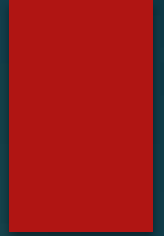


# Growth Charts and Growth patterns in Pediatrics



# WHO Growth Standards Birth to 24 Months

- Growth Parameters
  - Weight-for-age
  - Length-for-age
  - Weight-for-length
  - Head circumference-for-age



# Birth to 2 years

Weight to nearest 10g



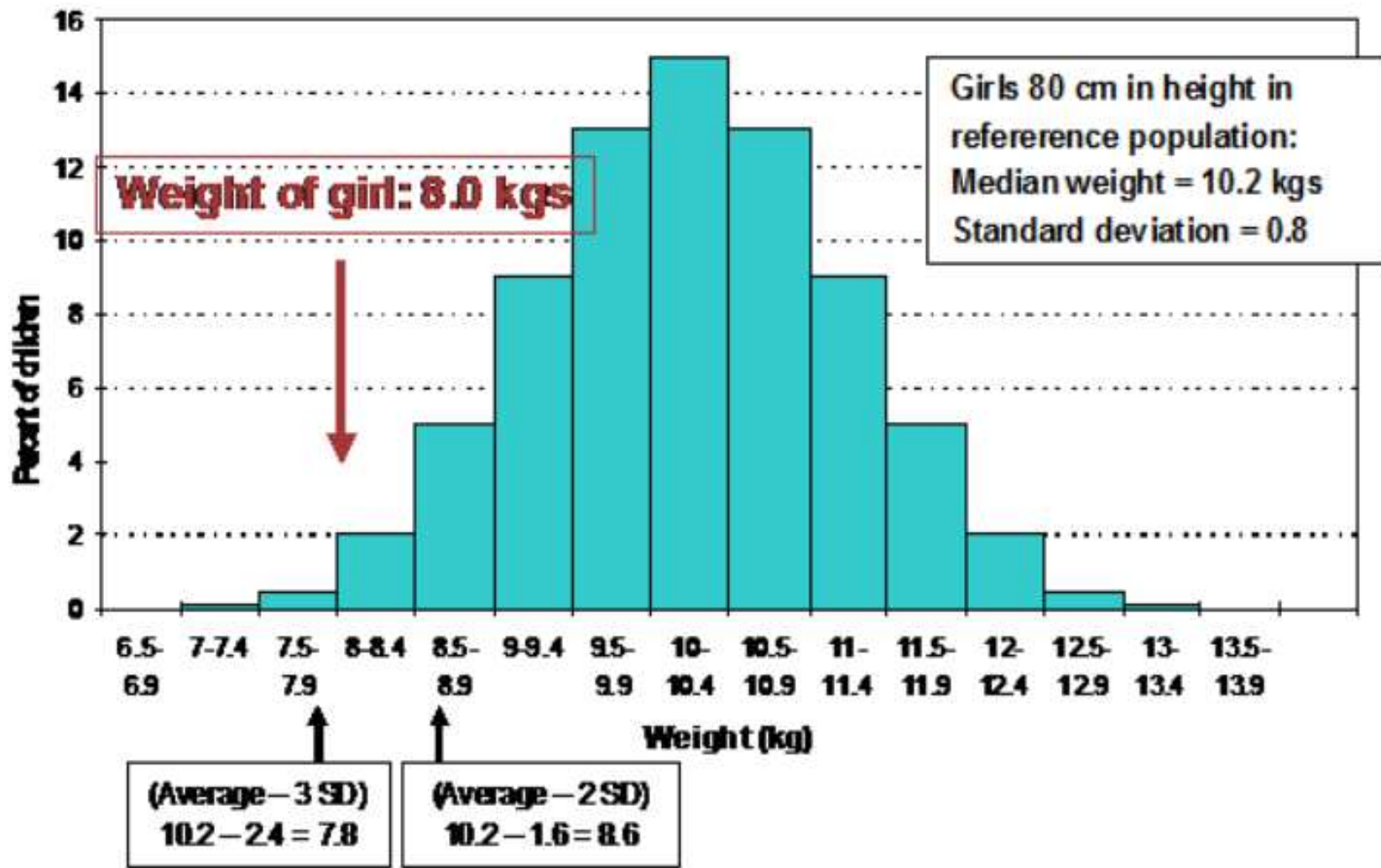
To nearest 0.1cm

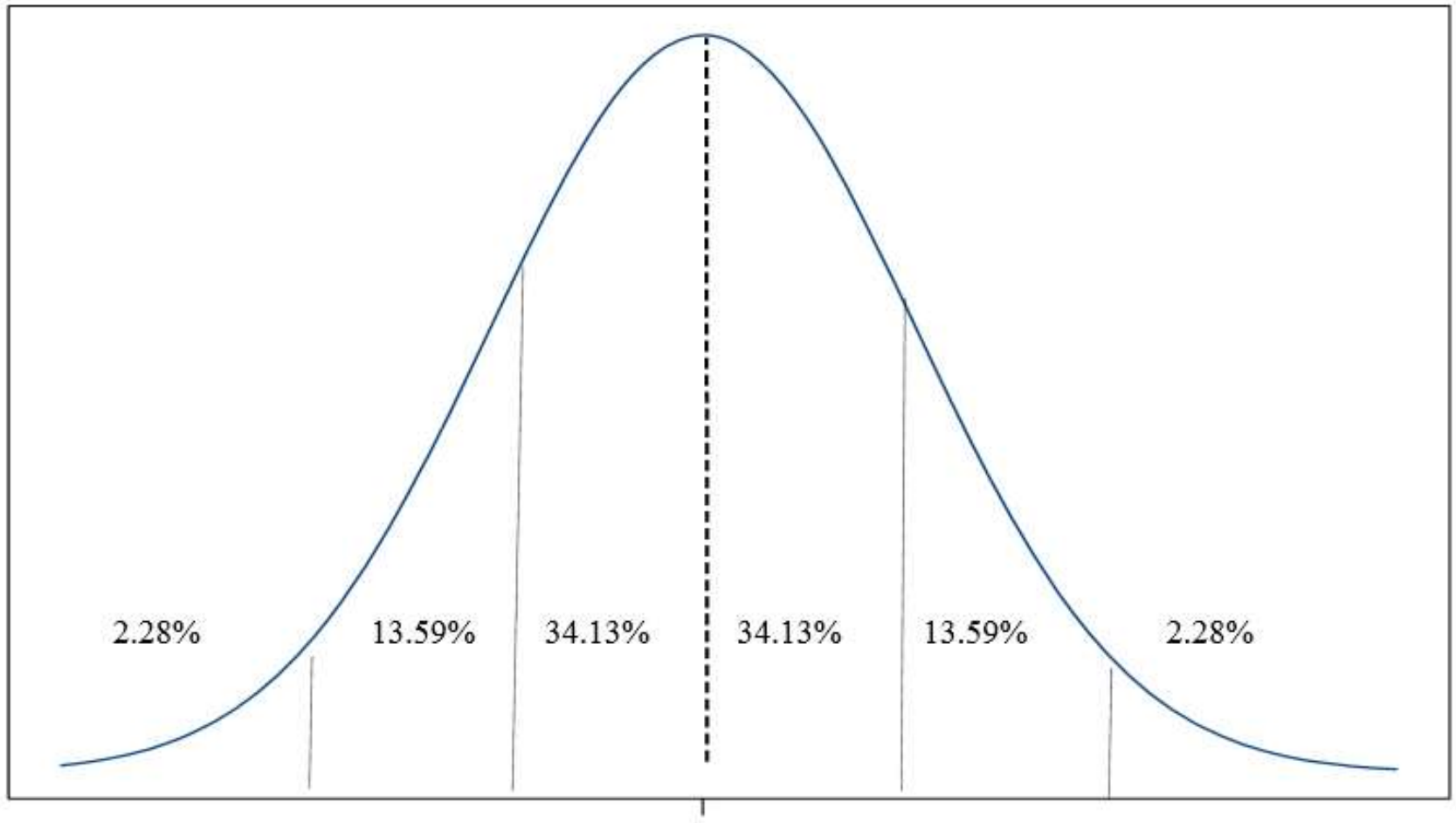


purpose 'infantometer'  
to nearest 0.1cm

2 & 3 ½  
years







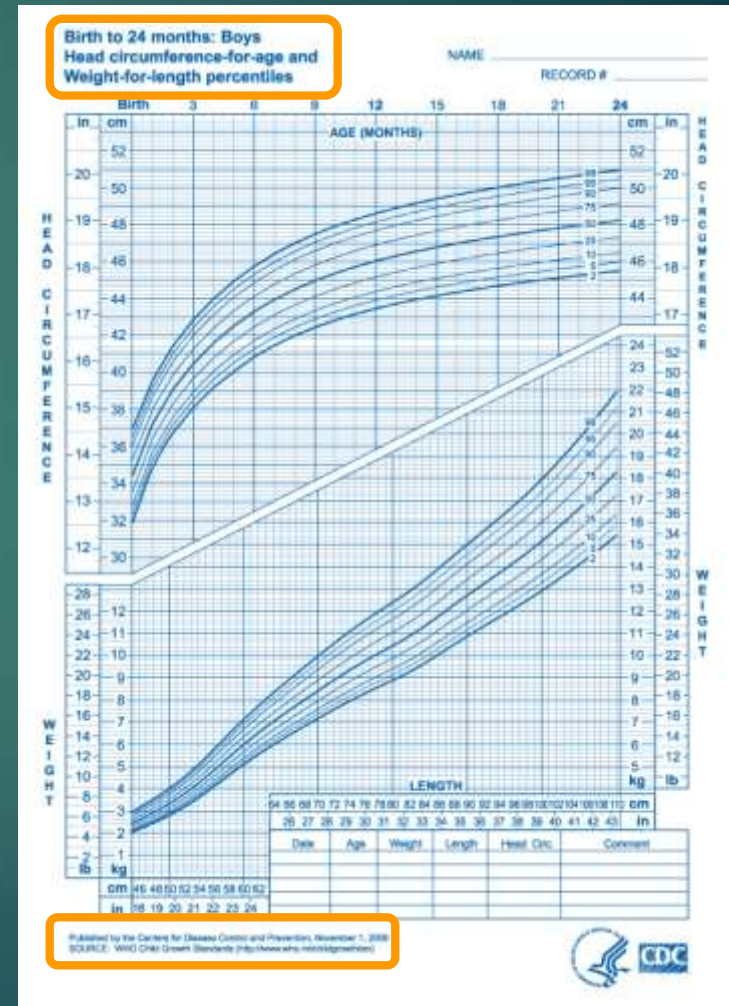
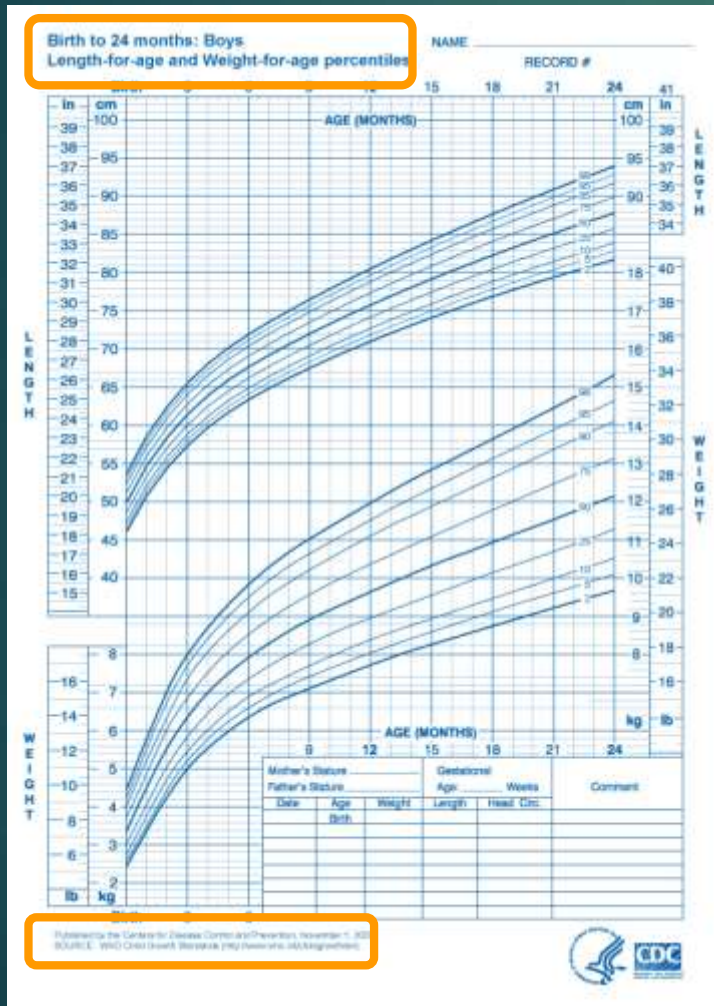
A normal bell-shaped curve cut into z-score segments



