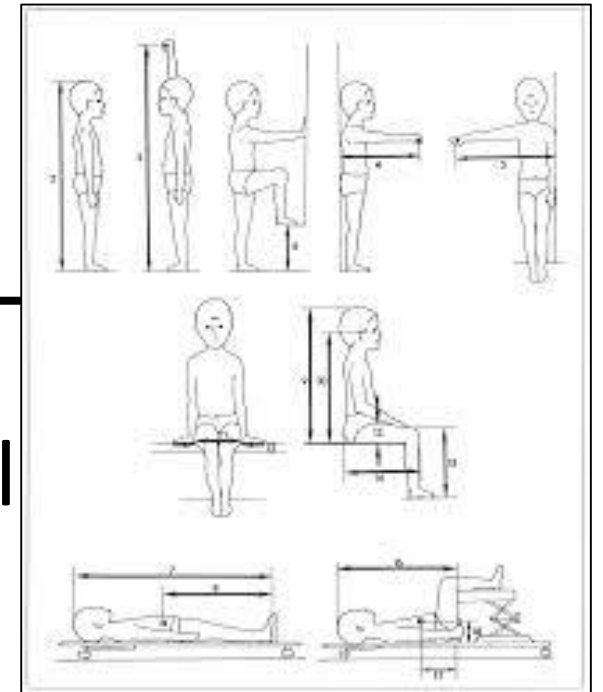
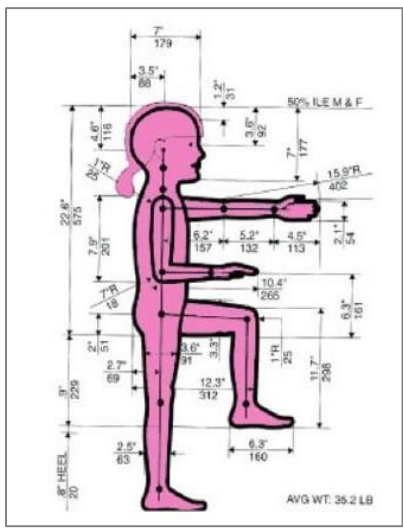


Anthropometric Measurements in Paediatrics

- Do's and Don'ts

Roslyn Tarrant RD, PhD
Coombe Women & Infants University Hospital
Dublin 8
Tuesday October 15th 2019





Anthropometry

‘Defined as the measurement of the human body’

‘....it is a simple reliable method for quantifying body size & proportions by measuring body weight, length, width, circumference, & skinfold thickness’

Assessment of Nutritional Status

1. First Line/Basic Assessment

Nutrient Intake

Clinical
Assessment

Anthropometry

2. Second Line Tests

Biochemistry

Haematology

Image adapted from Shaw & Lawson
(2007) Clinical Paediatric Dietetics

Importance of Anthropometry in Paediatrics



Background (1)

Body Weight

Informs the clinical picture =>

- Diagnosing (e.g. faltering growth in infants, NICE 2017; growth disorders)
- Monitoring growth/progress
- Nutritional status

Accurate measurement required when calculating:

- Macro/micro-nutrient requirements
- Medication/anaesthetic doses
- Fluid requirements

Background (2)

Height/Length

- Necessary for tracking growth & development in children
- Needed to calculate body mass index (BMI) - one of the most widely used screening tools to monitor nutritional status

Waist Circumference

- ...is a predictor of insulin resistance syndrome in children & adolescents – correlates highly with $\uparrow^{\text{ed}}$ metabolic risk factors for CVD & T2DM (Hirschler *et al.*, 2005)

Hirschler *et al.*, (2005) *Arch Pediatr Adolesc Med.* 159(8):740-744.

Background (3)

BMI (in > 2yr olds) – A useful measure of :

- Nutritional risk - & used in paed. screening tools (e.g. PYMS)
- Clinical/surgical risk e.g. complications post surgery
- Predictor of mortality & morbidity from chronic health issues related to being overweight/obese
- Used to define & diagnose childhood obesity/overweight
- Key parameter when monitoring the effects of dietary intervention

Anthropometry in Paediatrics - Do's...

* For all anthropometric procedures – firstly, explain the process to the parent & child





Be Aware of ...

- All the anthropometric measurements used in paediatrics
- Indications for using each measurement
- Limitations of each
- Practicalities in clinical practice
- Correct technique – formal training/accuracy
- Recommendations on how frequent to measure (healthy/sick)
- Equipment
- How to interpret data?

Measurement	Derived Indices	Points to Note
Body weight	Weight for age Weight for age z-score	Easy to measure Useful in everyday clinical practice Does not differentiate between lean tissue, body fat & oedema
Length/height	Length/height for age Length/height z score Height age	Difficult to accurately measure Needs more than one person to measure Does not change rapidly Best overall indicator of nutritional wellbeing
BMI		BMI indicates relative weight for height, but does not differentiate between lean and fat tissue
Waist circumference	Waist circumference for age	Easy to measure; requires removal of clothes Distinguishes between high weight due to muscle bulk/fat
Head circumference	Head circumference for age	Easy to measure; useful up to the age of 2yrs; useful as a proxy of length increase; does not normally change rapidly; affected by medical condition; may not indicate nutritional status
Mid arm circumference	Mid arm circumference for age Mid arm circumference z score	Easy to measure; useful to the age of 5 yrs; less likely to be affected by water retention or fat deposition than body weight
Skinfold thickness	Tricept SFT for age	Difficult to measure accurately; unpleasant procedure for children; usually triceps are only used in children; distinguishes between lean and fat tissue

Improving Accuracy – Minimising Error

(Daly *et al.*, 1991)

- In assessing growth – accuracy is key
- Accuracy can be improved by minimising:

Instrument variation – use of approp. equipment/calibrated

Subject variation – take m'ments $\approx$ same time of day/similar conditions,
& standardising methods/training

Observer variation – errors $\downarrow^{\text{ed}}$ by standardisation of methods/training

Body Weight

(1) Technique

INDI Nutrition Support Reference Guide
(2015); HSE (2012)

Infants & toddlers (< 2yrs)

- Weigh nude ideally & without a nappy – scales placed on a hard surface
- Ideally - weight at the same time of day/consistently either before/after feed
- Record if weight was taken with/without a nappy

Children (> 2 yrs)

Ideally, should be weighed in vest & pants, but no shoes, footwear, dolls or teddies in hand

- For unsettled young children, consider taking parent's weight 1st, then weigh both parent & child together – subtract parent's weight from the total weight

Body Weight

(2) Equipment/Technique



Equipment/technique

- Scales should meet EC standards (Directive 90/384/EEC)
- Only Grade 3 clinical electronic scales in metric setting should be used – green sticker with background letter M (which means approved for medical use)
- Weigh in kg and g
- Calibrate & service equipment regularly
 - SECA recommend a service annually to ensure accurate readings
https://www.seca.com/en_gb.html



Body Weight

(3) Expected Weight Gain

In term infants, birth weight:

- doubles by 6 months
- triples by 1 year

Expected Weight Gain

First 3 months	200g/week
Second 3 months	150g/week
Third 3 months	100g/week
Fourth 3 months	50-75g/week
1-2 years	2.5kg over the year
Each year of age thereafter until puberty	2-3kg per year

Assess Serial Measurements over Time



- Weight usually tracks within one centile
- A measurement pattern **over time** is what is most important
- Small dips – avoid focussing/being overly concerned about one-off dips
- Short period of wt. loss, followed by rapid catch-up, happens quite often if the baby has a viral illness/gastroenteritis/resp. infection
- Continuous weight loss is a cause of concern – needs r/v
- Referrals should be considered when there are ≥ 2 readings of concern with an appropriate time interval between m'ments (e.g. 2 wks if $< 3\text{mo}$)

Body Weight

(4) Frequency

In healthy term infants, weight measurements should be taken:

- At birth; then again at 6-8 weeks check with GP/Paediatrician or as needed
- At each PHN developmental check/opportunistic times e.g. immunisations
- School entry

In hospitalised sick infants:

- On admission
- Daily if there are issues with fluid balance/related concerns
- Otherwise, twice weekly weights is recommended (or alternate days)

NICE Guidelines on Faltering Growth (2017) - weekly from 1-6 months, fortnightly from 6-12 months, monthly from 1 year

Height/Length

1. Frequency

In healthy infants, length may be measured:

- At birth; the 72 hour visit by the PHN; 2 week check with the GP/practice nurse; 6 week check with GP/practice nurse
- At each PHN developmental check up to the age of 2 years

In sick infants, inpatients = measure weekly

In older children - if there are any concerns about growth/wt. gain – consider more frequent measures

HSE (2018) 'Your Child's Growth, Weight and Length'; INDI Nutrition Support Reference Guide (2015)

Height/Length

2. Equipment/Technique

For < 2 yrs

- Supine length is measured using a length board (infantometer) or baby mat
- Ideally – measuring length without a nappy or footwear
- Length measures for measuring preterm infants in incubators are available (Leicester Incubator Measure – measures up to 44cm)

For > 2 yrs or whenever a child can stand straight & unsupported

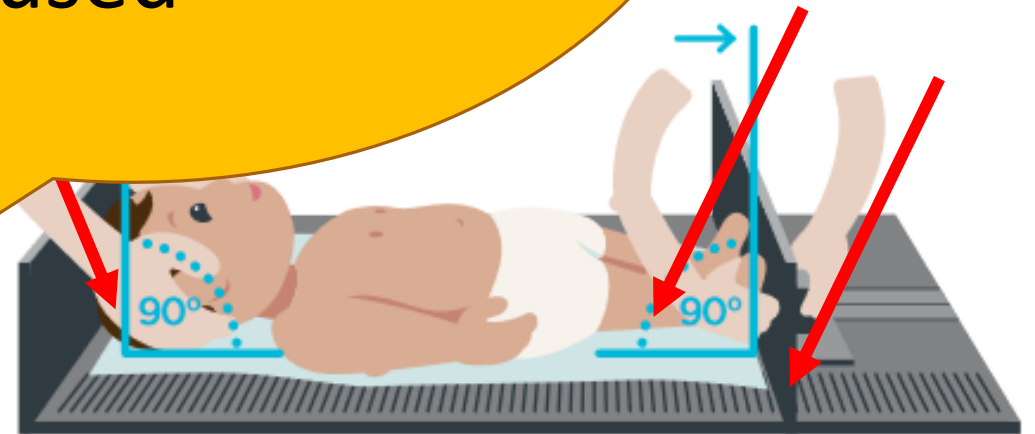
- Measure standing height using a stadiometer
- Good practice to take an average of 3 separate consecutive m'ments
- If a child is aged 2 yrs or older & cannot stand, measure supine length & **subtract 0.7cm** to convert to height (WHO 2008)

Measuring Length (< 2yrs)

- Two people are required to measure length in infants
- E.g. measurer & parent
 - Record to nearest 0.1cm



When measuring length, tape measures are inaccurate & should not be used



4.

