% of infants drop or rise through more than 2 centile spaces after the first few weeks.

Very rapid head growth with upward centile crossing can be a sign of hydrocephalus or other problems while slowing of head growth, with a fall down the centiles may also be a sign of underlying problems of brain or skull growth and development.

If there is a fall or rise through 2 or more centile spaces, the child should be carefully assessed.

Body Mass Index (BMI) conversion chart

Body mass index (BMI) tells you how heavy a child is relative to their height and is the best measure of fatness and thinness from the age of 2, when height can be measured fairly accurately. The BMI conversion chart provides an approximate BMI centile accurate to a quarter of a centile space.



How to calculate and plot BMI

1. Read off the weight and height centiles from the A4 chart.
2. Plot the weight centile (left axis) against the height centile (bottom axis) on the BMI conversion chart.
3. Read off the corresponding BMI centile from the slanting lines.
4. Record the centile with the date in the data box underneath the lookup.

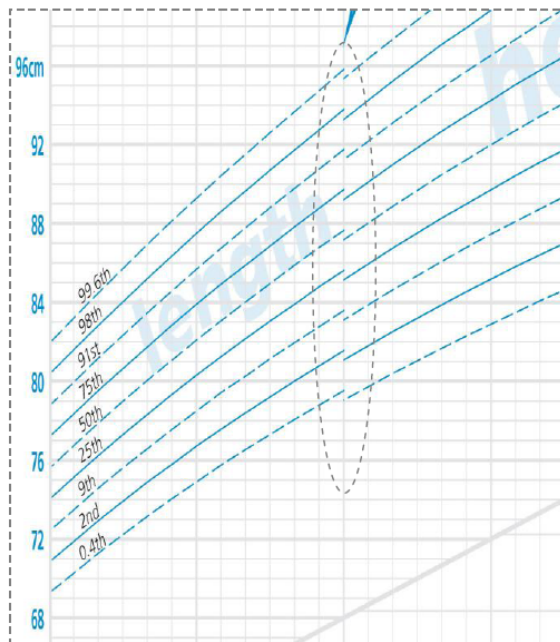
Interpreting Body Mass Index (BMI)

- A child whose weight is *average* for their height will have a BMI between the 25th and 75th centiles (whatever their height centile)
- BMI above the 91st centile suggests that the child is overweight
- BMI above the 98th centile is *very* overweight (clinically obese) and is usually associated with excess fatness

BMI below the 2nd centile is unusual and may reflect undernutrition, though it may also be seen in children with unusual body shapes, particularly if they have chronic illness or disability

Length to height change at 2 years

Measure length up to age 2, and height from then on. A child's height is usually slightly less than their length since when a child is measured standing up the spine is squashed a little compared with lying down.



The centile lines on the chart shift down slightly at age 2 to allow for this.

It is important that this transition does not worry parents; what matters is whether the child continues to follow their new centile position after the transition.

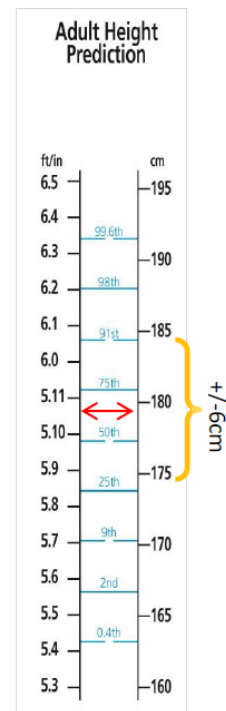
Adult height prediction

For example, if a boy's height is mid-way between the 50th and the 75th centile, the corresponding centile on the Adult Height Prediction scale (see right) suggests his adult height will be 179 cm (5 foot 10½ inches). The prediction has a range of uncertainty such that four-fifths of boys will be within plus or minus 6 cm of the predicted value. So there is a four-fifths chance that his height will be between 173 and 185 cm.

The prediction has a range of uncertainty such that four-fifths of boys will be within plus or minus 6 cm of the predicted value. So there is a four-fifths chance that his height will be between 173cm and 185cm, i.e. between 5 feet 10½ inches and 6 feet one inch.

The adult height prediction differs from the target height calculation on the UK1990 height chart.