# Boys: Birth to 24 months

Length-for-age  
Weight-for-age

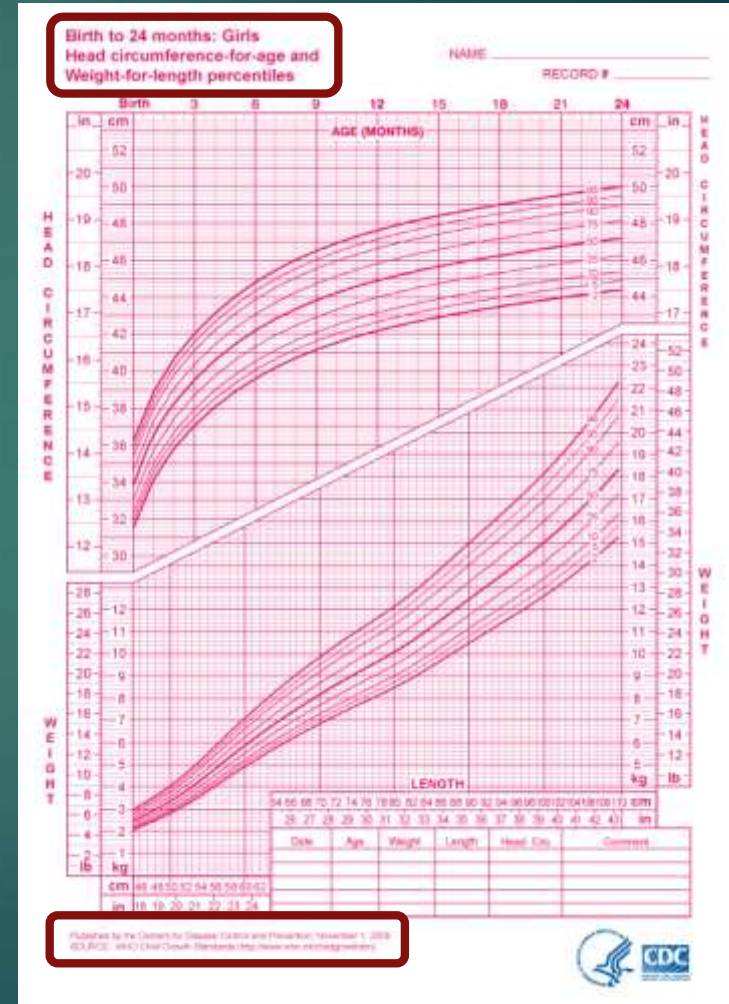
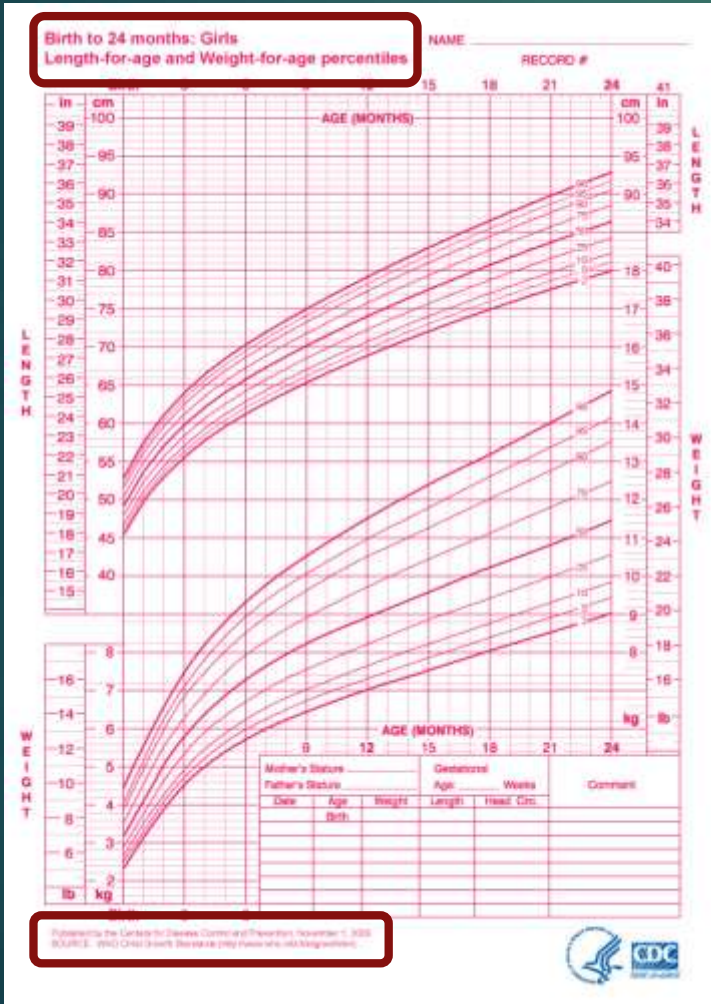
Head circumference-for-age  
Weight-for-length



# Girls: Birth to 24 months

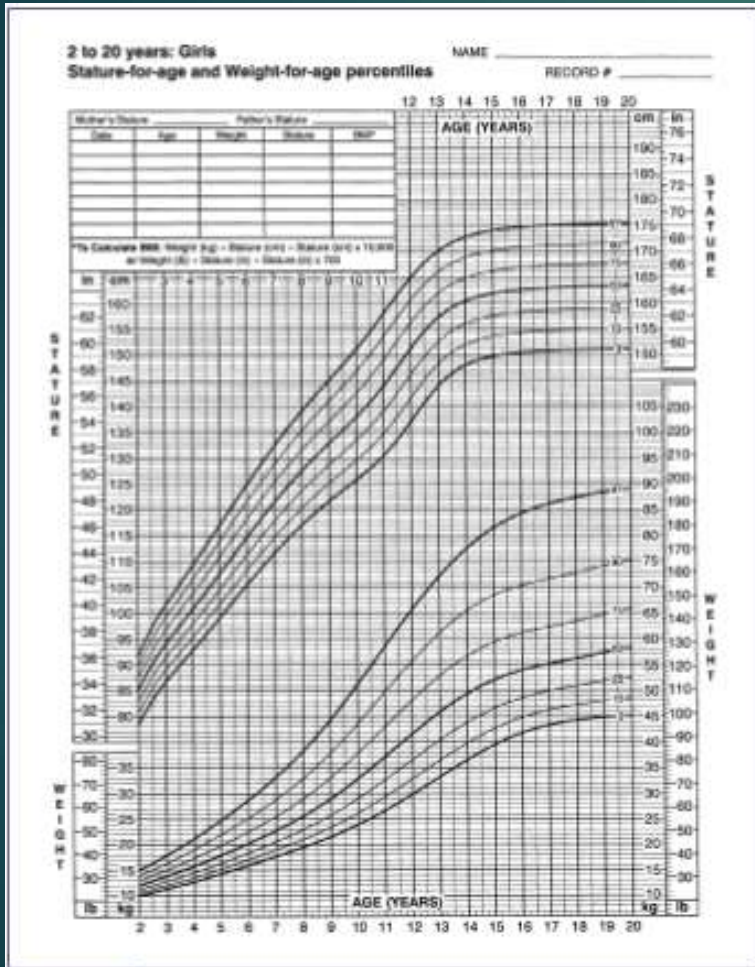
Length-for-age  
Weight-for-age

Head circumference-for-age  
Weight-for-length

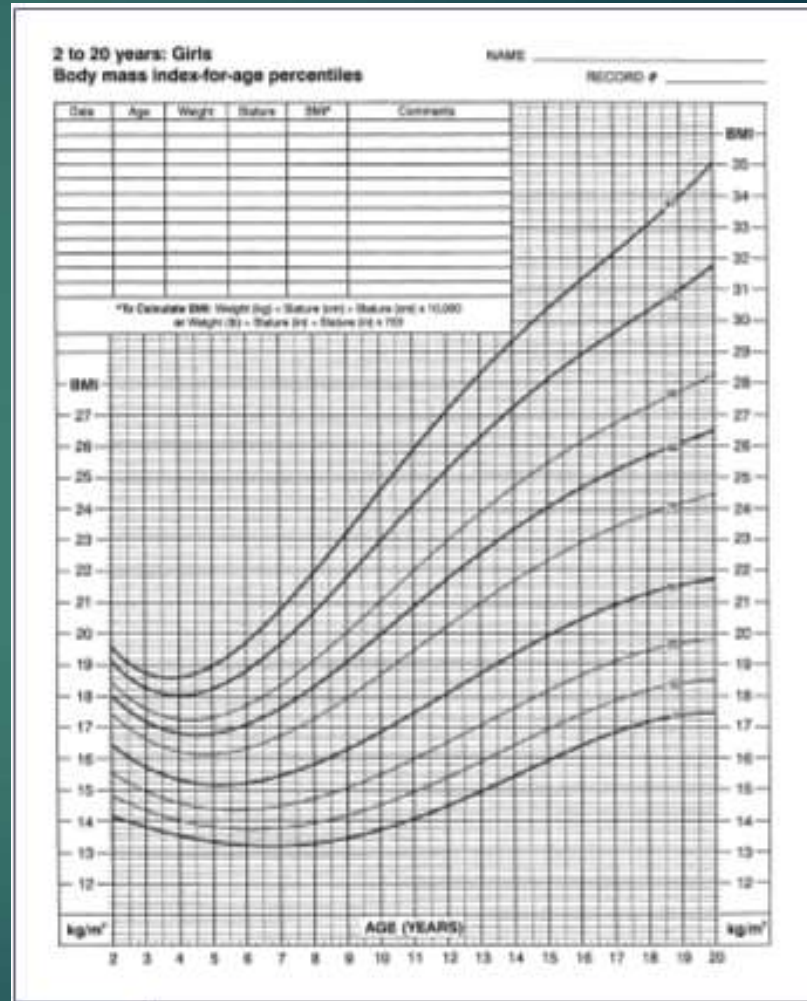




# Stature and weight for girls ages 2–20 years

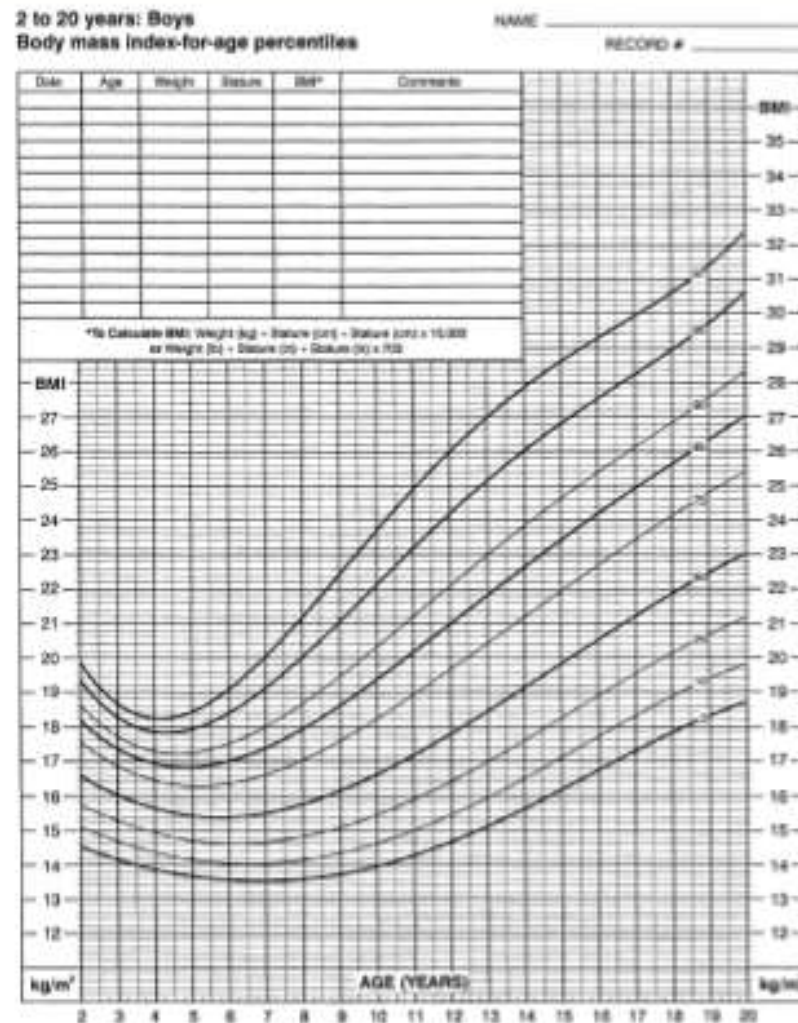
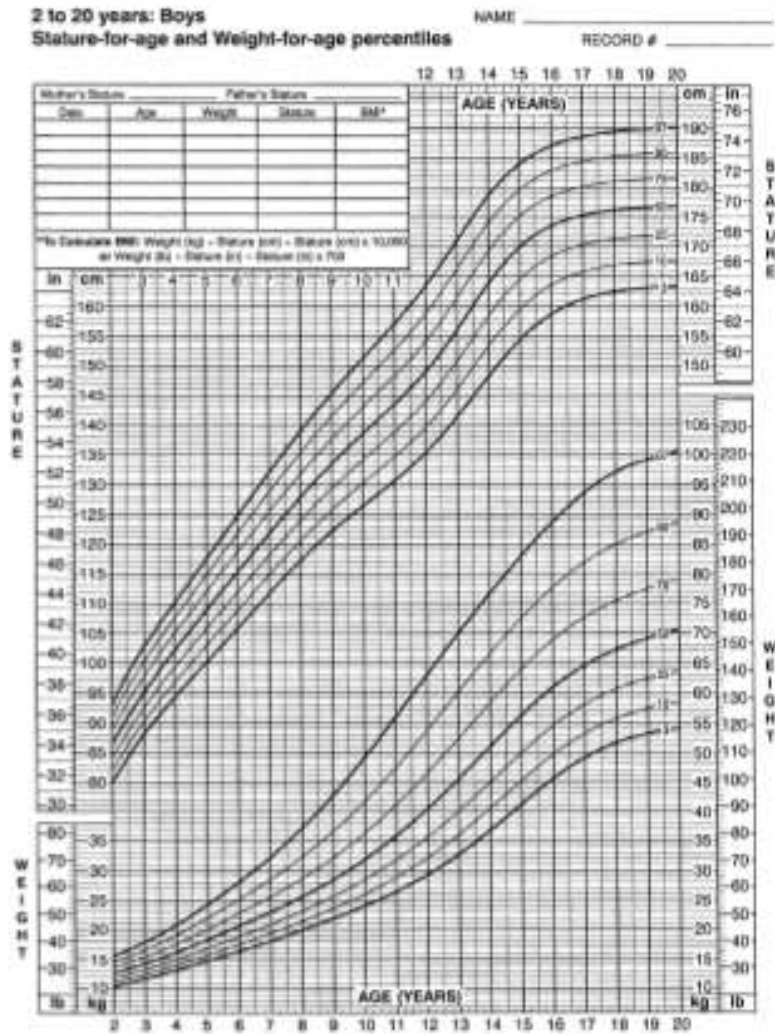