Apply firm pressure to the child's feet and knees. The child's feet should be at right angles to the base of the board.

5.

Read the length to the nearest complete millimetre (do not round up!)

6.

Plot the length measurement on the relevant chart and include in the child's medical record.

accurately measuring
of a child

for children under 2 years,

correct measurement.

3.

Hold the child's knees and feet so they are together and flat against the board.

Measuring Height (> 2yrs)

- Ensure the Child is in the Correct Position
- Shoes must be removed
- Heels, bottom, back & head are touching the apparatus
- Eyes & ears at 90°
- Measure on the expiration

Guide to accurately measuring the height of a child

Standing height measurement is appropriate for most children 2 years, and older.

1.

The child should stand barefoot, with heels together, legs straight and shoulders relaxed.

2.

Heels, buttocks and, if possible, scapulae should be against the wall.

3.

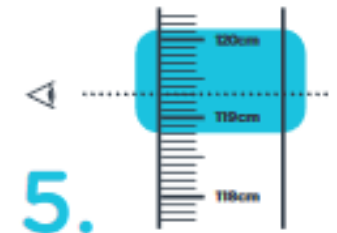
Position the headboard on the child's head and check that the child is looking straight ahead, with the lower margins of their eyes in the same horizontal plane as their ear canal.

4.



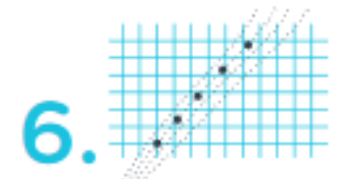
Tell the child to 'breathe in and stand tall'. Apply gentle but firm pressure to help the child stretch. Ensure the heels are not lifted from the ground. Tell the child to 'breathe out and relax' while the measurer maintains pressure on the head.

5.



Read the height to the last complete millimetre (do not round up!) Read from the same height as the top of the head.

6.



Plot the height measurement on the standard centile chart of height for age and sex and include in the child's medical record.

Height/Length

3. Expected Longitudinal Growth

Expected Longitudinal Growth (Shaw & Lawson 2007)

1 st year*	25cm/year
2 nd year	12cm/year
3 rd year +	6-10cm/year until growth spurt at puberty

*After the 1st month, approx. length increase of 2.5-3cm per month (HSE ([2018] 'Your Child's Growth, Weight and Length')

4. Consider Calculating Mid-Parental Height...

- If the child's ht. appears **disproportionate** to the adult ht's of his/her biological parents
- Helps to assess if the child's growth is proceeding as expected
- If either parent is not of normal stature – not appropriate to use
- Need to accurately check the ht. of both biological parents

5. Length/Height - Not Always Possible to Obtain

- Spinal deformity e.g. scoliosis, kyphosis; those unable to stand, CP
- Several proxy measures to monitor longitudinal growth

1. Knee Height – the preferred proxy measure of length/height as it has been shown to have the lowest level of technical error

- Serial m'ments of knee height may be useful to assess growth in those unable to stand (Hardy *et al.*, 2018)

2. Upper Arm Length - a reliable indicator to estimate stature in children aged 4-6.92yrs (Banik *et al.*, 2010)

3. Lower Leg Length/Tibial Length

Proxy Measure of Height

1. Knee Height

1. Measured with the child sitting down & the knee & ankle bent to 90°
2. On the left side, or least affected side, - using a sliding caliper – measure the distance between the heel to the superior surface of the knee over the femoral condyle
3. Two measurements should be taken & averaged
4. Doc. which limb the measurement was taken, & consistently use for subsequent measures



Figure 3. Measurement of knee height.

Knee Height (KH)

Estimate of Stature (S) in cm

(Samson-Fang & Bell (2013) Eur J Clin Nutr 67:S5-S8.)

Children up to 12yrs

$$S = (2.69 \times KH) + 24.2$$

White boys 6-18yrs

$$S = (2.22 \times KH) + 40.54$$

Black boys 6-18yrs

$$S = (2.18 \times KH) + 39.60$$

White girls 6-18yrs

$$S = (2.15 \times KH) + 43.21$$

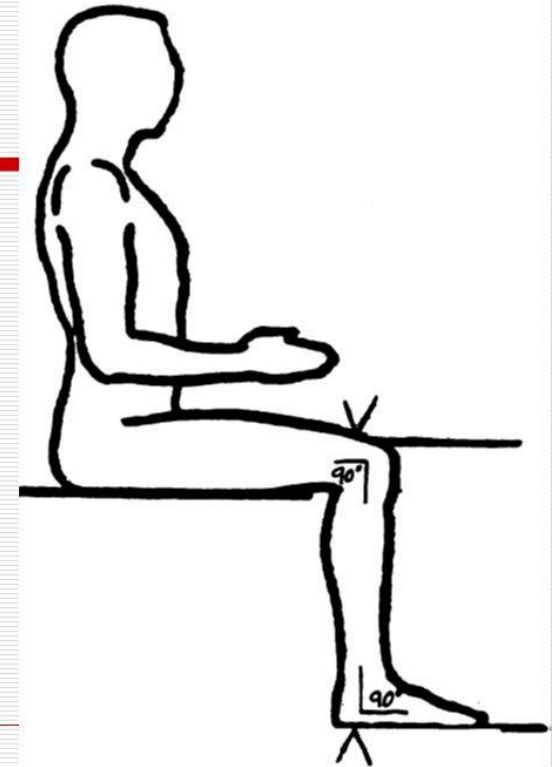
Black girls 6-18yrs

$$S = (2.02 \times KH) + 46.59$$

Knee Height



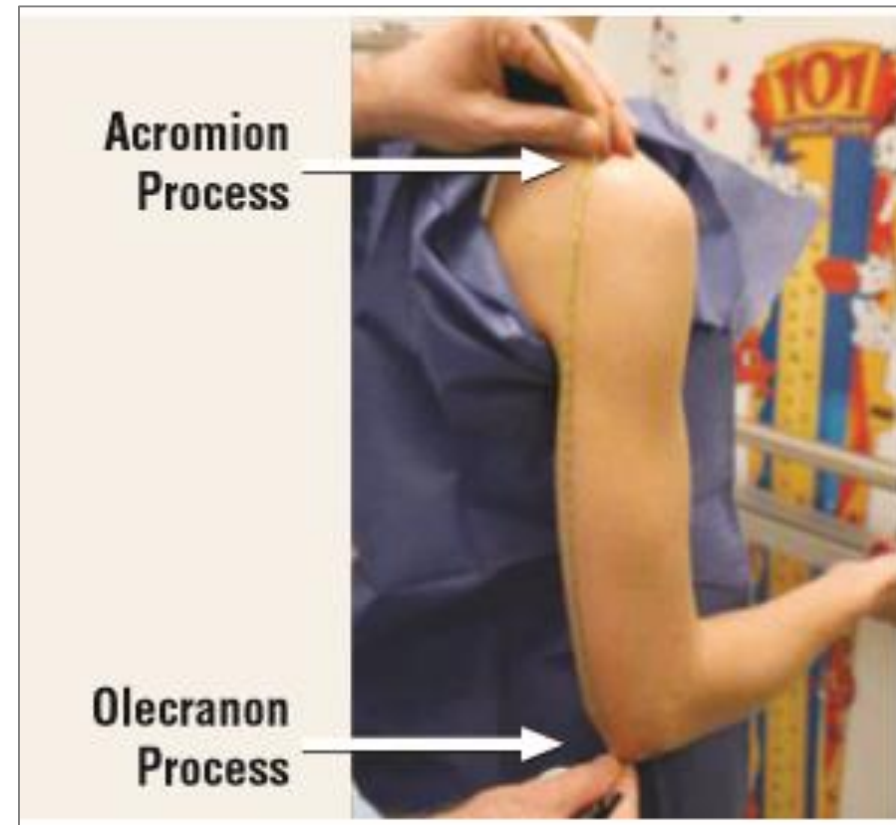
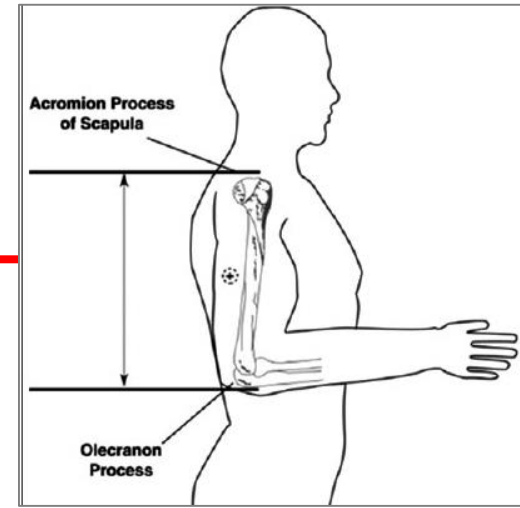
Sliding Scale Calipers



Proxy measure of height

2. Upper Arm Length (UAL)

1. Face the child away from the measurer
2. Measure the right or least affected side
3. Bend the right arm at a 90° angle at the elbow with the right palm facing up
4. UAL is measured posteriorly from the Acromion Process to the head of the radius (Olecranon Process)
- Measure to the nearest 0.1cm & record
5. For accuracy, best to use an anthropometer (take average of 2 m'ments)



