

MONITORING GROWTH IN CHILDREN WITH CHRONIC KIDNEY DISEASE

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The guideline scope 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 and young people with CKD. Where this monitoring indicates growth concerns, clinicians should manage and refer cases according to their local or regional paediatric endocrine referral pathways.

Background: Growth retardation is well documented in children with CKD^{1,2,3,4}, even in children with mild-moderate chronic renal insufficiency^{2,4}. Short stature is associated with increased morbidity and mortality^{5,6}. A combination of regular anthropometric measurements, clinical assessment of growth and a nutritional assessment is an essential part of treatment in these children^{7,8}.

The guideline rationale: Data on growth monitoring in the UK Renal Registry Annual reports on children receiving renal replacement therapy is incomplete, suggesting scope to improve monitoring to identify growth failure at an earlier stage of CKD.

Evidence indicates that growth hormone (rhGH) therapy achieves a better final height outcome when commenced at a younger age and at a lesser severity of CKD (e.g. stage 3 rather than end stage 4-5)¹².

When there are linear growth concerns, the initial step remains identification and treatment of nutritional deficiencies and metabolic abnormalities. Then recombinant human growth hormone (rhGH) should be considered if there is growth failure despite the treatment of nutritional deficiencies and metabolic abnormalities¹⁰.

Growth hormone treatment for children with growth failure associated with Chronic Renal Insufficiency (also known as CKD) is approved by the National Institute of Health and Clinical Excellence (NICE). Treatment with somatropin should always be initiated and monitored by a paediatrician with specialist expertise in managing growth hormone disorders. Growth hormone prescribing is beyond the remit of this guideline whose purpose is to enhance early detection of growth problems and facilitate onward referral.

Evidence base: 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^{8,9} 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 page2). Children displaying growth delay or unstable medical or nutritional status will require more frequent monitoring¹⁰, as will those with more complex social or medical problems.

There are other international guidelines on growth monitoring in children with CKD (US and Australia^{10,13}). This guideline is the second version of a 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 10.06.2015 and repeated 28.09.2022. The Cochrane database was also searched for articles with the search terms 'kidney', 'children' and 'growth'.

Grading of Recommendations: The modified GRADE system was used to define the strength of recommendation and level of evidence supporting this guideline¹¹. 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 provides significant benefits in our opinion but has a weak evidence base due to a general lack of studies in this area(1D).

This guideline is 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).

Stages of Chronic Kidney Disease (CKD) ¹⁴			
Stage	GFR*	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 end-stage renal failure
5	<15	Very severe (end-stage) renal failure	Transplant / Dialysis

* GFR: Glomerular Filtration Rate values normalised to an average surface area (size) of 1.73m²

Notes on Growth Monitoring (measuring and plotting)

The table on the following page outlines the detail of the required growth monitoring with frequency of measurement and plotting at various ages and according to CKD stage (CKD stage defined on previous page).

Staff should be competent in measuring and plotting and use appropriate growth charts. The Royal College of Paediatrics and Child Health (RCPCH) provides education and training information for healthcare professionals. Along with currently available UK-WHO growth charts, training guides can be found at www.rcpch.ac.uk/growthcharts¹⁵. Items to note are:

- Measure infants nude and older children in light clothing and without shoes.
- 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.
- Measurements should be plotted on UK WHO 0-4 (2009) and UK 2-18 (2013) growth charts
- Or if there are clinical concerns requiring close growth monitoring, the following are useful:
 - a) In children < 2 years: the UK-WHO Neonatal and Close Monitoring (NICM) charts (2009).
 - b) Childhood and puberty close monitoring (CPCM) growth charts UK 2-20yr (2013) (These are available but not yet widely adopted, and include puberty phase specific centile lines.
 - c) Use additional condition specific growth charts where appropriate, eg Trisomy 21.

Notes regarding onward referral

The guideline focusses on the monitoring of growth. This guideline does not quote absolute referral criteria. This is consistent with current RCPCH Growth Monitoring Guidelines, as there is no evidence based criteria as to what cut-off constitutes poor growth in all children.

Within the renal arena, there are differing thresholds in three nations recommendations (US takes height less than or equal to 2nd centile as the cut-off¹⁰, Australia uses 25th centile¹², whilst NICE UK outlines to consider GH in CRI for 'growth failure'¹⁶, a term which is not quantified in that guideline). These highlight the lack of firm evidence base.

The importance is for the clinician to accurately monitor and chart a child's growth to enable the clinician to identify whether the growth is optimal or not and for the clinician to consider next steps.

This guideline's pragmatic suggestion is for the clinician to consider paediatric endocrine referral if:

- **growth is slowing (crossing height centiles or height velocity < 25th centile)**
- **or child's height centile is beneath the mid-parental height range.**

Investigations to undertake prior to referral include: nutritional assessment by renal dietician, bloods to include TFTs, IGF-I, coeliac screen and bone age Xray.

Growth Monitoring Timetable for Children with Chronic Kidney Disease

GFR ml/min 1.73m ²	CKD Stage	MEASUREMENT	FREQUENCY OF MEASUREMENT	ACTION
> 90	Stage 1	Normal childhood growth monitoring	Which is opportunistically, i.e. at clinic appointments, as per RCPCH guidance.	Measure, document and plot on growth chart.
60-89	Stage 2	Length/height and weight	Annually ¹⁰	Measure, document and plot on growth chart
GFR ml/min 1.73m ²	CKD Stage 3-5	MEASUREMENT	FREQUENCY OF MEASUREMENT (minimum recommended)	ACTION
≤ 59	All these items for Children with greater severity CKD i.e. Stages 3 - 5	Weight (Euvolaemic i.e normal fluid status, as from a growth monitoring perspective it is unhelpful to plot oedematous weights on growth chart, could plot estimated dry weight) ^{4,7,13,10,17}	Measure every clinic visit but for growth purposes required: Every month if aged < 6 months Every 2 months if 6-12 months Every 3 months if >1 yr	Measure, document and plot on growth chart
		Head circumference ^{4,10,16}	Every 2 months if < 1 yr	Measure, document and plot on standard head circumference curve on growth chart.
			Every 3 months if 1-2 yrs	
		Length/Height ^{4,7,10,13,16}	Every 2 months if 0-1 yr	Measure supine length if <2 years on validated length mat ie. rollametre or kiddimetre. Measure standing height if >2 years on wall-mounted stadiometer ⁴ . Document and plot on growth chart. Sitting height, knee height or total leg length can be used as height proxies ^{18,19} .
			Every 3 months if > 1 yr (Do not plot height on chart more often than this, as it can give a visually confusing picture of growth trajectory).	
		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 is as expected or whether concern of pubertal delay. Consider using CPCM Chart. If concerns assess six monthly.
Body Mass Index (BMI) ^{4,7,9,10,19}	Only applicable if > 2 years, then do so every 6 months ^{4,20}	Calculate and plot on growth chart (UK 2-18 yrs) against chronological age ²¹		
Parental heights	At commencement of growth monitoring.	Calculate Mid-parental height using information on growth chart. Document in notes and on growth chart		

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