# Body mass index for girls ages 2–20 year



# Stature and weight for boys ages 2–20 years

# Body mass index for boys ages 2–20 year



# Compare the WHO Growth Standards and the CDC Growth Reference

<b>Comparison</b>	<b>WHO Growth Chart</b>	<b>CDC Growth Chart</b>
<b>Studied population</b>	<b>Breastfed infants and toddlers</b>	<b>Breastfed and formula fed infants and toddlers</b>
<b>Growth pattern</b>	<b>How healthy children SHOULD GROW in ideal conditions</b>	<b>How certain groups of children HAVE GROWN in the past</b>
<b>Cutoff values</b>	<b>2nd and 98th</b>	<b>5th and 95th</b>

# When Growth Deviates from the Norm

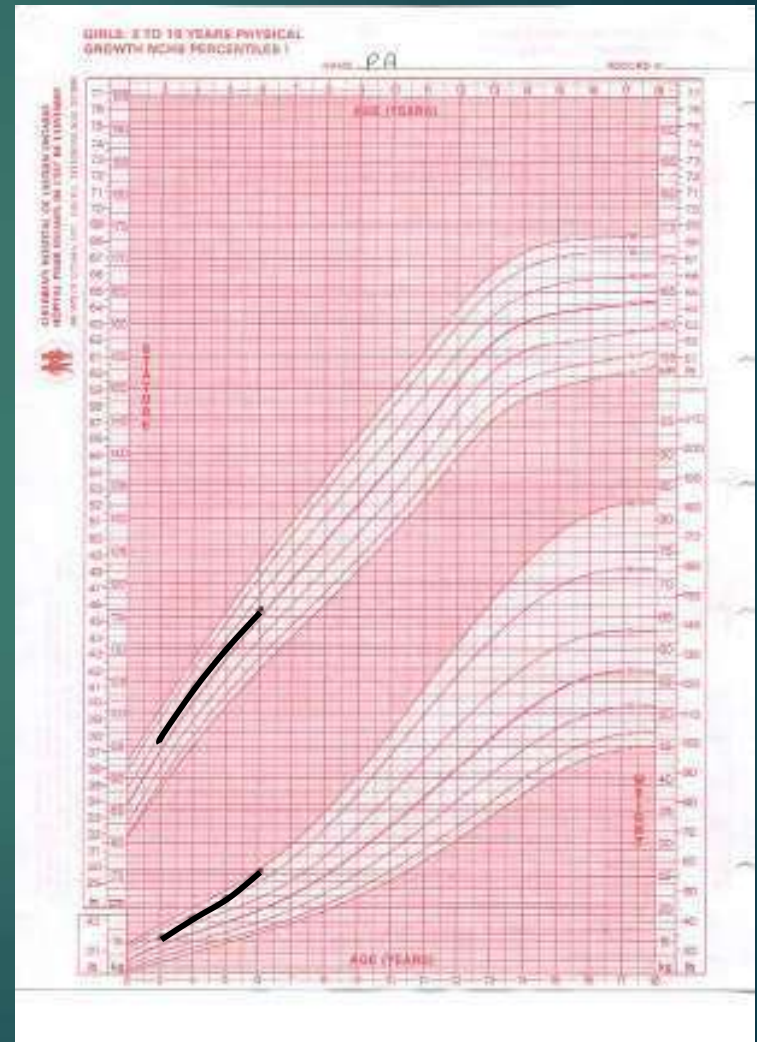
- ▶ Check accuracy of your measurements
- ▶ Note that individual growth may not follow a smooth curve
- ▶ Recognize limitations of a single growth percentile value
- ▶ Obtain serial measurements over time
- ▶ If weight-for-length is  $< 2^{\text{nd}}$  % or  $> 98$  %, assess fully, follow closely and refer, if needed



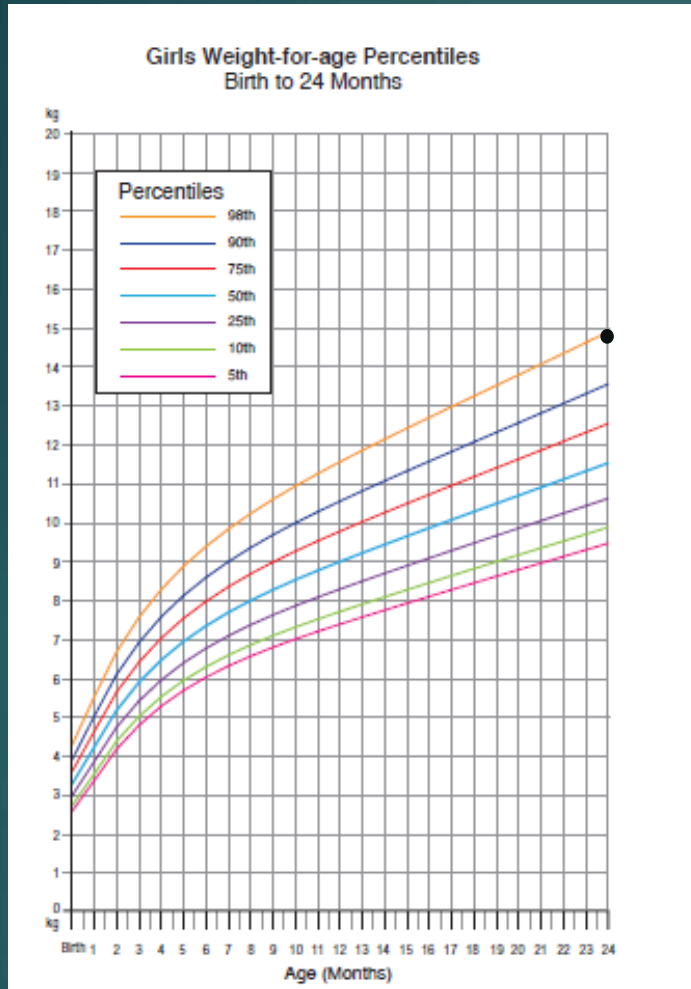
# Principles of child growth assessment

- ▶ Serial measurements of both weight and length / stature
- ▶ Head circumference reflects early brain growth
- ▶ Poor growth – decline in rate of weight gain first, followed by length/height gain
- ▶ Appropriate growth when weight and length/height track along a curve – even it is ‘off’ chart
- ▶ Correct for prematurity until 2 years