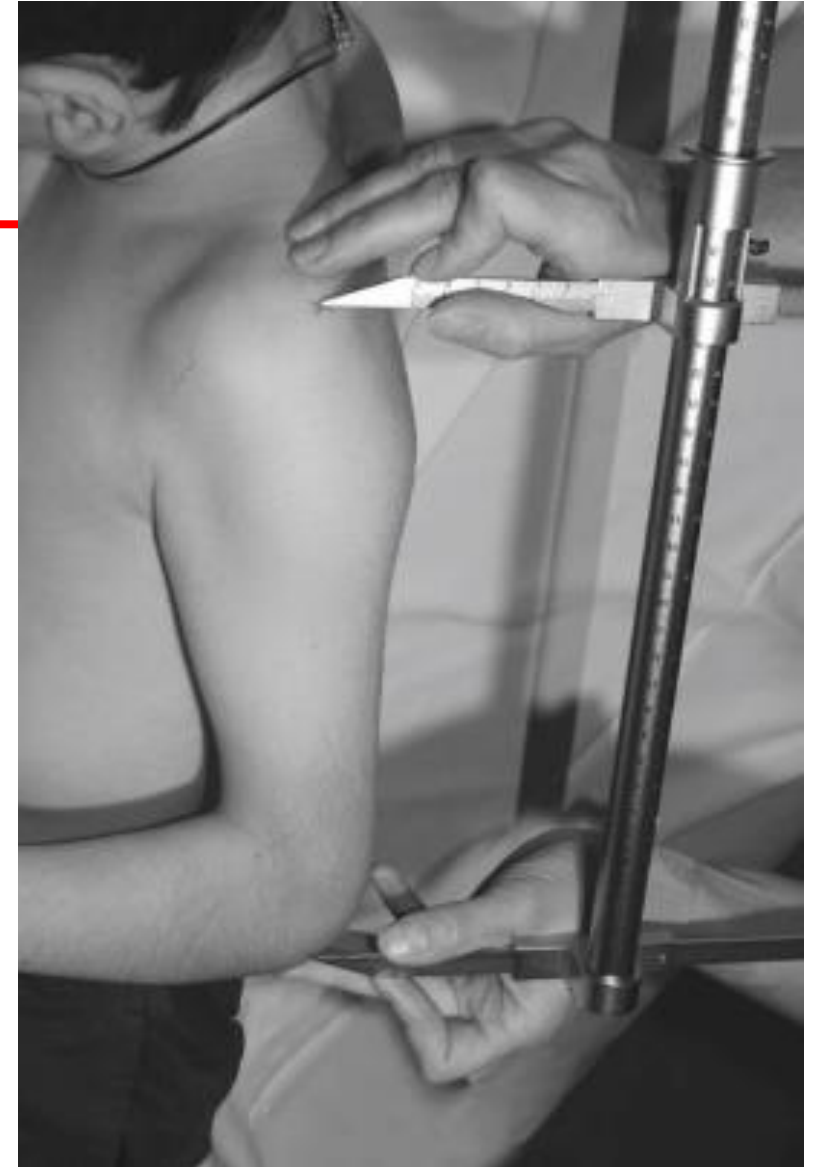
Upper Arm Length (UAL) Estimate of Stature (cm)

This measurement can be converted into a height measure & plotted on a normal growth chart, using the following formula:

$$\text{Stature} = (4.35 \times \text{UAL}) + 21.8$$

The technical error is +/- 1.7cm

(Samson-Fang & Bell [2013] Eur J Clin Nutr S5-S8)



Head Circumference (HC)

(or..Occipito-Frontal Circumference = OFC)

- HC is a simple, inexpensive & easily accessible tool for monitoring brain development & identifying infants at risk of neurodevelopmental disorders (Garcia-Alix et al., 2004)
- HC usually tracks within one centile space (HSE, 2012)
- Frequency of measurement recommended at: (HSE, 2018):
 - ≈ the time of birth
 - 6 week check with GP
 - 3 month developmental assessment with PHN

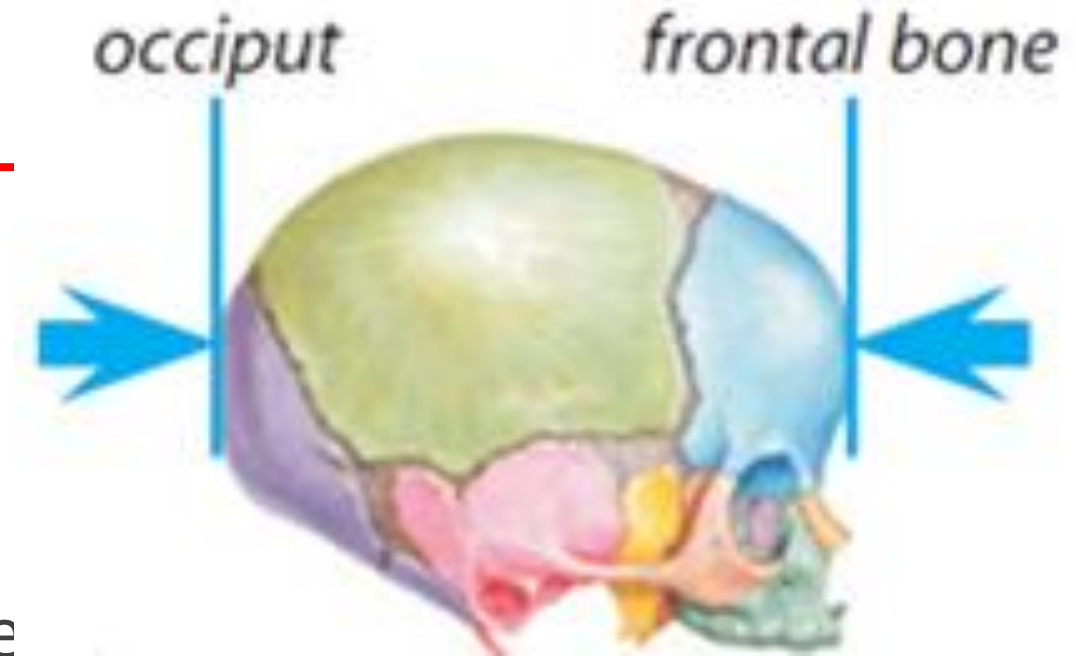
HC – How to Measure?

1. HC is measured using a narrow, flexible, non-stretch plastic or disposable lasso tape

*Do not use stretchy tape

2. Measurement should be made just above the eyes to include the maximum circumference of the head, with the child supported in an upright position and looking straight ahead

3. Record measurement to the nearest 0.1cm; use average of 3 consecutive m'ments



Body Mass Index (BMI)

$$\text{weight (kg)/height (m)}^2 = \text{kg/m}^2$$

- Simplest measure of thinness & fatness from age of 2 yrs (HSE, 2012)
- BMI is only meaningful when plotted correctly on age & sex specific centile charts
- BMI does not differentiate between well between heaviness due to lean tissue vs. excess fat deposition
- Should be interpreted with caution
- Waist circumference measurement is useful – a high BMI coupled with a high waist circumference will confirm fatness more conclusively

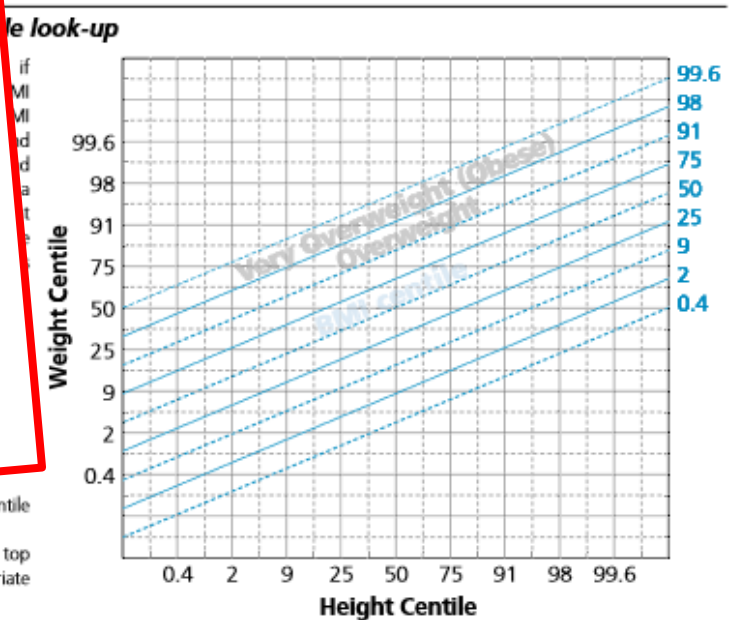
associated with possible underlying disease.
 • If there are any other concerns about the child's growth.

simply using this chart for plotting growth data, it does a number of new features which you may wish to help interpret the data.

precocious and runner
 If the point is within 1/4 of a space of the line they are on the centile: e.g. 91st

Small BMI Look-Up Chart - no calculation required

Helps to detect if the child is falling into the overweight/obese range
 BMI > 91st centile = suggests overweight
 BMI > 98th centile = clinically obese
 - BMI < 2nd centile = can detect undernutrition



by placing a small dot where a line through the child's age crosses a horizontal line the measured value.
 ing on the charts ('weight', 'length' etc.) sits on the line to provide orientation.

Centile plotting scale
 starts at age 2 years, but there is a plotting scale on the chart where for term infants, birth weight (and length) can be plotted to allow comparison of centile with later growth.

Mid-parental target height
 This can be obtained by plotting the mid-parental centile on the main chart at age 18 and reading off the corresponding height. Four boys out of five will have an adult height within ± 7 cm of this target height. However the predicted adult height (above) is usually closer than mid-parental target

4. Read off the corresponding BMI centile from the blue slanting lines.
5. 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?

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 build.