Target height compares the child's height with those of their parents, and identifies children who are unusually tall or short compared to their parents. The adult height prediction tool provides a good prediction of adult height for most children, including those who are unusually tall or short, but it does not compare them with their parents.



Summary

Plotting and assessing infants and toddlers:

- ✓ Weigh at the time of routine immunisations / checks
- ✓ Measure length or height and head whenever concerned about weight gain, growth or development
- ✓ Any child with measurements consistently below the 0.4th centile should be assessed in more detail
- ✓ If weight is above the 99.6th centile BMI should be calculated using BMI conversion chart
- ✓ Adult height can be predicted from recent height centile using the adult height predictor

Further reading

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UK-WHO Growth Charts - Fact Sheet 3

Measuring and Plotting

This fact sheet outlines the essentials of measuring and plotting at all ages. Anyone who measures a child, plots or interprets charts should be suitably trained, or be supervised by someone qualified to do so. If you have never been formally taught, this fact sheet will introduce you to what you need to know. If you have been taught you can use it to refresh and check on your knowledge.

Topics covered in this fact sheet include:

- ✓ Measuring weight, length, height and head circumference
- ✓ Plotting measurements on the chart
- ✓ Calculating age
- ✓ Understanding centile positions

Calculating age

Age calculation errors or misplotting of age are the commonest mistakes made when plotting charts.

To prevent errors in calculating age, calculate in weeks for at least the first 6 months, then in calendar months.

When calculating **age in weeks** use a ...

- ✓ Calendar
- ✓ Date wheel

When calculating **age in calendar months** use the day of the birth date. If a child's date of birth was 23/1/10 then the child will be 9 calendar months old on 23/10/10, 10 months old on 23/11/10 and so on ...

- ✓ Remember there are 13 weeks per 3 calendar months

How to measure

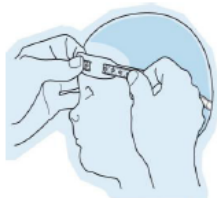
(Video clips of proper measuring technique are available at: www.growthcharts.rcpch.ac.uk)

Measuring weight

Babies should be weighed without any clothes or nappy. Children older than two years can be weighed in vest and pants, but without shoes, footwear, and any dolls or teddies in hand. Only class III clinical electronic scales in metric setting should be used, to give accurate readings.

Measuring Head circumference

Head circumference should be measured using a narrow plastic or disposable paper tape and measurement should be taken where the head circumference is widest. It is good practice to take three measurements and use the average.



Any hat or bonnet should be removed.



Measuring length and height

Proper equipment is essential for both. Always remove shoes or other footwear. Length should also be measured without nappy using a length board or mat. It is good practice to take three measurements and use the average.

- ✓ Under two years of age, measure length using a length board or mat



- ✓ Over 2 years, measure height using a rigid upright measure with a T piece or a stadiometer

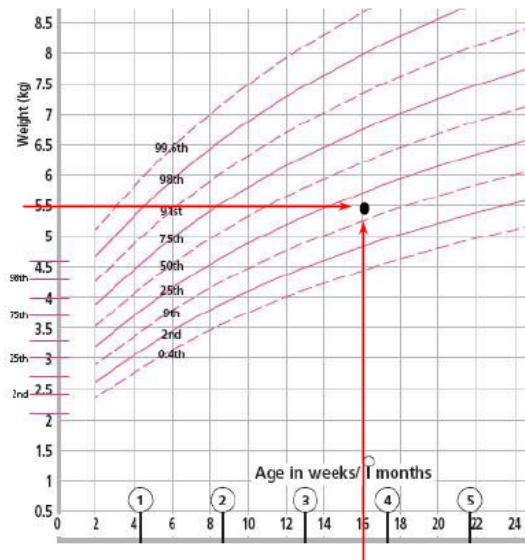


Plotting measurements on the chart

Basic plotting

Whatever measurement is being plotted an accurate calculation of age is needed.

The chart section below indicates correct plotting using age and weight. The point on the graph is marked with a small but noticeable dot • drawn with a pencil, *not an ink pen*.



This chart section also shows the plotted weight of a child who is 16 weeks old and weighs 5.5kg. This child is described as being between the 9th and 25th centile for weight.

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