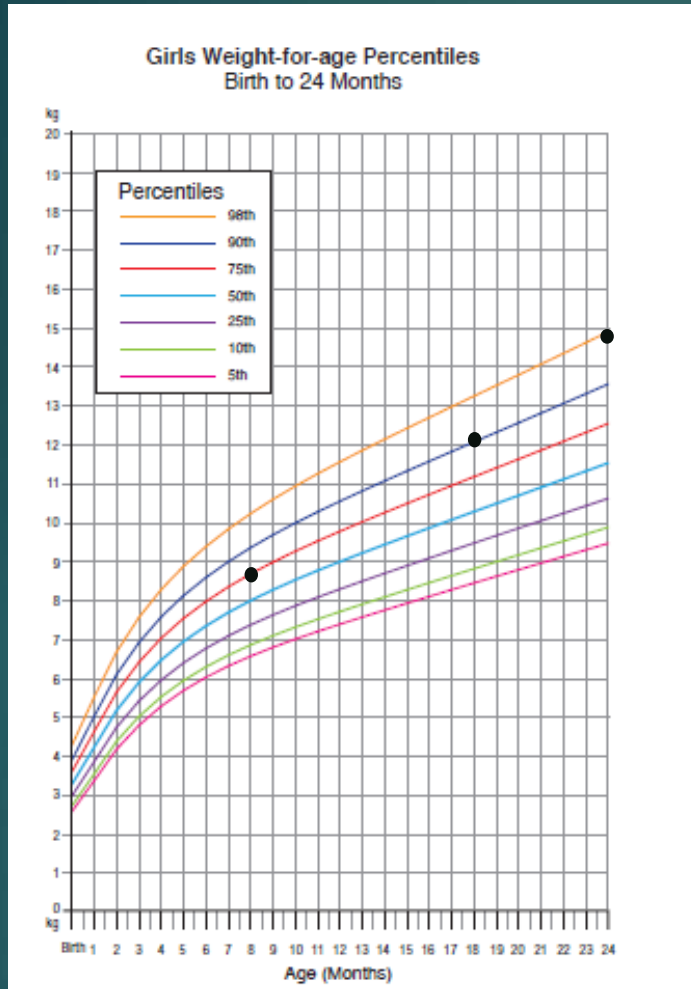
What do you think of this Growth chart



# Comparison 6: normal or overweight?

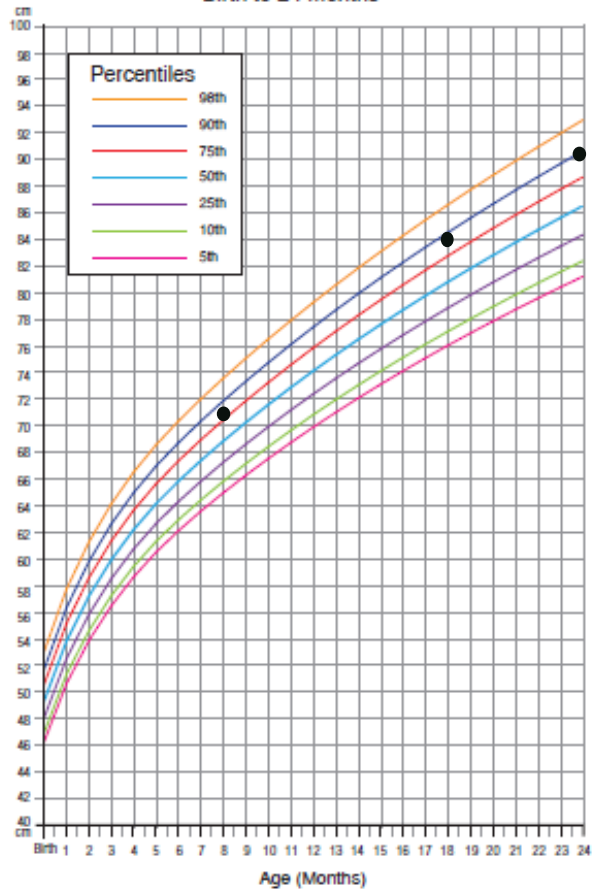


# Comparison 6: normal or overweight?



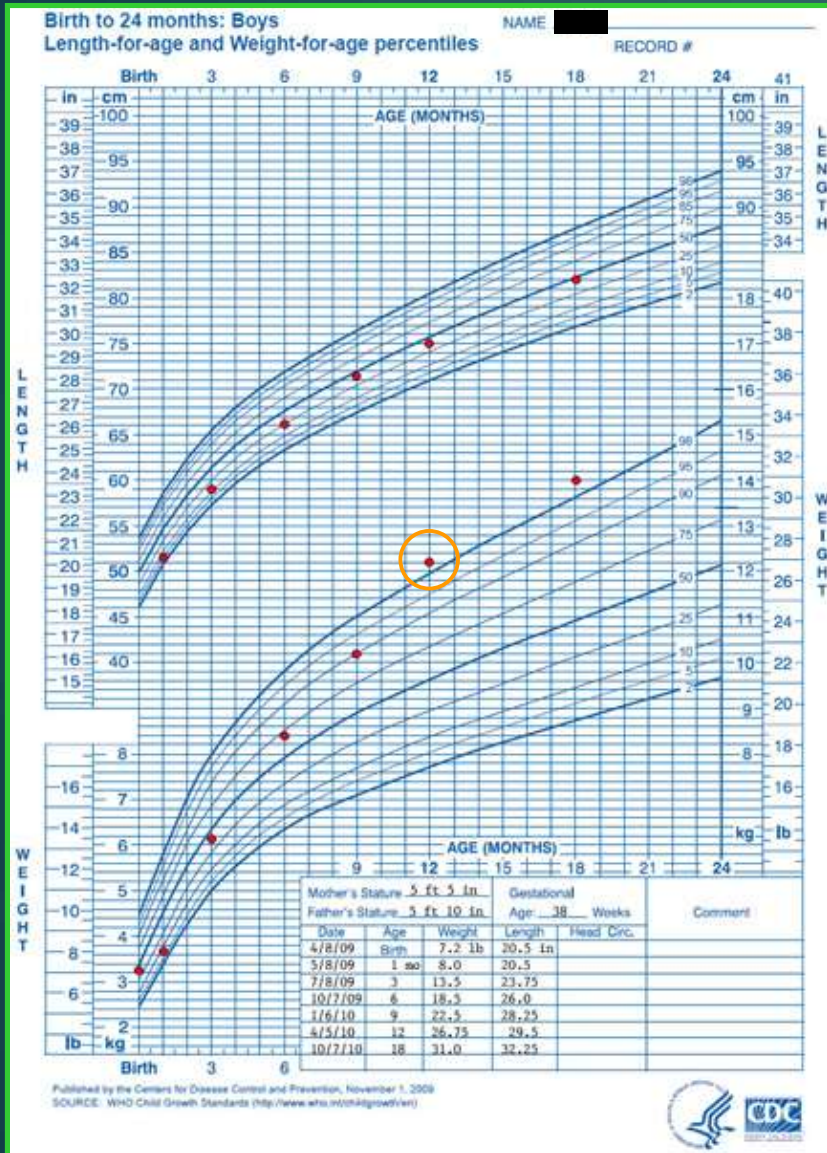


Girls Length-for-age Percentiles  
Birth to 24 Months

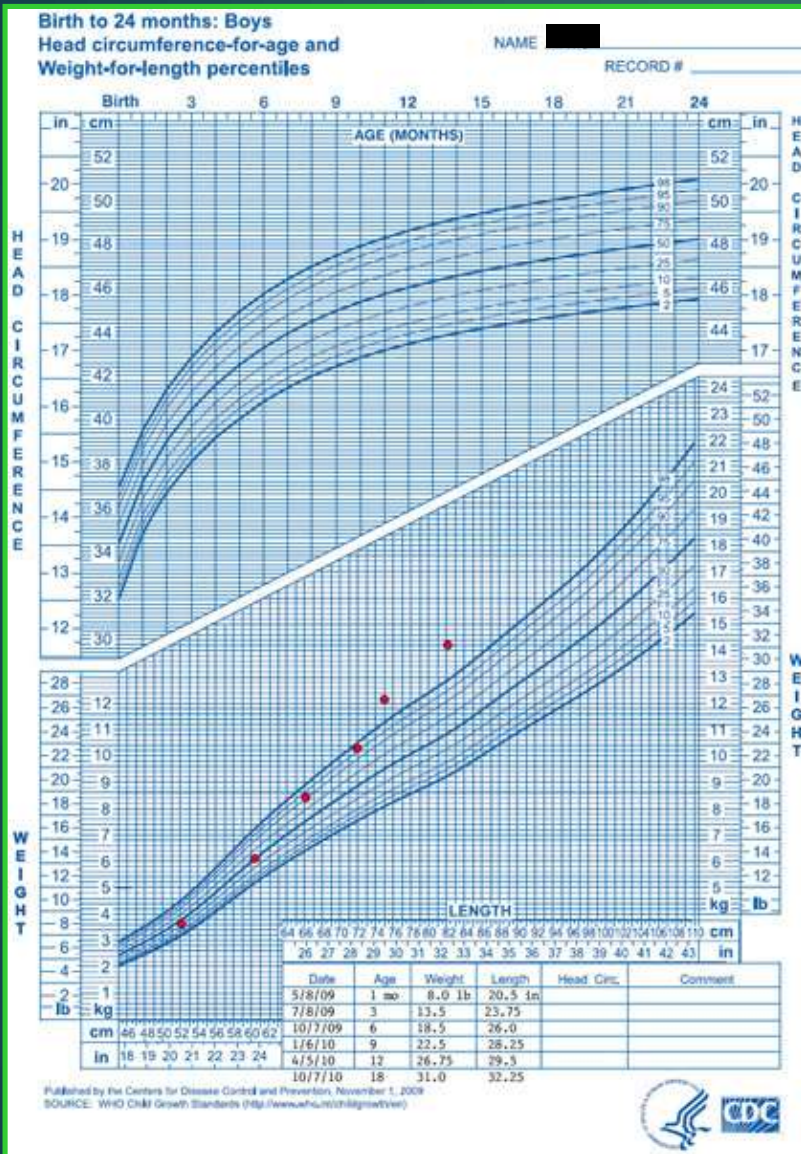


# Growth Chart examples

WHO Weight-for-Age Growth Chart



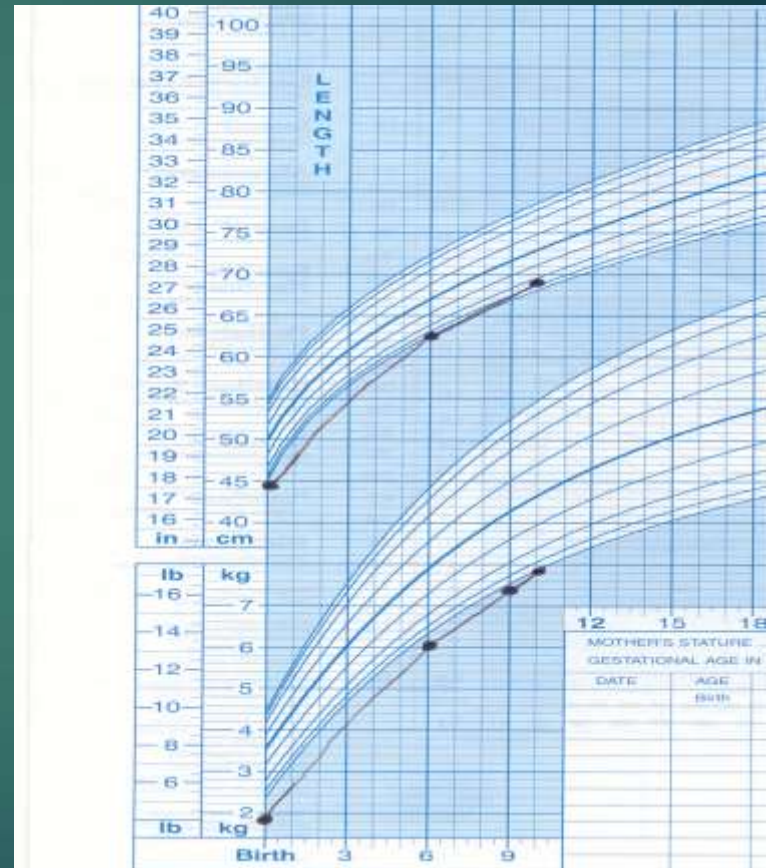
# Comparing Weight-for-Length



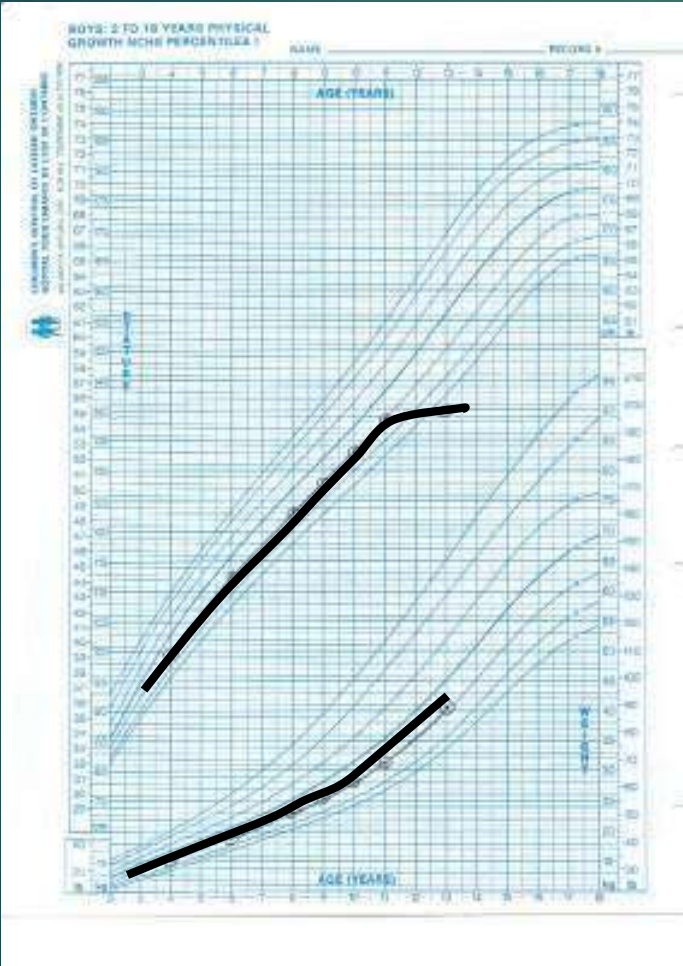
WHO Weight-for-Length Growth Chart



# What do you think?







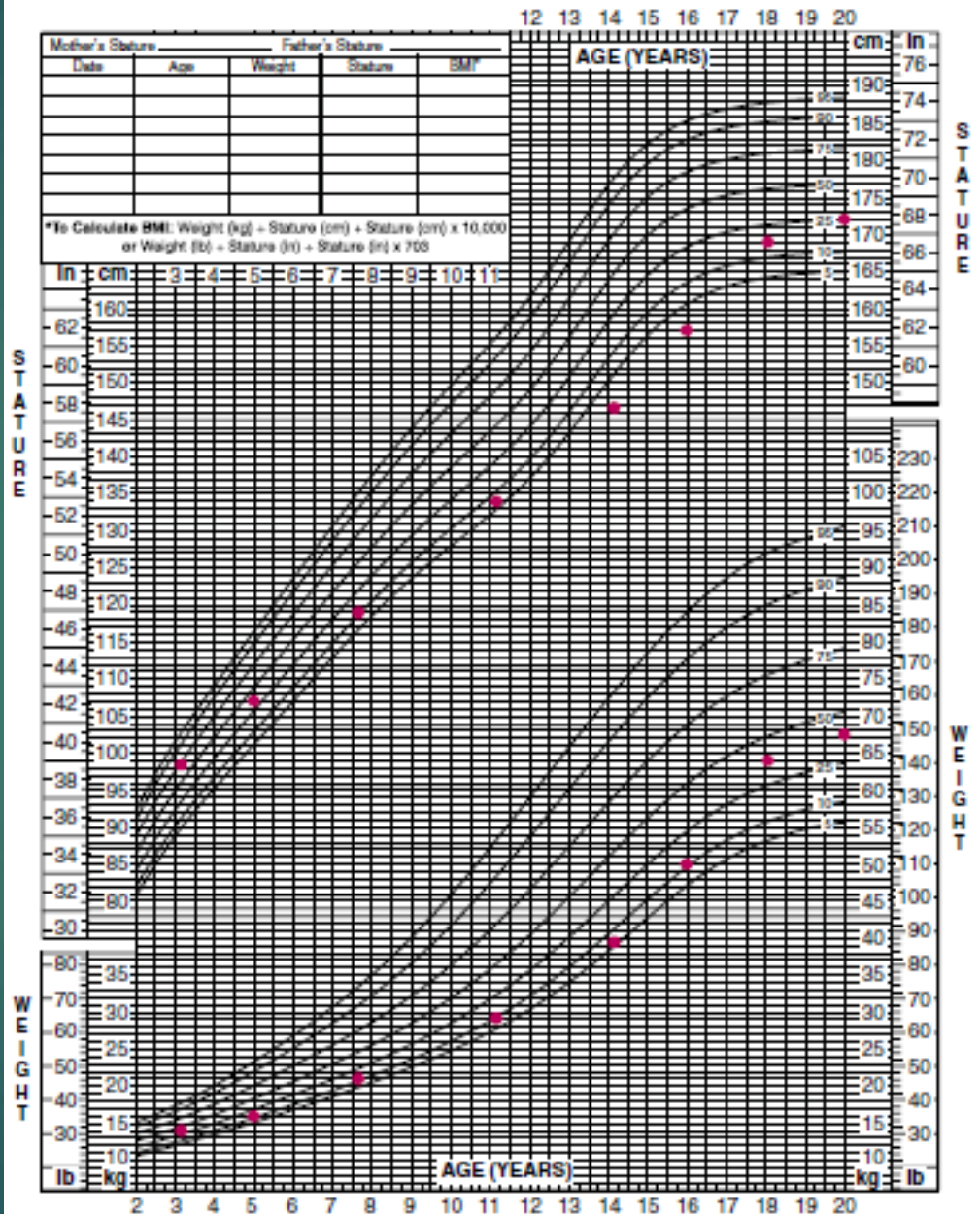
? Scoliosis

# Constitutional Delay of Puberty

2 to 20 years: Boys  
Stature-for-age and Weight-for-age percentiles

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_