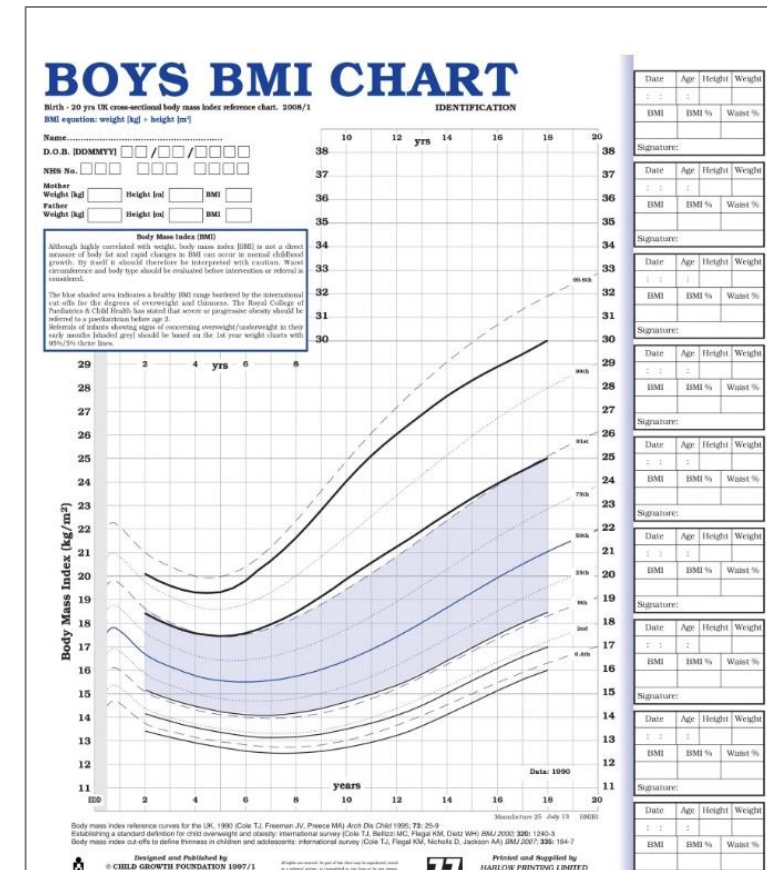
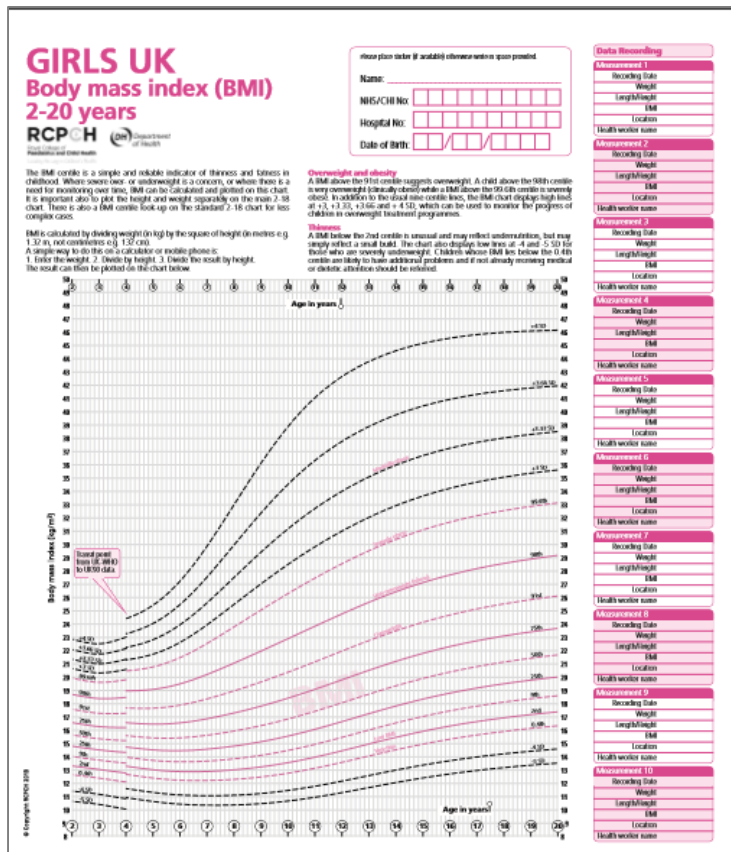
References

1. Freeman JV, Cole TJ, Chinn S, Jones PRM, White EM, Preece MA. Cross sectional stature and weight reference curves for the UK, 1990. Arch Dis Child 1995; 73:17-24.
 2. www.who.int/chidgrowth/en
- For further relevant references see fact sheet downloadable from www.growthcharts.RCPCH.ac.uk

For More Accurate Assessment of BMI

New BMI Charts (2-20yrs) based on WHO data & UK 1990 (4-20 year) data

UK (1990) BMI Charts - 6 months-20 years



Waist Circumference (WC)

- a useful tool to identify central obesity

- An indirect measure of central adiposity
- Easy, simple measure with inexpensive equipment
- Has a low observer error, offers good reliability & validity¹
- Can help distinguish between a ↑ weight for age that is caused by ↑ body lean tissue or ↑ body fat

¹Lobstein, Baur et al., (2004) Obes Rev 5 Suppl 1: 4-104.

SHORT COMMUNICATION

What is the best way to measure waist circumference?

MARY C. J. RUDOLF¹, JENNY WALKER² & TIM J. COLE³

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Abstract

Waist circumference is a measure of potential value in paediatrics, given its relation to cardiovascular risk in adults. However, three different methods of measurement are currently in use, giving potential for confusion. This study was undertaken to assess consistency across the measures in a population of overweight and normal weight children. We found that when expressed as standard deviation score (SDS) on the British 1990 reference, all three methods correlated highly with body mass index standard deviation score (BMI SDS); however, there was bias and variability between the measures. Based on ease of measurement, the site 4 cm above the umbilicus was the most convenient. This method was also endorsed by children's views. We therefore recommend that 4 cm above the umbilicus is adopted for clinical use until such time as the methods are verified against the gold standard of visceral fat, as measured by magnetic resonance imaging scan.

Key words: *Waist circumference, abdominal girth, waist measurement*

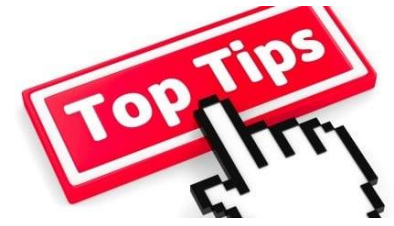
Introduction

undertook a study to assess the consistency be-

How to Measure Waist Circumference ?

➤ The waist is defined as the mid-way point between the lowest rib cage & the iliac crest –
& should be measured preferably with a special tension tape





Anthropometric Tape

(National Institute for Health Research UK)

Any Anthropometric tape used should be:

- Flexible
- Non-extensible
- Metal tapes are preferable to plastic-coated fabric tapes, which can stretch with use over time (↑^{ing} measurement error risk)
- Ideally should be narrow & have a blank space at the beginning of the tape
- Clean with a disinfectant wipe, you must dry the length of the tape with a hand tissue before allowing the tape to retract

E.g. Lufkin Executive Thinline Tapes

- 2 meters; code: W606PM
- Can buy on Amazon





How to Measure WC?

- Child wears only underclothes ideally; feet together
- Weight evenly distributed with arms relaxed
- Breathing normally - take the waist measurement at the end of a normal expiration
- If wearing a shirt or vest, deduct 1cm before recording & plotting the measurement
- Before reading the tape measure, ensure that it is snug but does not compress the skin, & is parallel to the floor
- Measure to the nearest 0.1cm (1mm); take an average of 3 m'ments

UK90 BMI Identification Chart

Harlow Printing

<https://www.healthforallchildren.com/shop-base/shop/growth-charts/uk90-bmi-identification-charts/>

- £30 for 100 charts

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

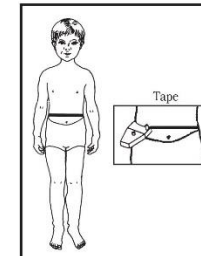
Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

Date	Age	Height	Weight
:	:	:	:
BMI	BMI %	Waist %	
Signature:			

BOYS WAIST CIRCUMFERENCE

D.O.B. [DDMMYY] / /



Because a high BMI by itself may not be a guarantor of obesity/overweight, a high waist centile added to a high BMI centile will confirm fatness more conclusively. The shaded area represents a healthy waist range.

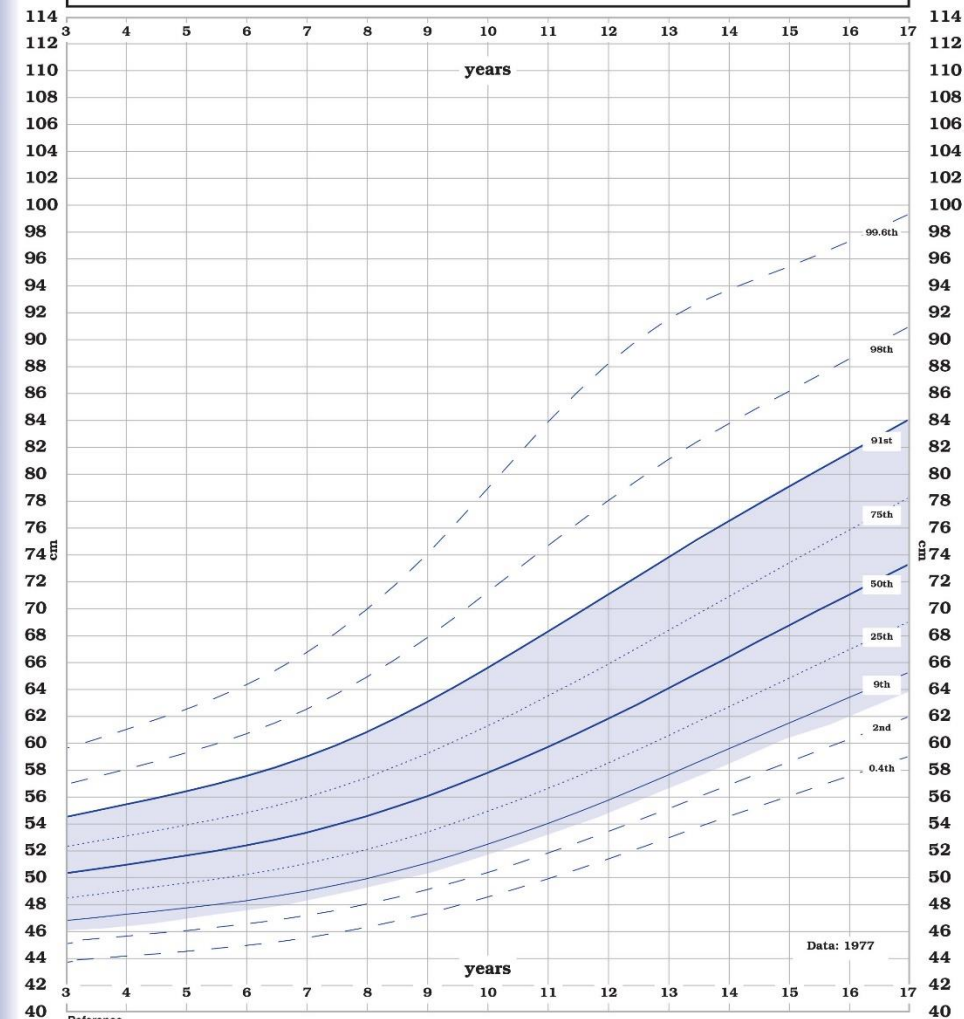
Measuring the Waist

The waist is defined as the mid-way point between the lowest rib cage and the iliac crest and should be measured, preferably, with a special tension tape [see illustrations below].