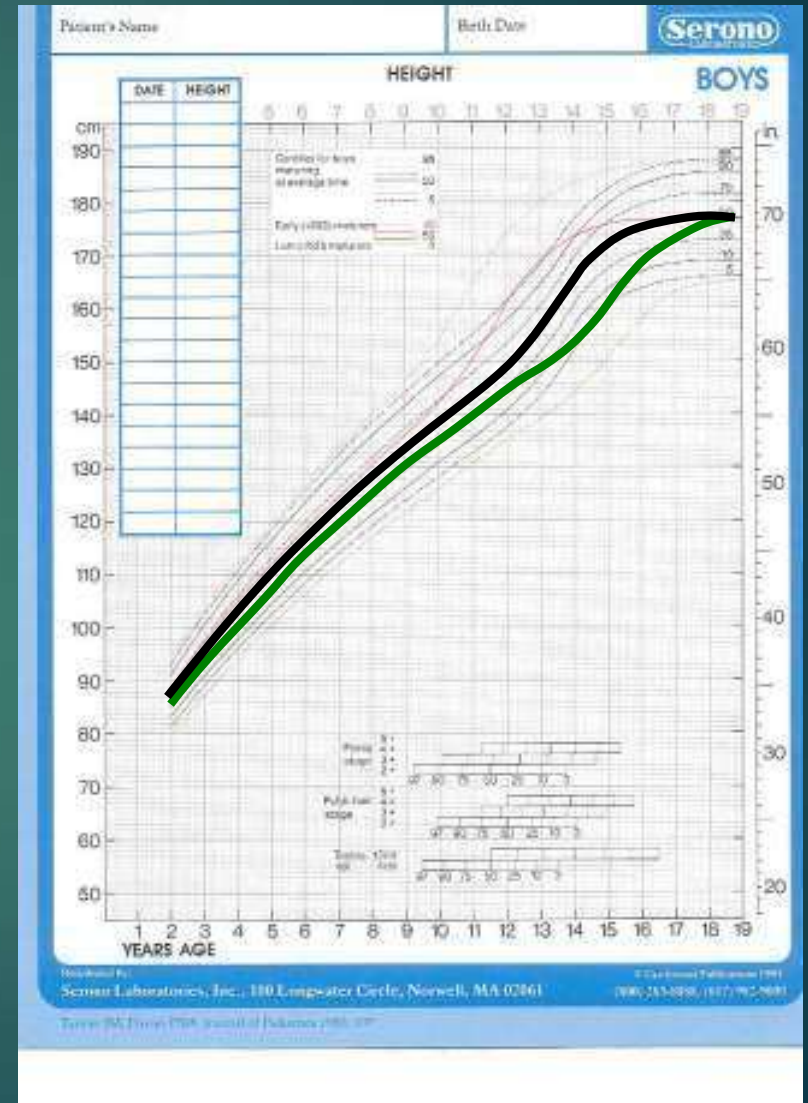
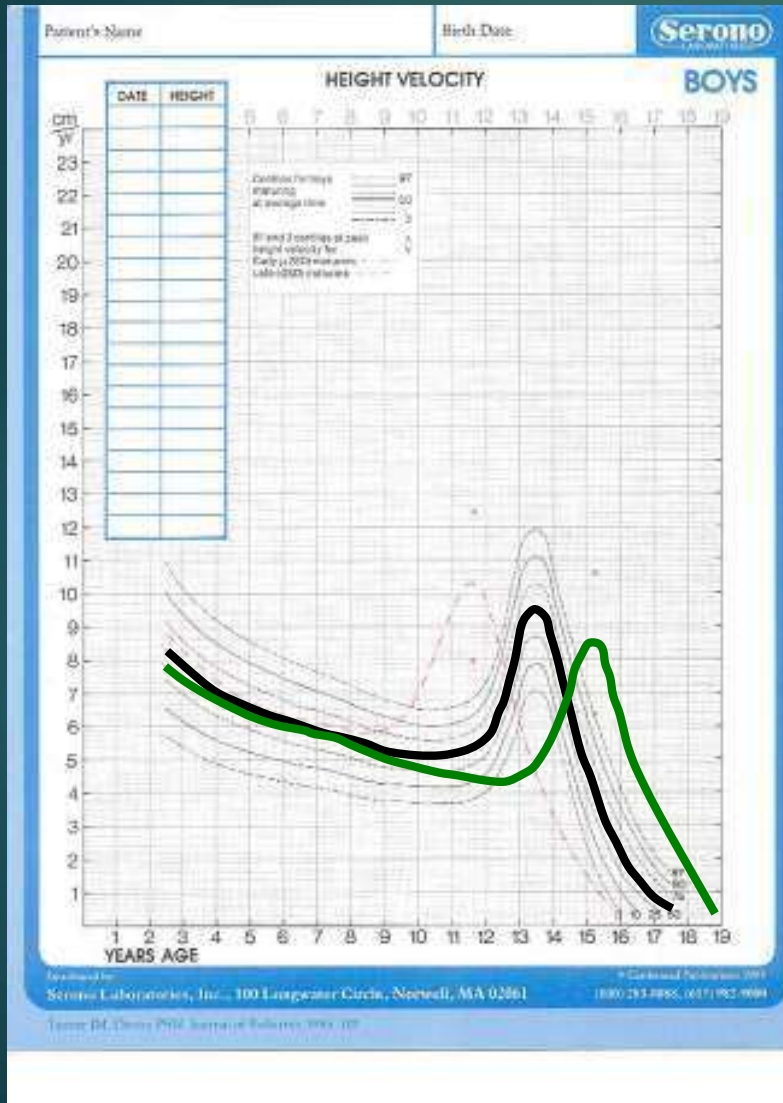


Revised and corrected November 20, 2000.

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000). <http://www.cdc.gov/growthcharts>

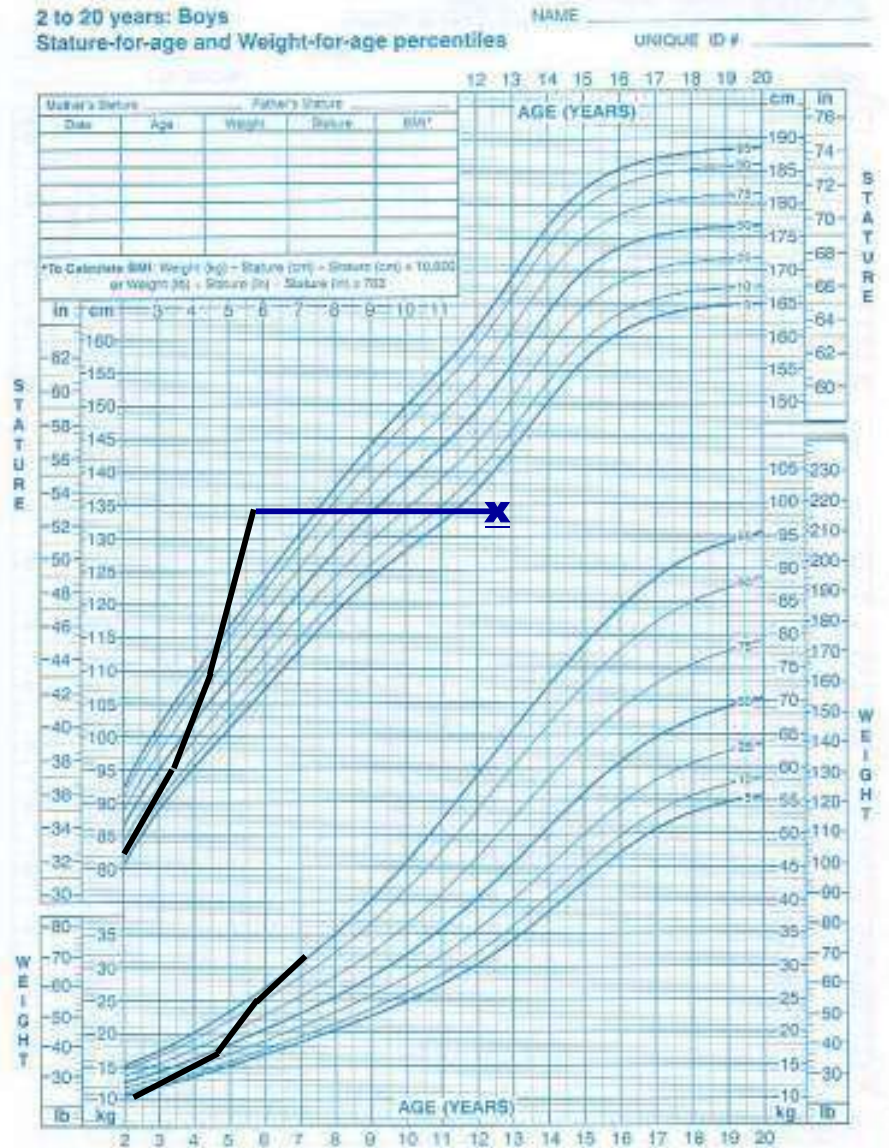


# Constitutional Delay of Growth and Puberty





A 5 year old boy presents with pubic hair, growth acceleration. He has Tanner 4 pubic hair and genitalia with 2 ml teste, what do you think?





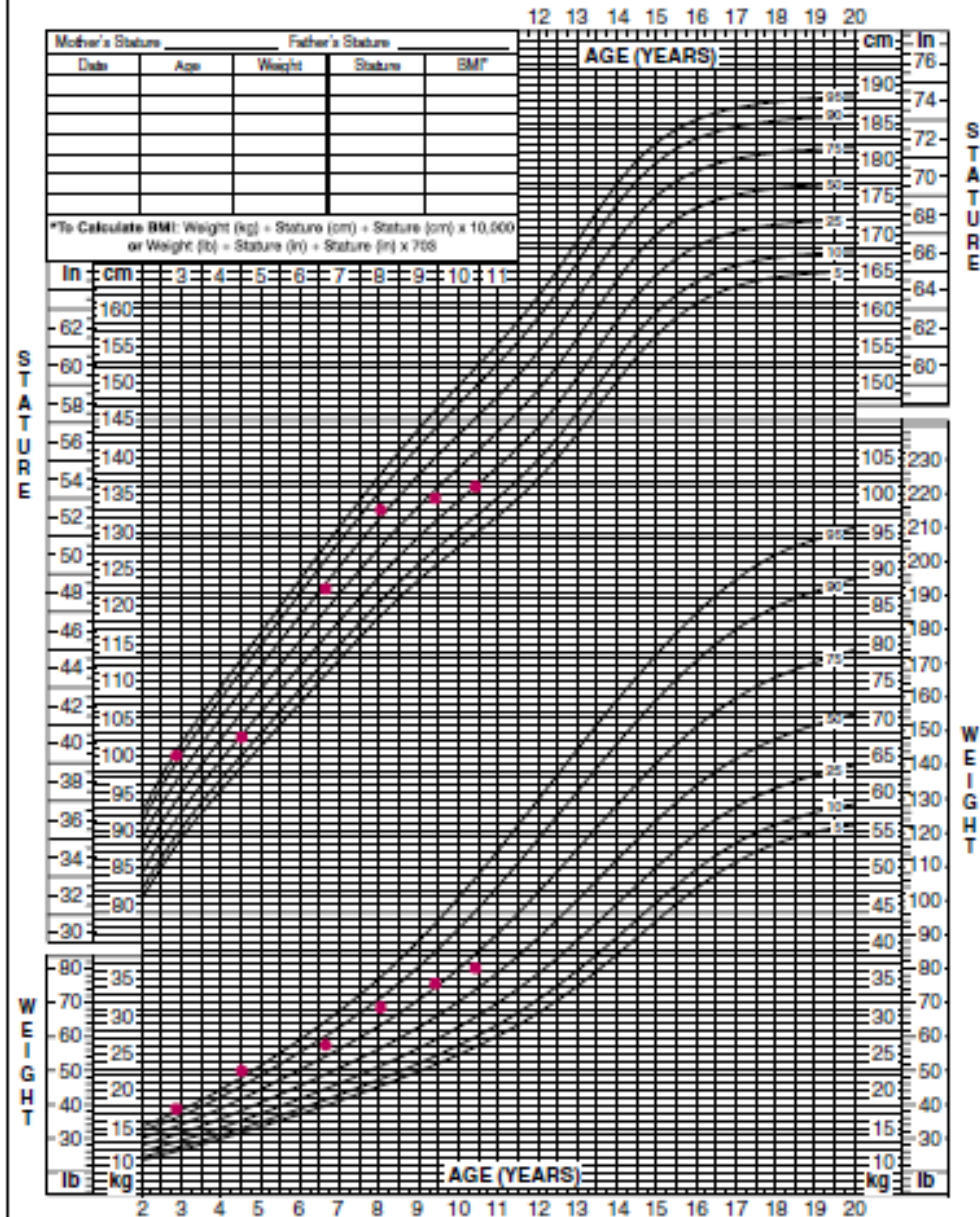
# Acquired Growth Hormone Deficiency

2 to 20 years: Boys

Stature-for-age and Weight-for-age percentiles

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_

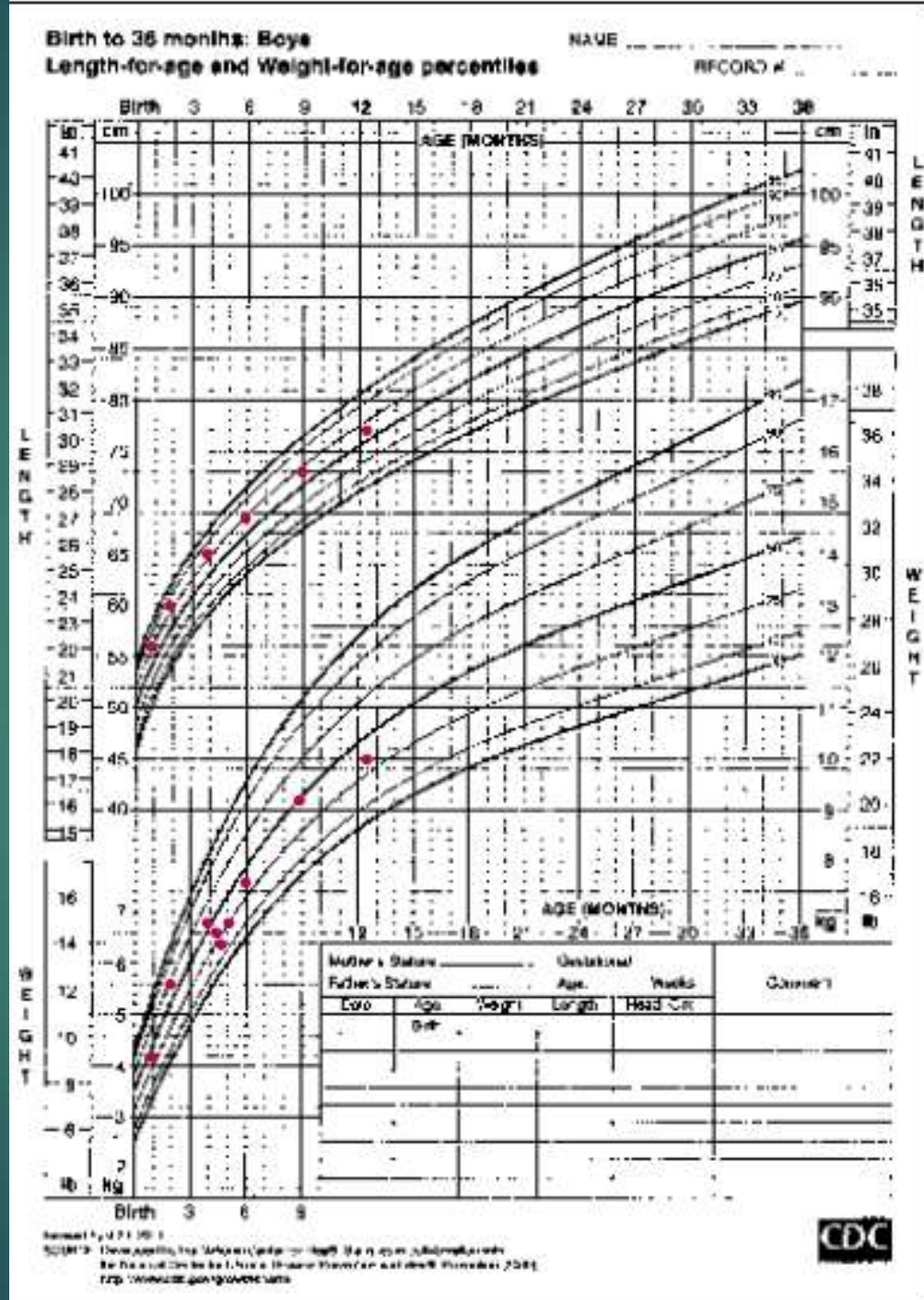


Revised and corrected November 26, 2000.

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000). <http://www.cdc.gov/growthcharts>



# Acute Weight Loss Due to Illness at 2 Months



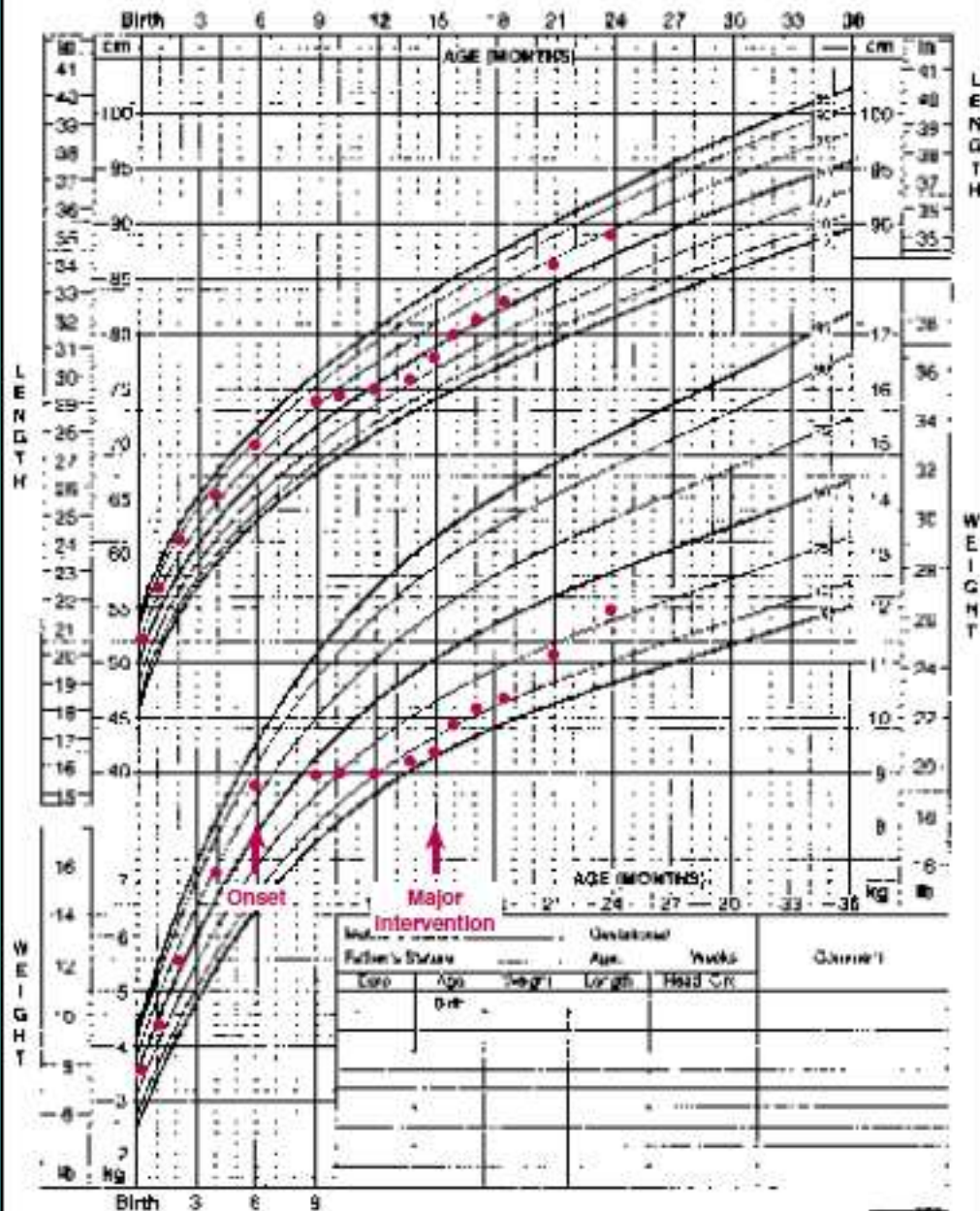
# Failure to Thrive

Birth to 36 months: Boys

Length-for-age and Weight-for-age percentiles

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_



Revised 4/27/2011

©2011 U.S. Department of Health and Human Services  
 For more information on this chart, please visit the CDC website at  
<http://www.cdc.gov/growthcharts>



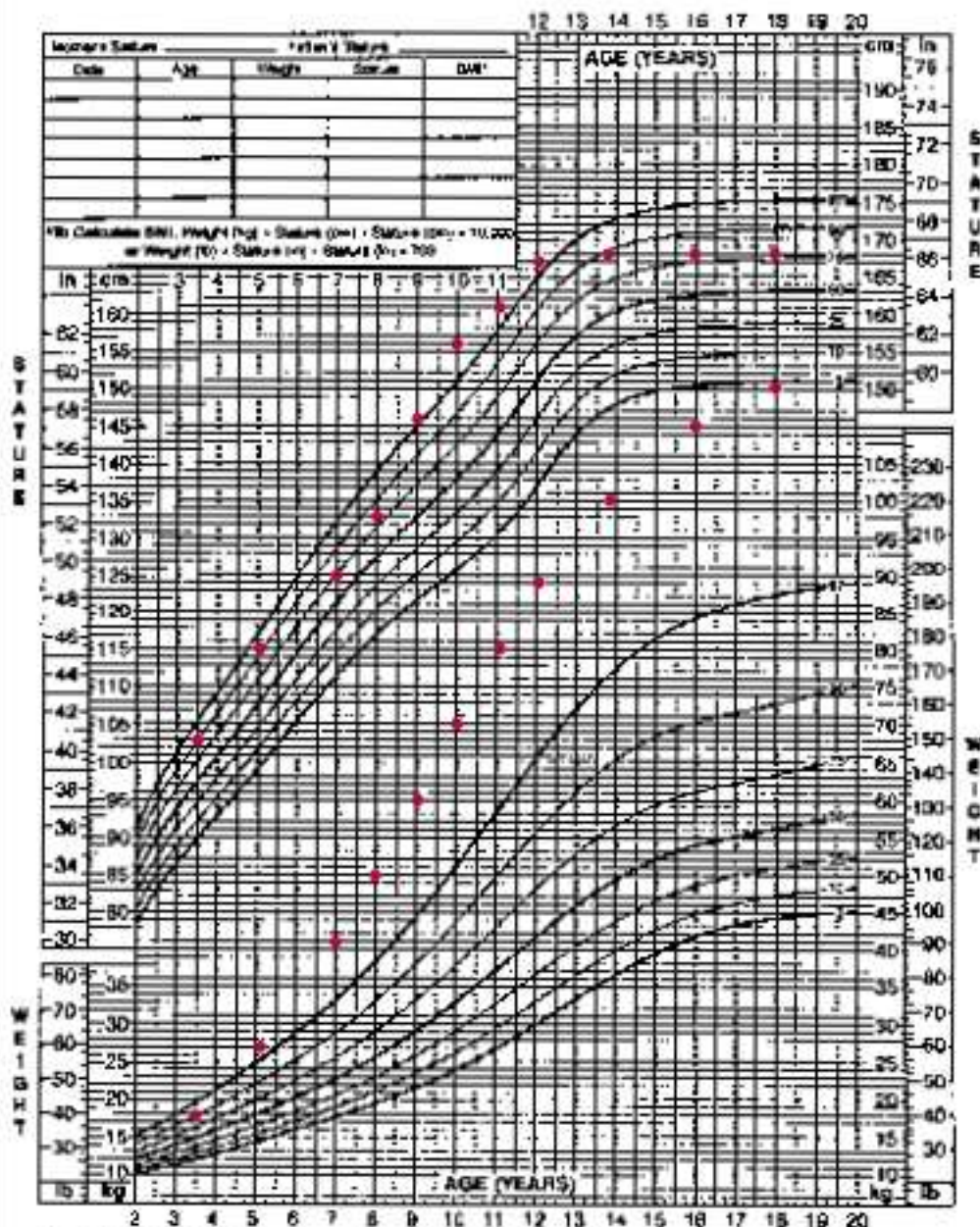


# Exogenous Obesity

2 to 20 years: Girls  
Stature-for-age and Weight-for-age percentiles

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_



Revised and extended MATHUSI, 1988  
SOURCE: Developed by the National Center for Health Statistics in collaboration with  
the National Center for Chronic Disease Prevention and Health Promotion policy  
<http://www.cdc.gov/growthcharts>

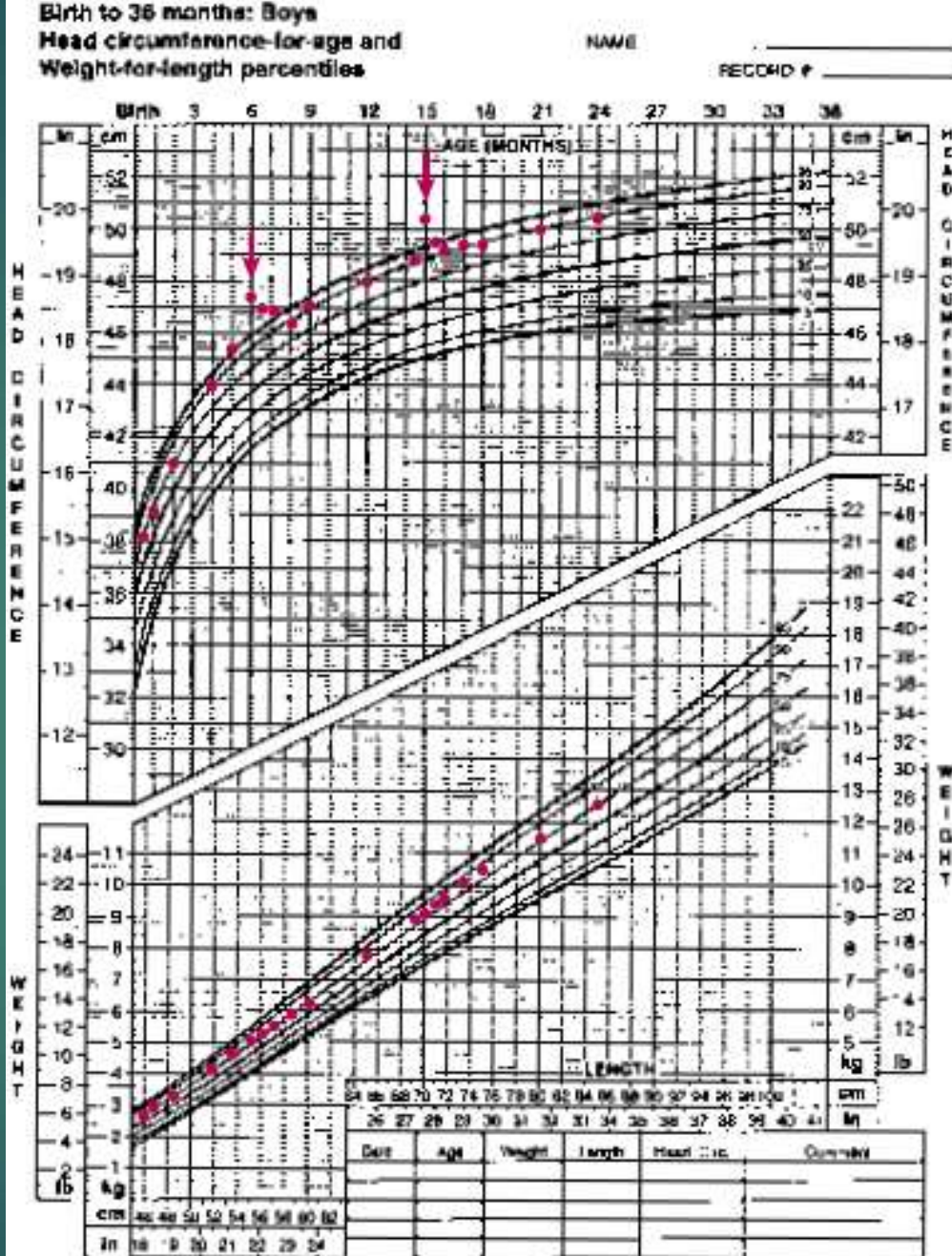




# Hydrocephalus

A ventriculo-peritoneal shunt was placed at 6 mo of age.

It became nonfunctional at 15 mo and was revised.