When measuring his waist, the boy should ideally be wearing only underclothes. Ask him to stand with his feet together and weight evenly distributed with his arms relaxed. Ask him to breathe normally and take the waist measurement at the end of a normal expiration.

The waist can also be identified by asking him to bend to one side. Measurement is taken at the point of flexure. If he is wearing a shirt or vest, deduct 1cm before recording and plotting the waist measurement.

There is no consensus about how to define paediatric obesity using waist measurement. For clinical use the 99.6th or 98th centiles are suggested cut-offs for obesity and the 91st centile for overweight, like the BMI [see chart overleaf].

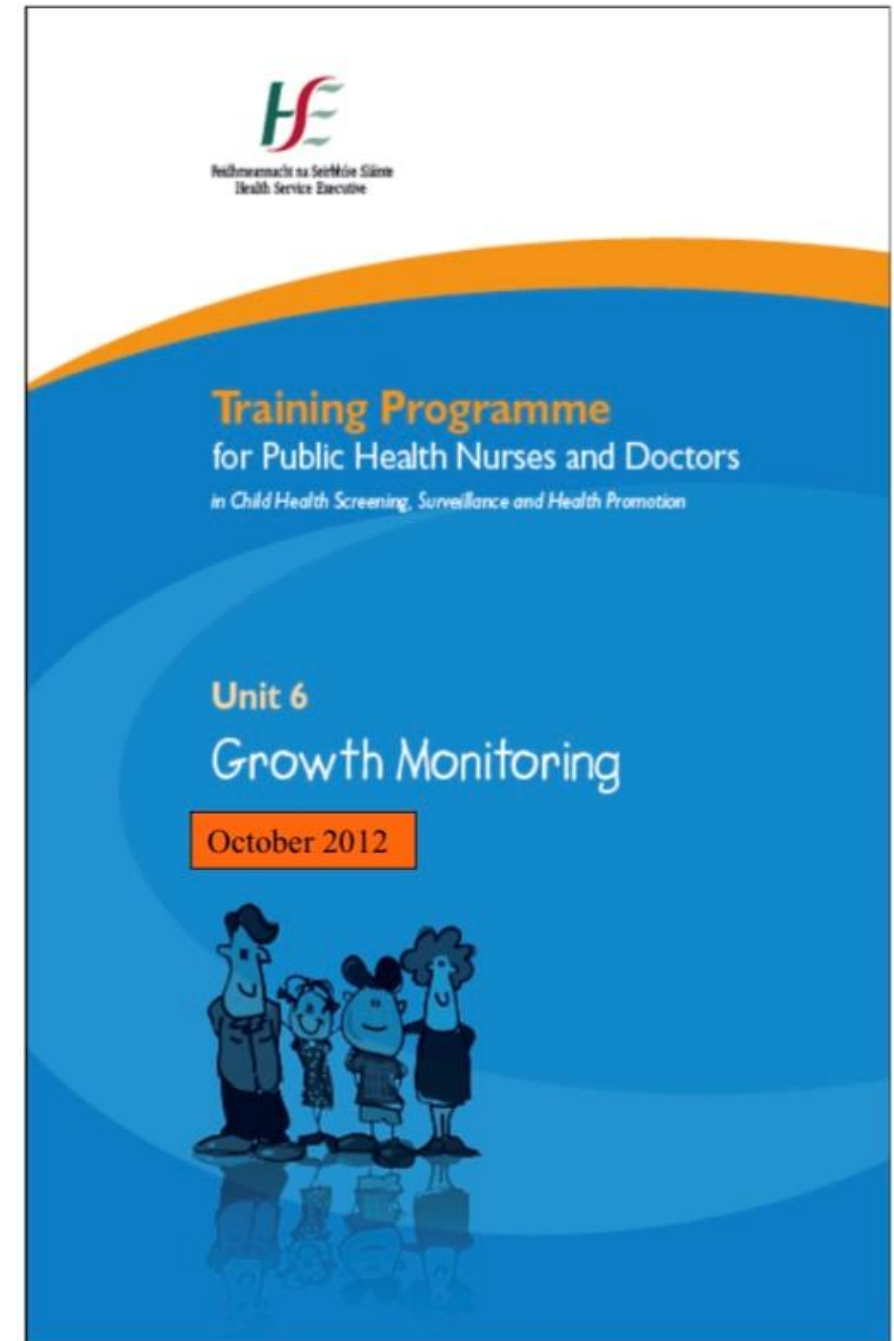


Reference
The development of waist circumference percentiles in British children aged 5-16.9 yrs: (McCarthy HD et al) *European Journal of Clinical Nutrition* (2001); 55: 902-907.

Growth Charts

Do's and Don'ts.....

<https://www.hse.ie/eng/health/child/growthmonitoring/#charts>



Growth Charts

Do's....

- Accurately plot weight & height/length on appropriate age & gender-specific growth charts
- Know what growth chart to use
- & the growth charts recommended by the HSE (2012) by age group

- Term infants (≥ 37 wks) – use UK-WHO 0-4 yrs
- Preterm infants 32-36 weeks gestation –
 - plot in 'Preterm Section' of the UK-WHO 0-4 years chart, until 42 weeks gestation
- Use the Neonatal & Infant Close Monitoring (NICM) LBW chart
 - For infants < 32 weeks
 - For any (sick) neonate needing close monitoring
 - After 2 years corrected age, UK-WHO 0-4 years charts can be used

For Children > 4 years:

- New growth charts will be constructed based on data-generated centiles derived from Irish reference data of the 1980s (Hoey H, Tanner J & Cox L, 1987) to merge with younger child charts
- 'As an interim measure until these new charts are available, the UK growth charts 2-18yrs will be used to assess growth in children over 4 years up to 18 years old'
- For now, in > 4 year olds - use UK-WHO 2-18 year old charts

Growth Charts & Plotting

Check if time increments are in months, weeks, or decimal age

- Plot all term infants (37 or more weeks) at term (age 0)
- Infants born < 37 wks gestation are 'preterm'
- Only correct for gestational age in preterm infants (not term)
- For infants born 32-36 weeks – correct to 1 year of age
- For infants born before 32 weeks, correct to 2 years of age
- Corrected age: chronological age minus the number of weeks born before 40 wks of gestation
- For consistency & to standardise practice – get team agreement

Where to Access Growth Charts?

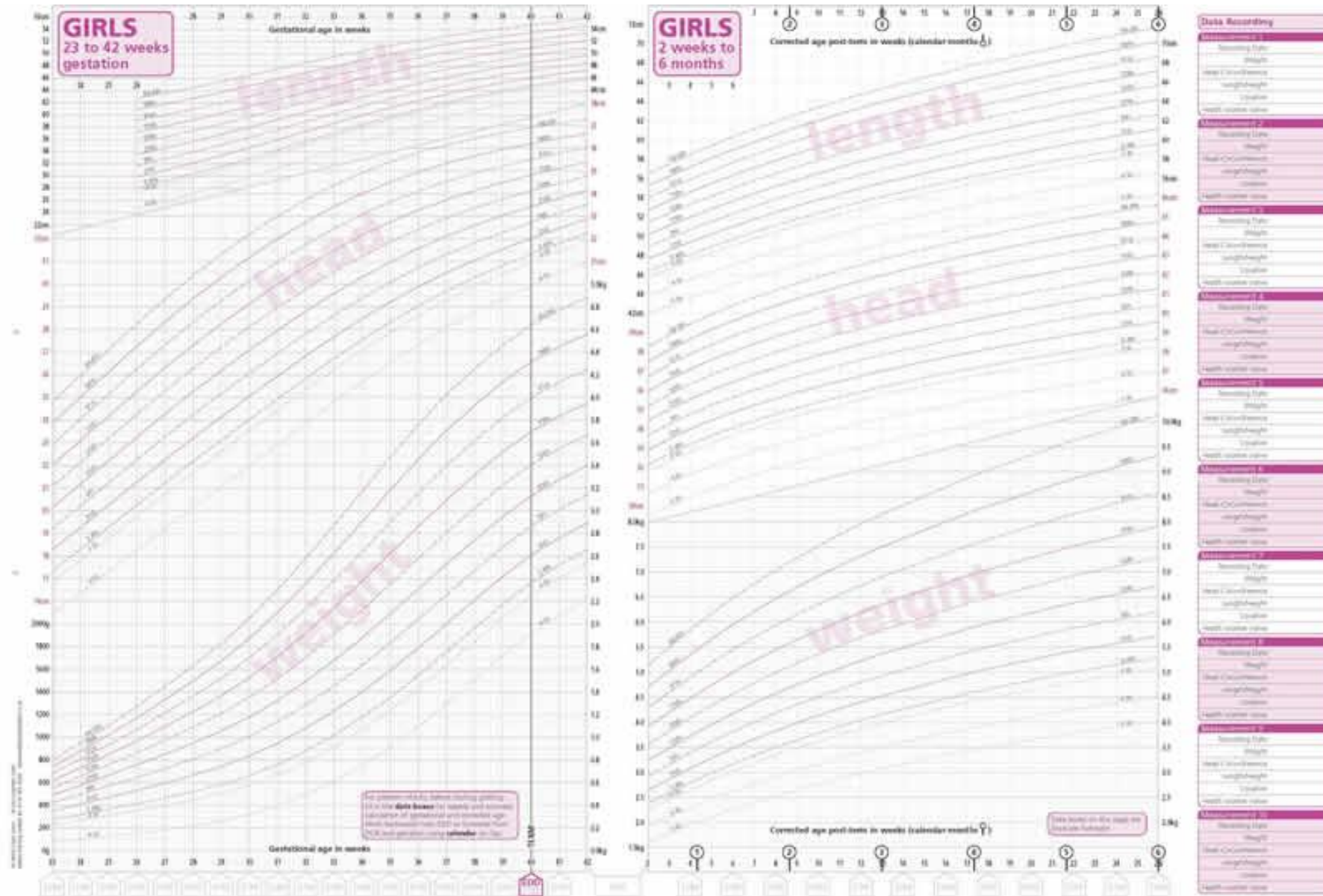
- Available to order from Harlow Printing
- $\approx$ £23 for 100 growth charts

<https://www.rcpch.ac.uk/resources/growth-charts>

- Specific growth charts: Down's Syndrome, Turner Syndrome, Williams Syndrome

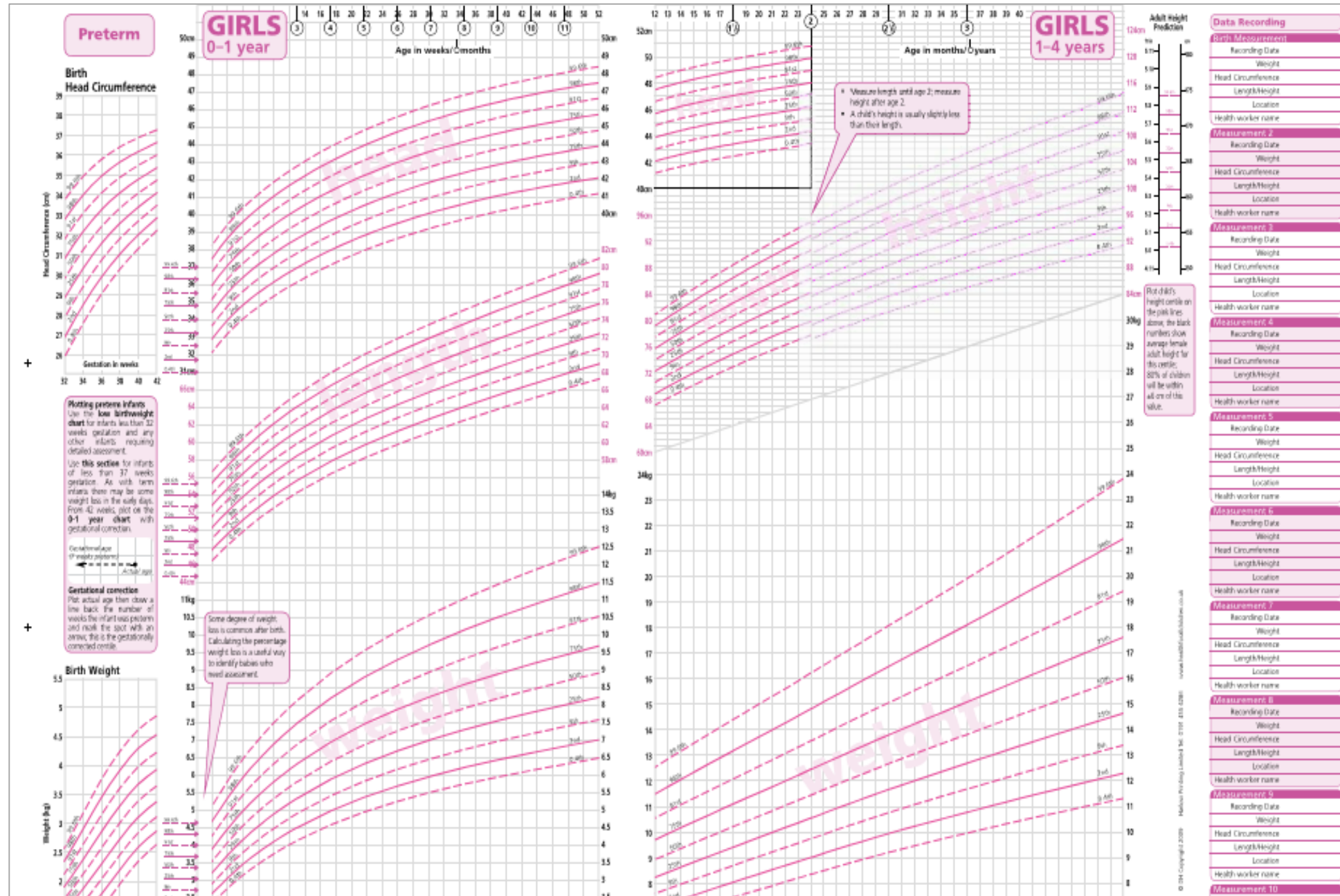
UK-WHO Neonatal Infant Close Monitoring Growth Chart

Designed for plotting growth measurements of preterm +/- LBW infants from birth-2 yrs, after which the UK-WHO 0-4yr charts can be used



UK-WHO Growth Charts for Children Aged 0-4 Years

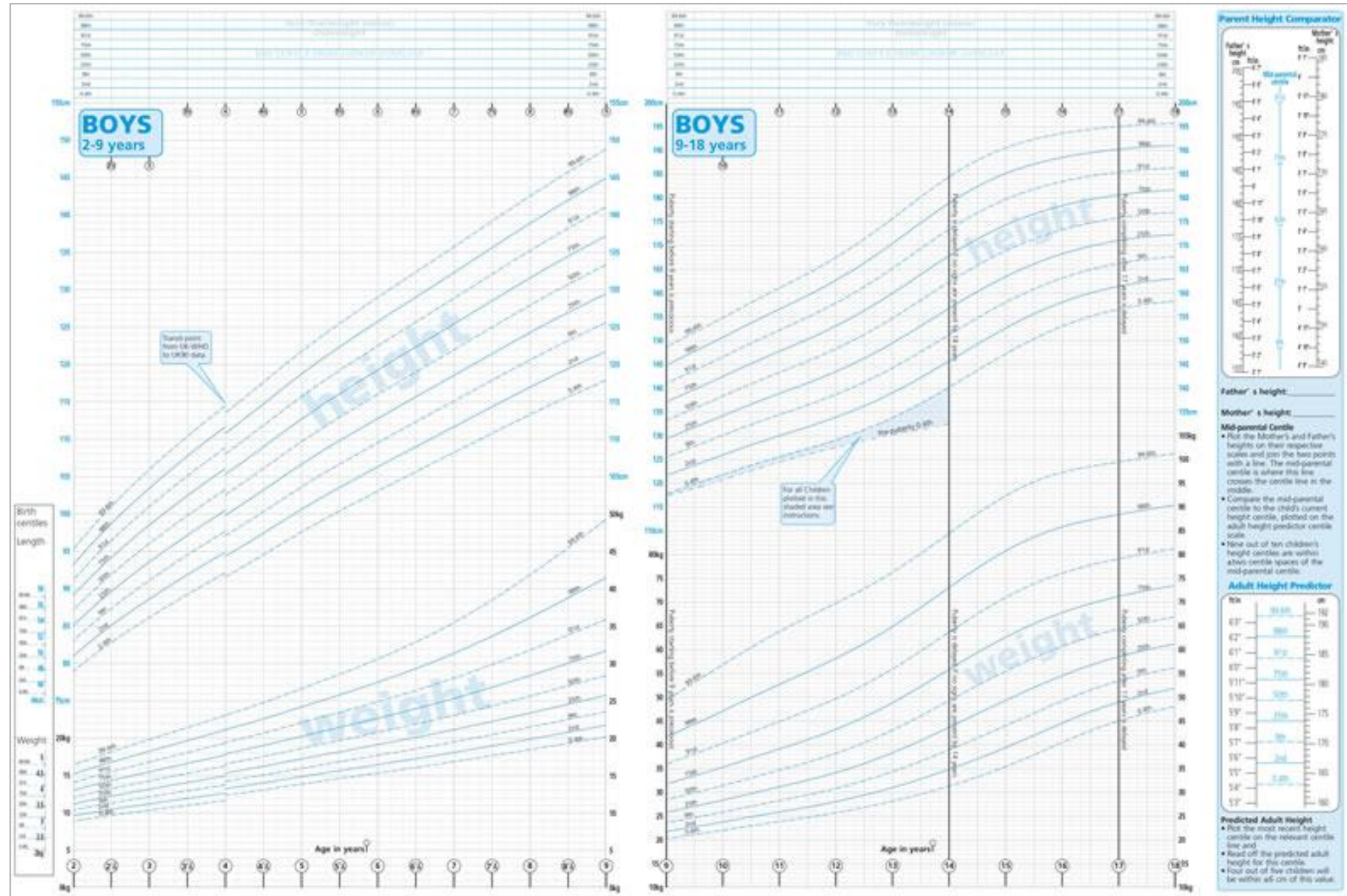
This growth chart combines WHO standards with UK preterm & birth data. The charts depict a healthy pattern of growth that is desirable for all children, whether breast fed or formula fed, & whatever ethnic origin.



UK-WHO Growth Charts 2-18 Years

Chart designed to assess the growth of school age children and young people.

The growth of most children < 4 years of age should be plotted on the more detailed UK-WHO 0-4 year growth charts.



Growth Charts

...Don'ts

- Inaccuracies in growth plotting - particularly affect infants/prems
- Measurements should be plotted on the relevant centile chart using a **small dot** rather than a cross or circle – or joined dots
 - If infants are regularly monitored/measured, several circled dots makes it difficult to plot & interpret patterns
- When > 1 health professional monitors an infant – it can get confusing when measurements are plotted using both uncorr. & corrected age
 - Lack of adjustment - $\uparrow^{\text{es}}$ risk that the child is classified as faltering growth
 - Consider team agreement to only plot measurements using corrected age

Is weight gain due to lean & fat tissue, or merely fat?