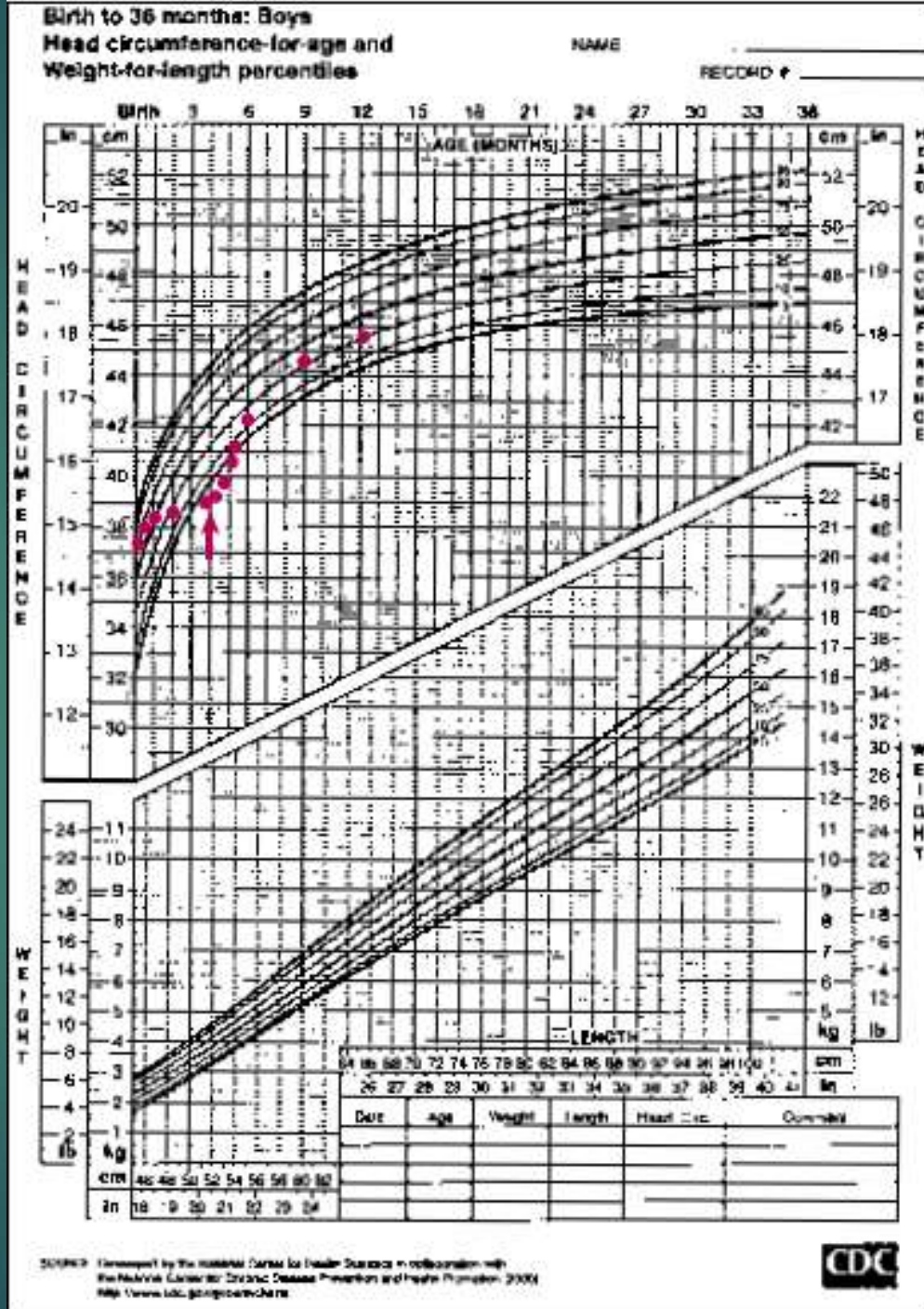


# Craniosynostosis

Premature closure of one or more sutures

Causes microcephaly, deceleration of head growth, and abnormal head shape.

Surgical repair occurred at 4 mos in this child.

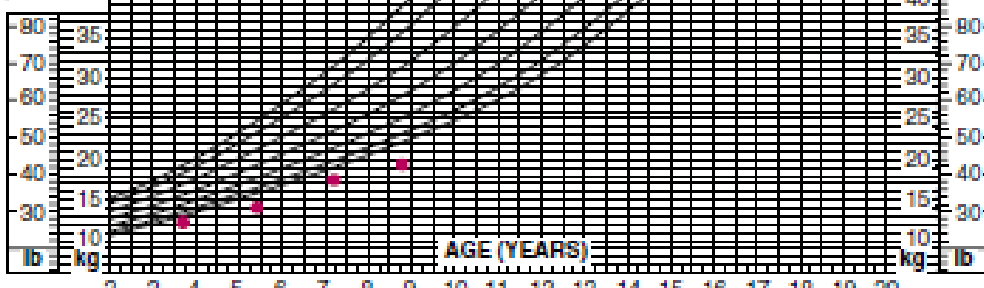
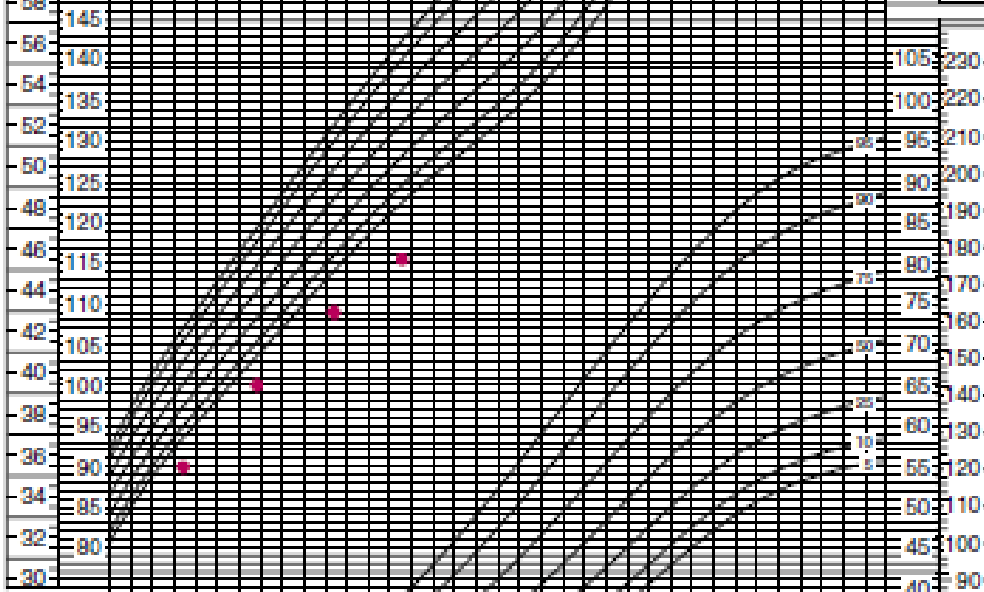


# Stature-for-age and Weight-for-age percentiles

12 13 14 15 16 17 18 19 20

Mother's Stature		Father's Stature		
Date	Age	Weight	Stature	BMF

To Calculate BMI: Weight (kg) ÷ Stature (cm) × Stature (cm) × 10,000  
 or Weight (lb) ÷ Stature (in) × Stature (in) × 703



STATURE

WEIGHT

← Father's height

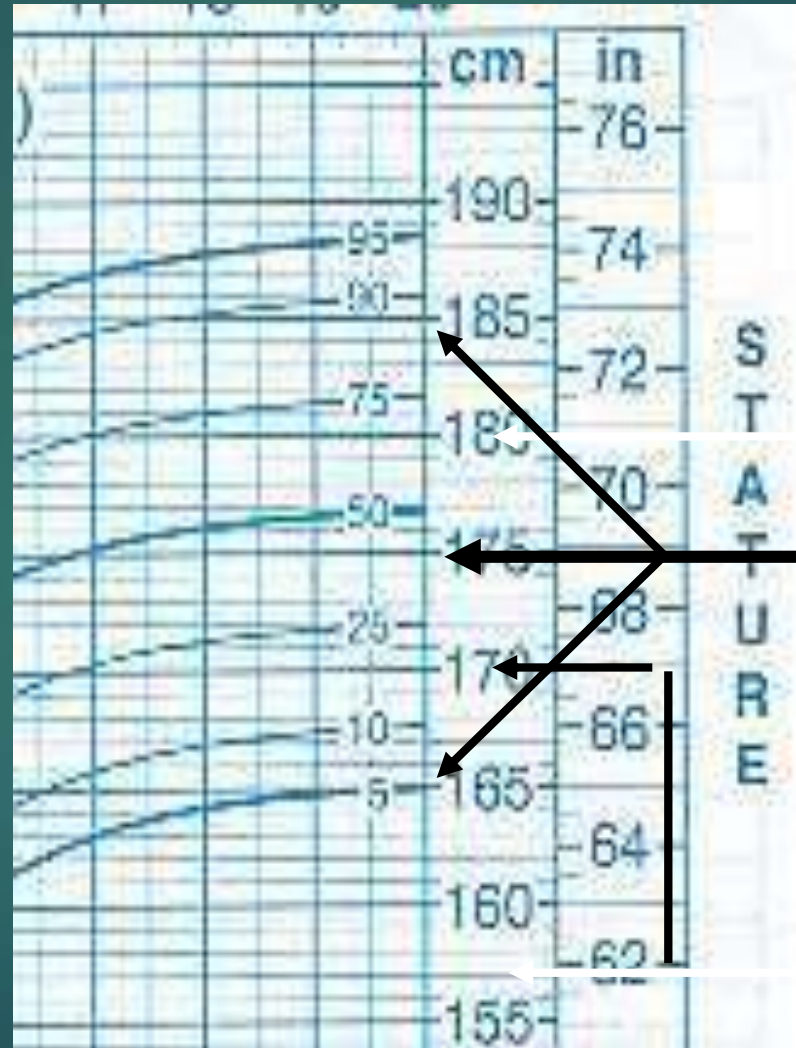
← Mother's height

# Genetic (familial) Short Stature





# Midparental [target] height: males



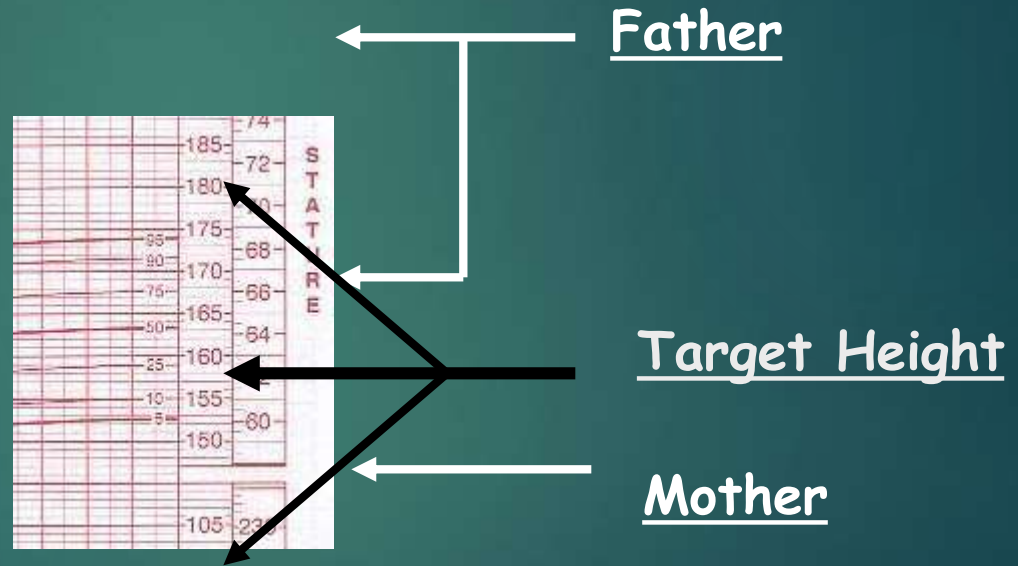
Father

Target Height

Mother



# Midparental [target] height: females

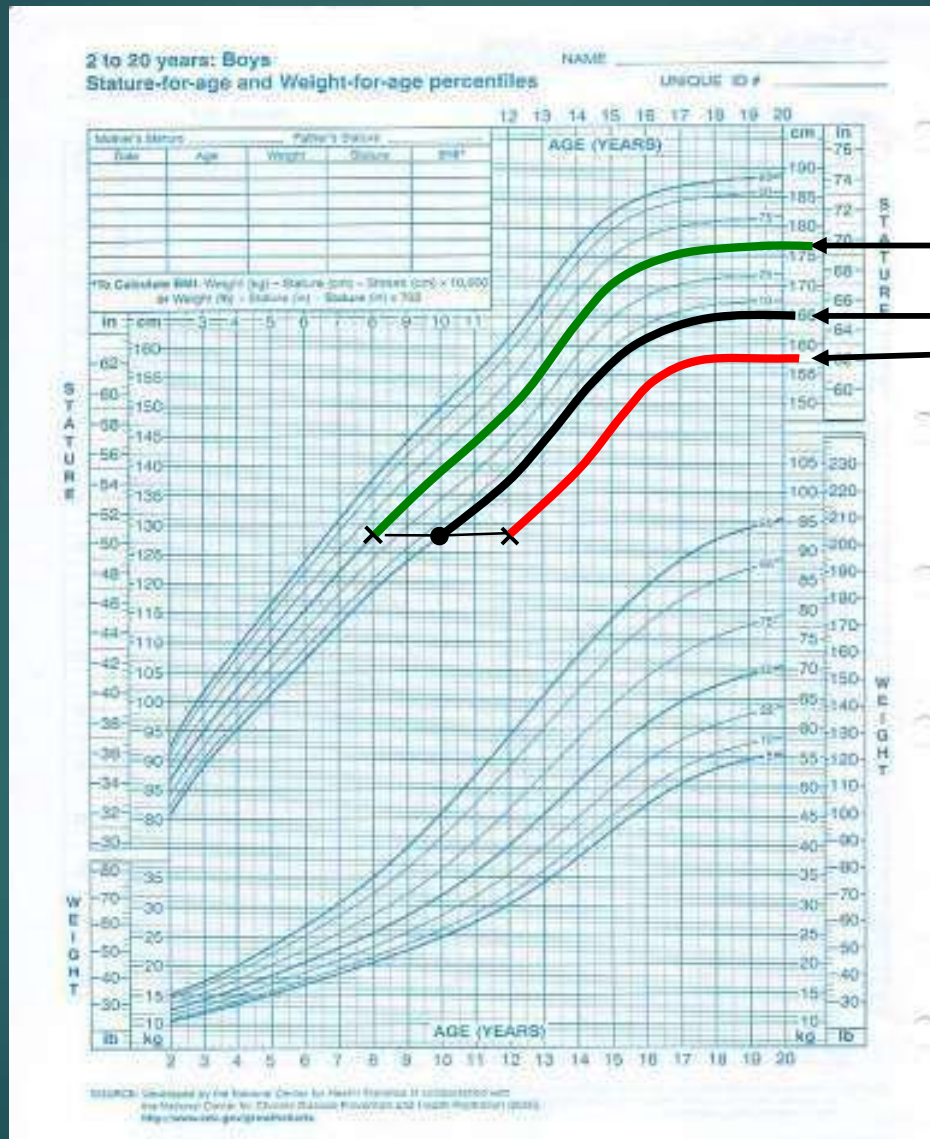


# Predicted

3 boys age 10  
128 cm

Bone age (BA)  
8, BA 10 and  
BA 12

Which will be  
taller as an  
adult?