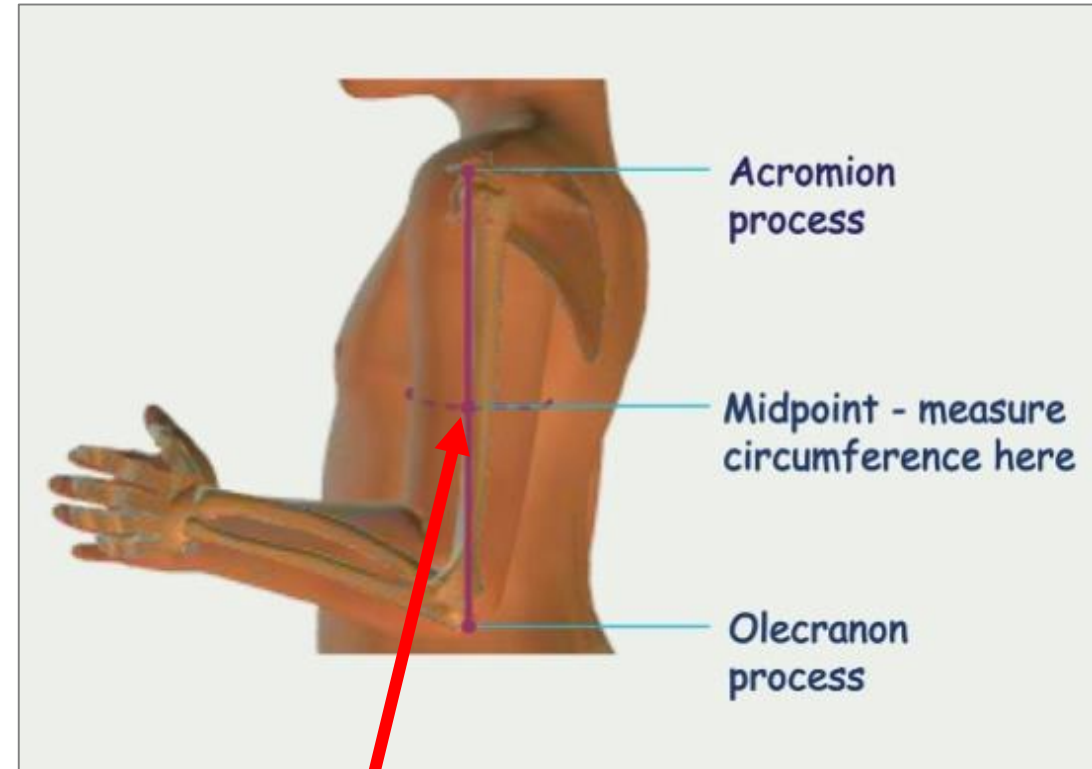
Increases in Mid Upper Arm Circumference (MUAC) are more likely to comprise of muscle and less likely to be affected by oedema than body weight

- MUAC indirectly assesses nutritional status by est. body fat & muscle bulk
- In < 5 year olds, MUAC is a useful tool to identify malnutrition
- Highly correlated with BMI
- Non-invasive, inexpensive, easy to measure, requires minimal training
- Less affected by acute dehydration than weight-based indices

MUAC - How to Measure (1)?

Step 1. Identify the mid-point between the shoulder (acromion) & elbow (olecranon)

- Patients non-dominant arm should be bent at the elbow at a right angle (90°) with palm up
- Measurement should be done on the posterior surface of the arm
- Using a tape measure, measure the distance between the acromion (bony protrusion surface of upper shoulder) & the olecranon process (bony point of elbow)
- Whilst still holding the tape in place, make a short horizontal line at the mid-point
- This marks the level at which the circumference will be measured



Mark the mid-point with a pen

MUAC - How to Measure (2)?

Step 2. Measure the MUAC

- Patient should stand with non-dominant arm hanging loosely by their side; supine position fine too
- Important that the child's arm is relaxed as a tense arm will give a very different reading
- Align the tape around the upper arm such that the mid-point mark is situated between the two parts of the tape
- The tape should be snug around the arm horizontally – do not cause pinching or indentation
- Take the average of 3 MUAC m'ments

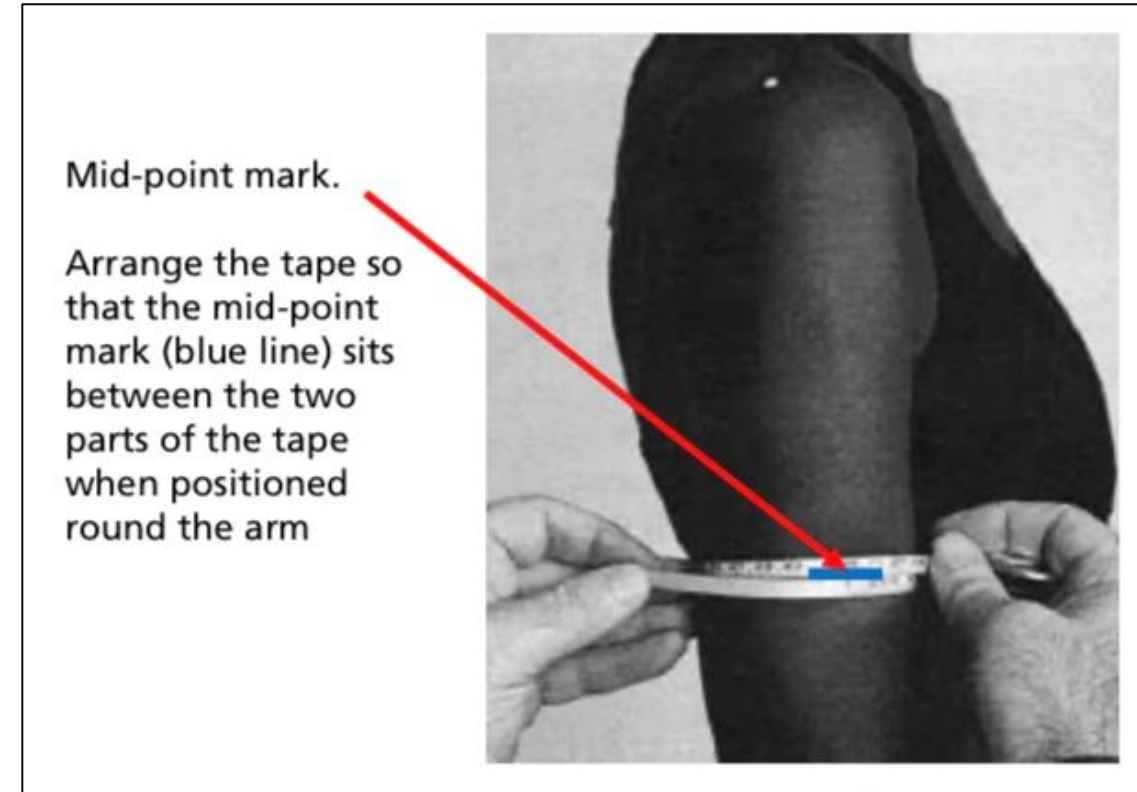


Image & description of procedure adapted from NIHR Southampton Biomedical Research Centre: 'Procedure for Measuring CIRCUMFERENCES OF CHILDREN' (2015)

Interpreting MUAC Measurement

- Standards for MUAC are age & gender dependent
- References available from the National Health and Nutrition Examination Survey (USA-data from 3-5 months up to 19 yrs)
- In children < 5yrs, a MUAC < 14cm is likely to indicate sig. malnutrition

Mid Upper Arm Circumference of 1-5 year olds (Hobbs et al., (1999)

< 14cm	Very likely to be a significantly malnourished child
14-15cm	May be malnourished
> 15cm	Nutrition likely to be reasonable

Be Aware of Recognised Growth
Patterns in Specific Paediatric
Populations

(1) Term Infants

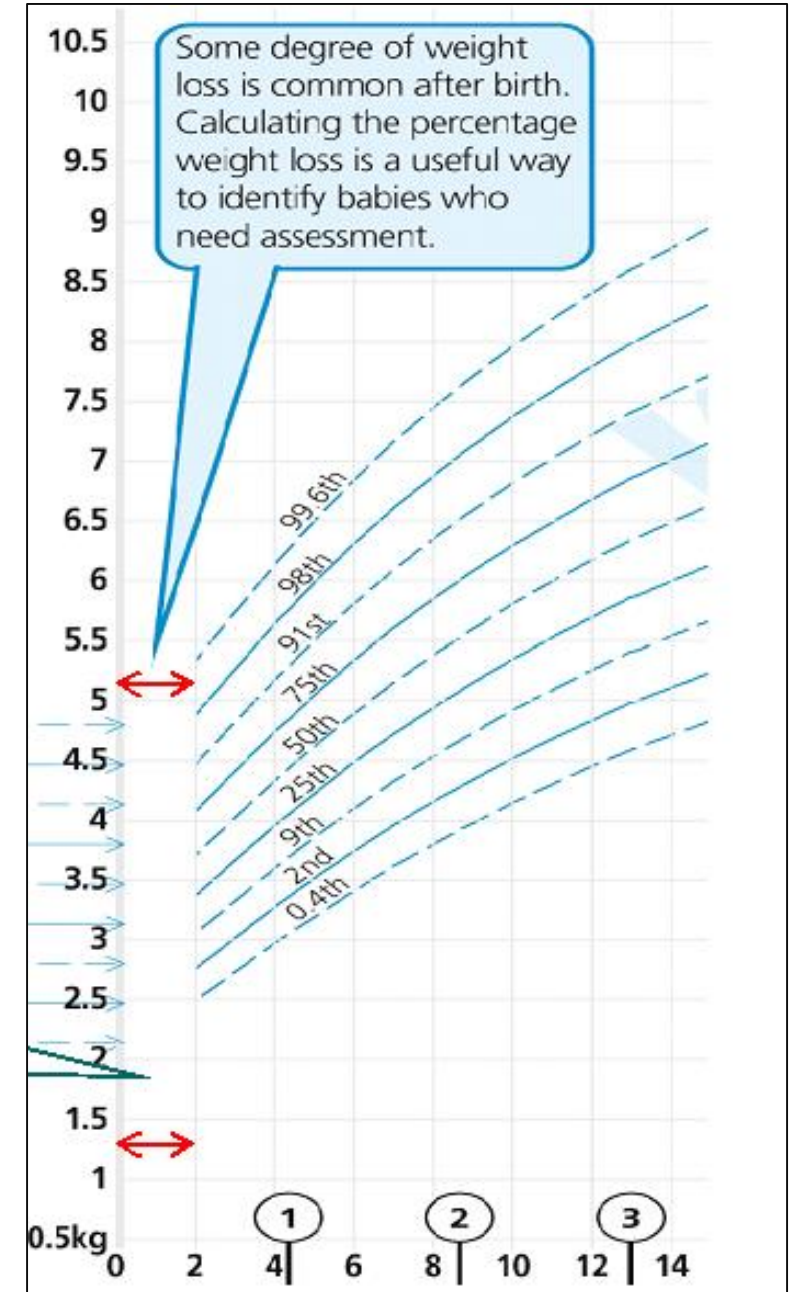
- be familiar with recognised infant growth patterns

- 50th centile birthweight for infants $\approx$ 3.5kg
- Growth patterns **over time** are more important than isolated m'ments
- Breastfed vs. formula fed infants – differ in growth pattern
- From 2 months-1 year formula-fed infants gain weight & length more rapidly than breast-fed infants (Zeigler *et al.*, 2006)

	Breastfed	Formula fed
0- 6 months	More rapid growth	Slower growth
6- 12 months	Slower growth	More rapid growth

Infants – Early Weight Pattern

- Some weight loss first 5-7 days is expected & normal
- Birth weight is usually regained by the 10th-14th day of life
- Loss of 10% of birth weight by 2 wks needs further r/v
- The child's max. weight centile achieved between 4-8 wks may be a better predictor of the centile at 12 months, than the birth centile (Edwards *et al.*, 1990)



(2) Preterm Infants

- Fat content of premature infants is 8% (DEXA)
- & up to 25% at term infants (Fusch et al., 1999)
- Fat mass is continuously accumulated during the third trimester of intrauterine development, & the water content of lean body mass drops – hence reason for the ↓^{ed} fat content in prems
- In VLBW infants - Intrauterine growth retardation is an independent risk factor for poor growth during the first year (Tsang et al., 2005)

3. Other Paediatric Populations

1. Spinal Deformity – Adolescents with Scoliosis

- Irish data - sig. lower weight & BMI compared with healthy controls
- Systematic r/v - sig. ↓^{er}BMI than controls (Tarrant *et al.*, 2015; 2018)

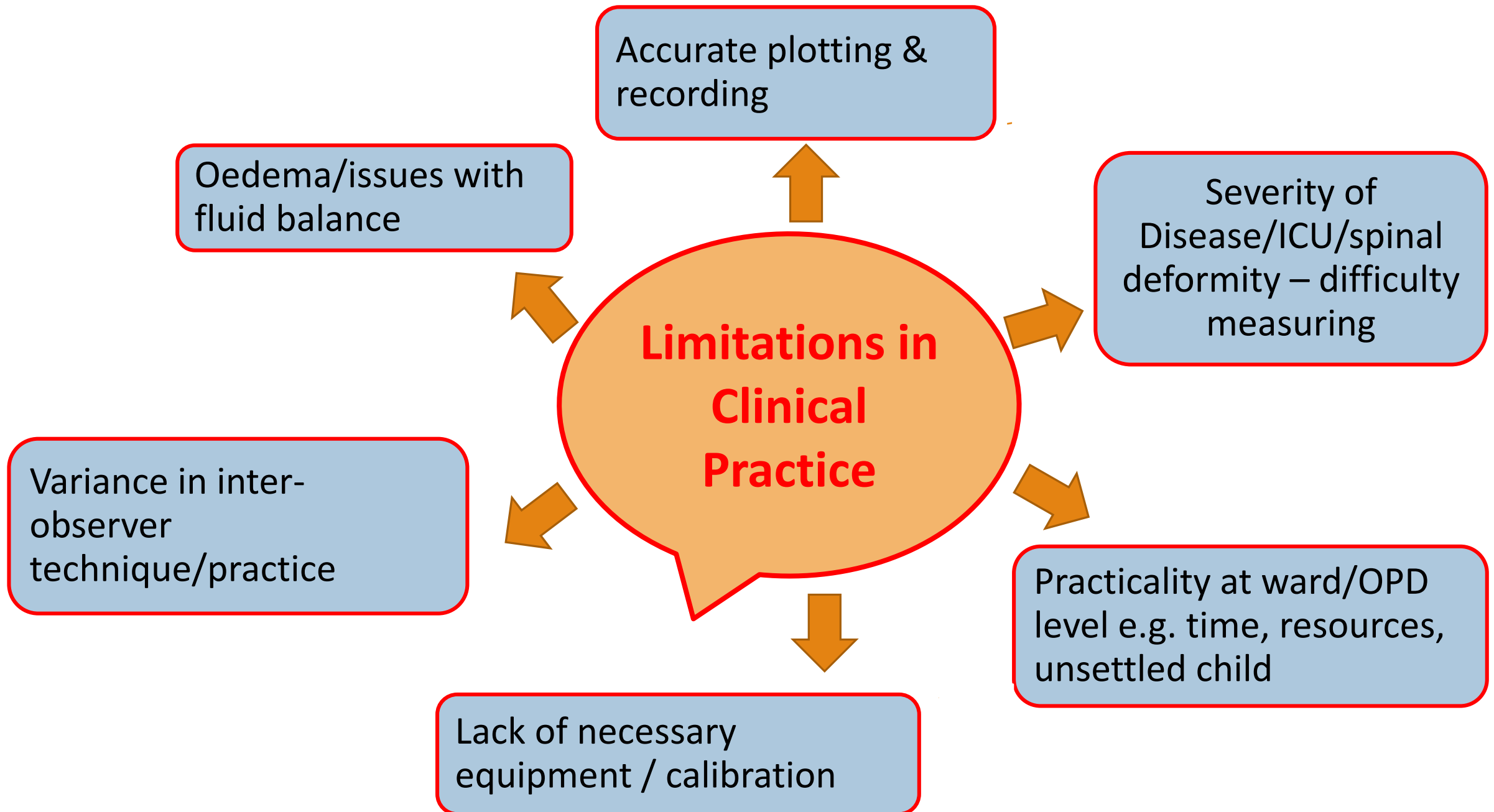
2. Food Allergy

- Poor growth related to avoidance diet; lower weight, weight for length & BMI vs. controls
- Children avoiding all forms of milk are shorter & weigh less than matched counterparts
- The presence of a milk and/or soy allergy impacts linear growth (Rhodes *et al.*, 2016; Hobbs *et al.*, 2015; Mehta *et al.*, 2014)

3. Ketogenic - Rapid ↓ in weight z scores in the 1st 3 months; ↓ in height z scores in the first 6 months (Vining *et al.*, 2002)

Anthropometric Measurements

Limitations to their Use & Accuracy
in Clinical Practice

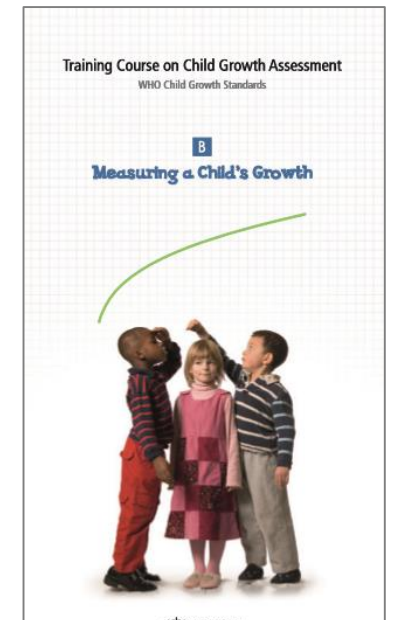
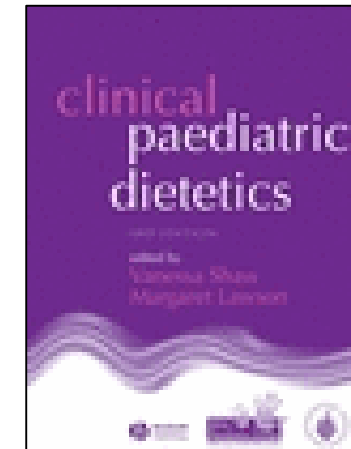
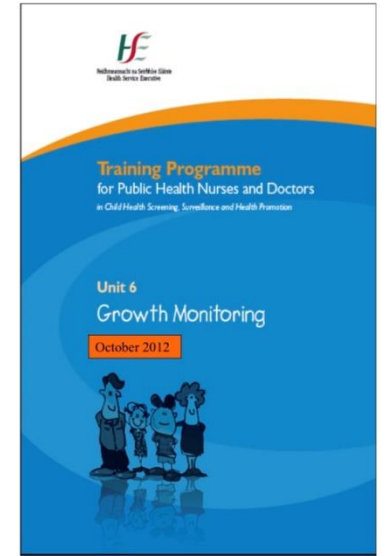


Summary

- ✓ In assessing growth, **accurate anthropometric measurements** is a key consideration
- ✓ Accurate anthropometry relies on **appropriate technique & instrumentation** by a trained clinician
- ✓ Relevant growth charts & precise plotting – team agreement to standardise this
- ✓ Serial measurements showing **a pattern over time** is most important
- ✓ Be familiar with **recognised growth patterns** in paed. population in your area
- ✓ Abnormal growth patterns will allow **early intervention** before poor patterns of nutrition & growth become established

Key References

1. HSE (2012) Growth Monitoring Training Manual October 2012
<https://www.hse.ie/eng/health/child/growthmonitoring/>
 - video demos
 - practice activities
 - HSE Land: modules on *'National Healthy Childhood Training Programme - Welcome and Introduction'* & *'Growth Monitoring in Children'*
2. INDI (2015) Nutrition Support Reference Guide
 - *Paediatric Section*
3. WHO (2008) – 'Measuring a Child's Growth'
'A Training Course on Child Growth Assessment'
4. Shaw & Lawson (2007) Clinical Paediatric Dietetics, 3rd Edition
5. Tsang *et al.*, (2005) Nutrition of the Preterm Infant (2nd Edition)



If you wish to become a 'Certified Anthropometrist' (Level 1-3)...



- Dedicated to formal training in Anthropometry
- Training applicable to paediatrics
- The International Society for the Advancement of Kinanthropometry (ISAK)
- ISAK has developed an international anthropometry accreditation scheme
- For details on courses in Ireland:
<https://www.isak.global/WhatIsIsak/Index>