# Normal Newborn Infant

## Physical growth

- Weight = 2.700 – 4 kg
- Wt loss 5% -10% by 3-4 days after birth
- Wt gain by 10<sup>th</sup> days of life
- Gain  $\frac{3}{4}$  kg by the end of the 1<sup>st</sup> month

# Weight:

They lose 5 % to 10 % of weight by 3-4 days after birth as result of :

- Withdrawal of hormones from mother.
- Loss of excessive extra cellular fluid.
- Passage of meconium (feces) and urine.
- Limited food intake.



## Classification by Gestational Age and Birth Weight

### Gestational Age

Classification	Gestational Age
▶ Preterm	▶ <34 wks
▶ Late preterm	▶ 34–36 wks
▶ Term	▶ 37–42 wks
▶ Postterm	▶ >42 wks

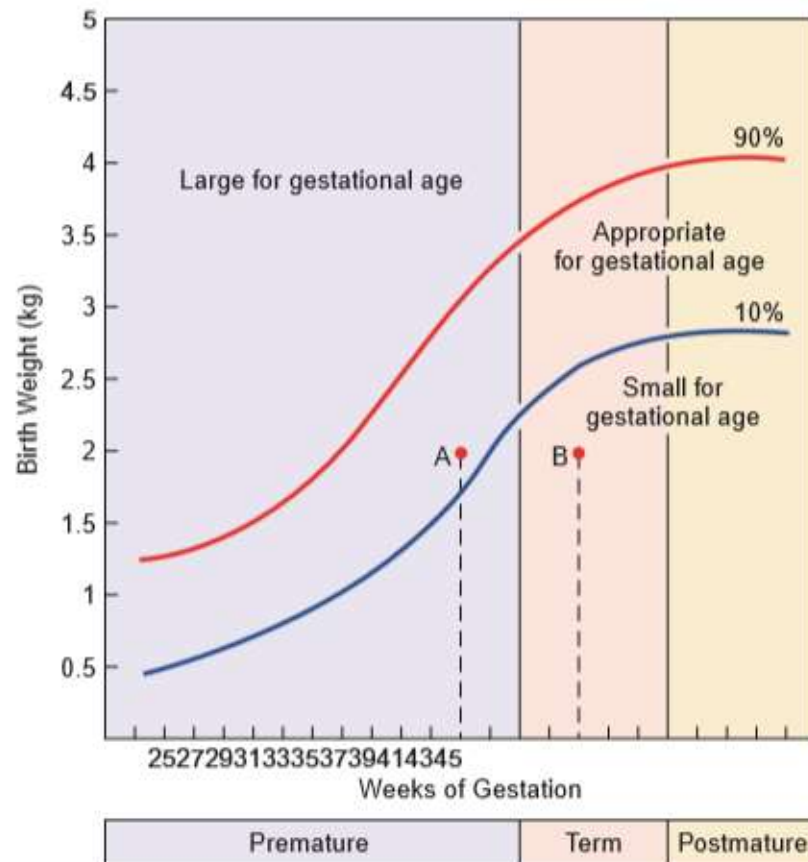
### Birth Weight

Classification	Weight
▶ Extremely low birth weight	▶ <1,000 g
▶ Very low birth weight	▶ <1,500 g
▶ Low birth weight	▶ <2,500 g
▶ Normal birth weight	▶ $\geq$ 2,500 g

## Newborn Classifications<sup>10</sup>

Category	Abbreviation	Percentile
Small for gestational age	SGA	<10th
Appropriate for gestational age	AGA	10–90th
Large for gestational age	LGA	>90th

# Intra Uterine GC



# What's BMI

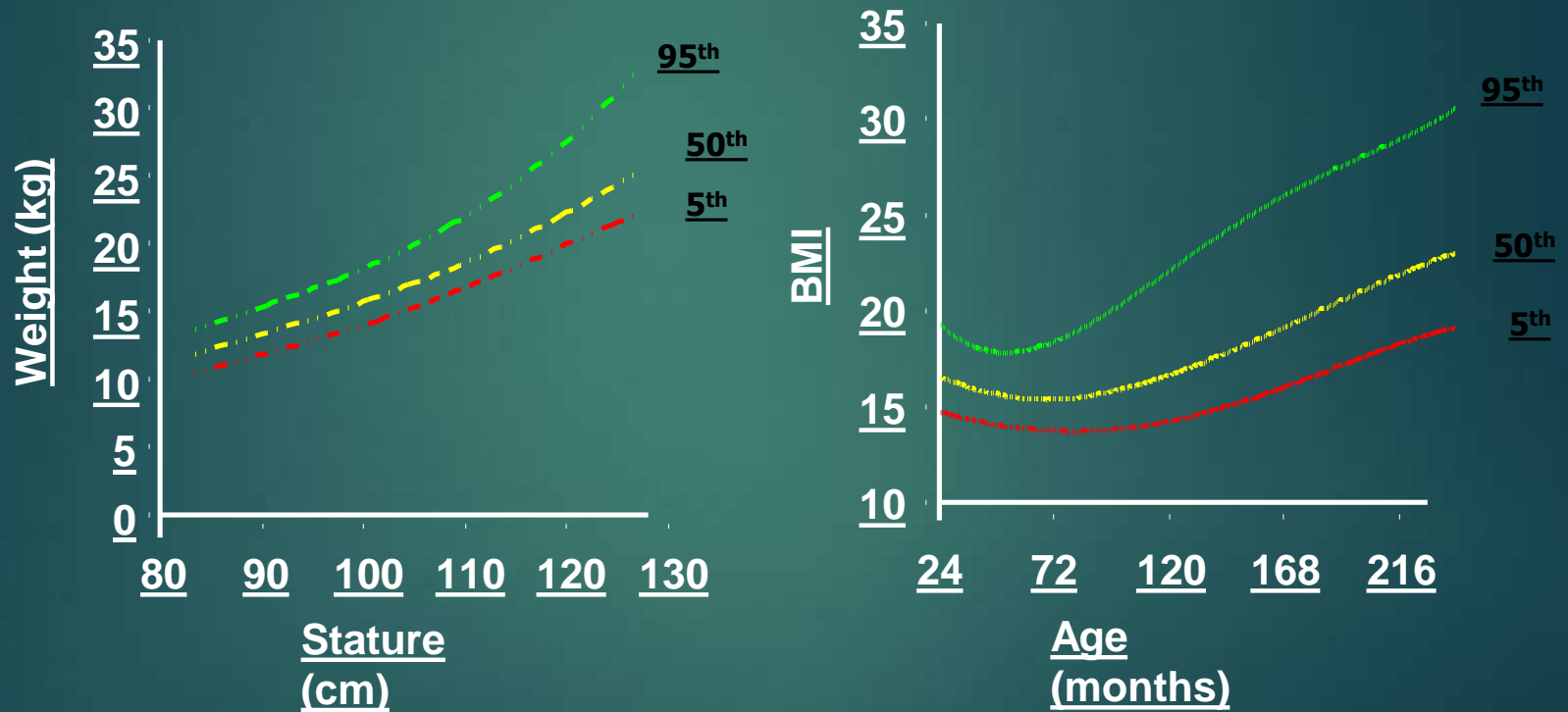
- ▶ Body mass index (BMI) =  
weight (kg)/height (m)<sup>2</sup>
- ▶ BMI is an effective screening tool; it is not a diagnostic tool
- ▶ For children, BMI is age and gender specific, so BMI-for-age is the measure used

# Interpreting the BMI-for-Age Chart

- ▶ **BMI-for-age indicates a child's weight in relation to his/her height for a specific age and gender**
- ▶ **Need a series of BMI plots to determine the growth trend**
- ▶ **If indices deviate from normal growth patterns, further assessment may be needed**



# Shape of Weight-for-Stature Curve versus BMI-for-Age Curve



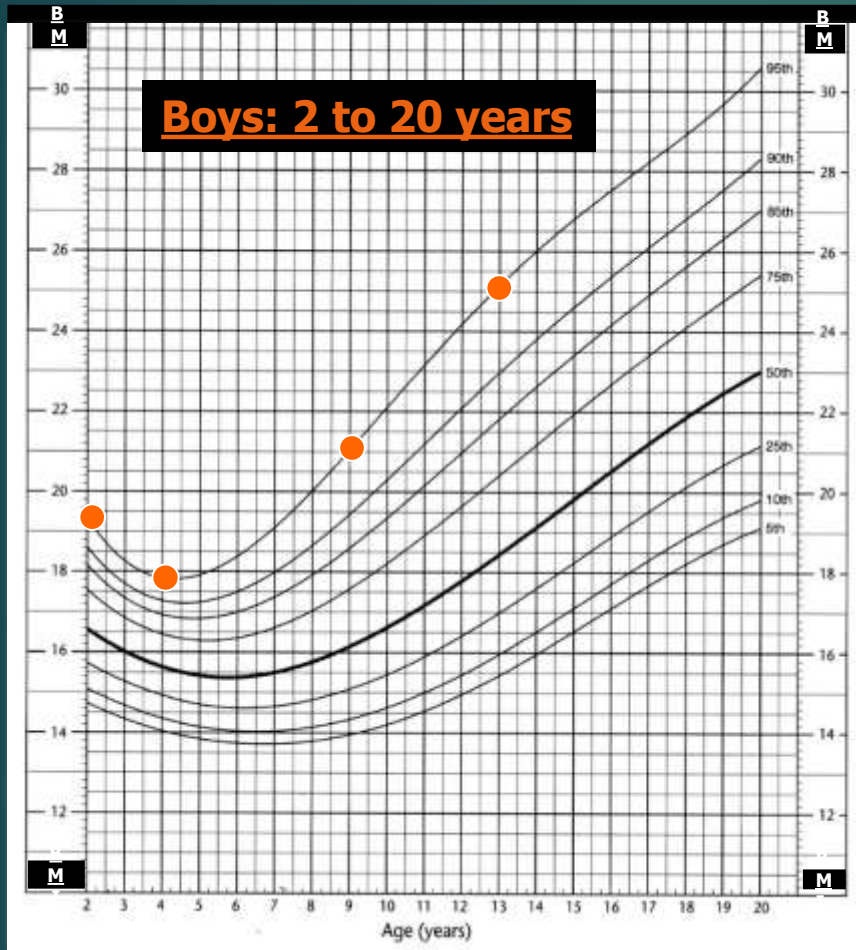
# BMI-for-Age Cutoffs

> 95<sup>th</sup> percentile      Obese

85<sup>th</sup> to < 95<sup>th</sup>  
percentile      Overweight

< 5<sup>th</sup> percentile      Underweight

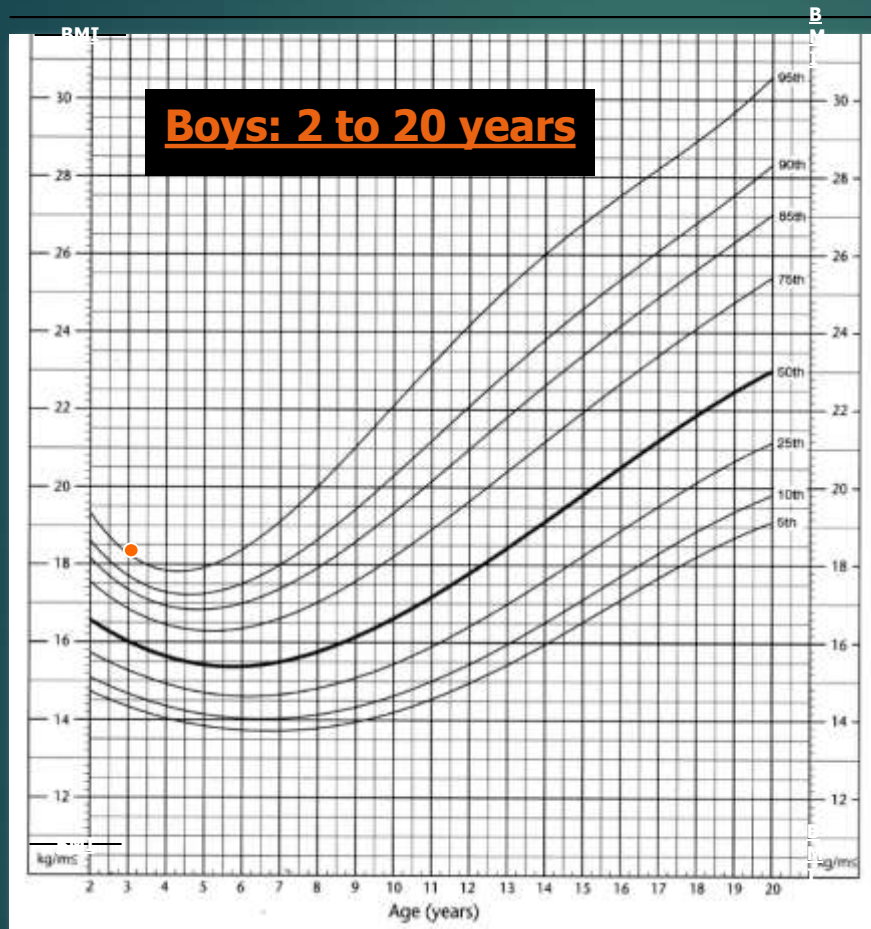
# For Children, BMI Changes with Age



## Example: 95th Percentile Tracking

<u>Age</u>	<u>BMI</u>
<u>2 yrs</u>	<u>19.3</u>
<u>4 yrs</u>	<u>17.8</u>
<u>9 yrs</u>	<u>21.0</u>
<u>13 yrs</u>	<u>25.1</u>

# Plotted BMI-for-Age



## Measurements:

Age=3 y 3 wks

Height=100.8 cm  
(39.7 in)

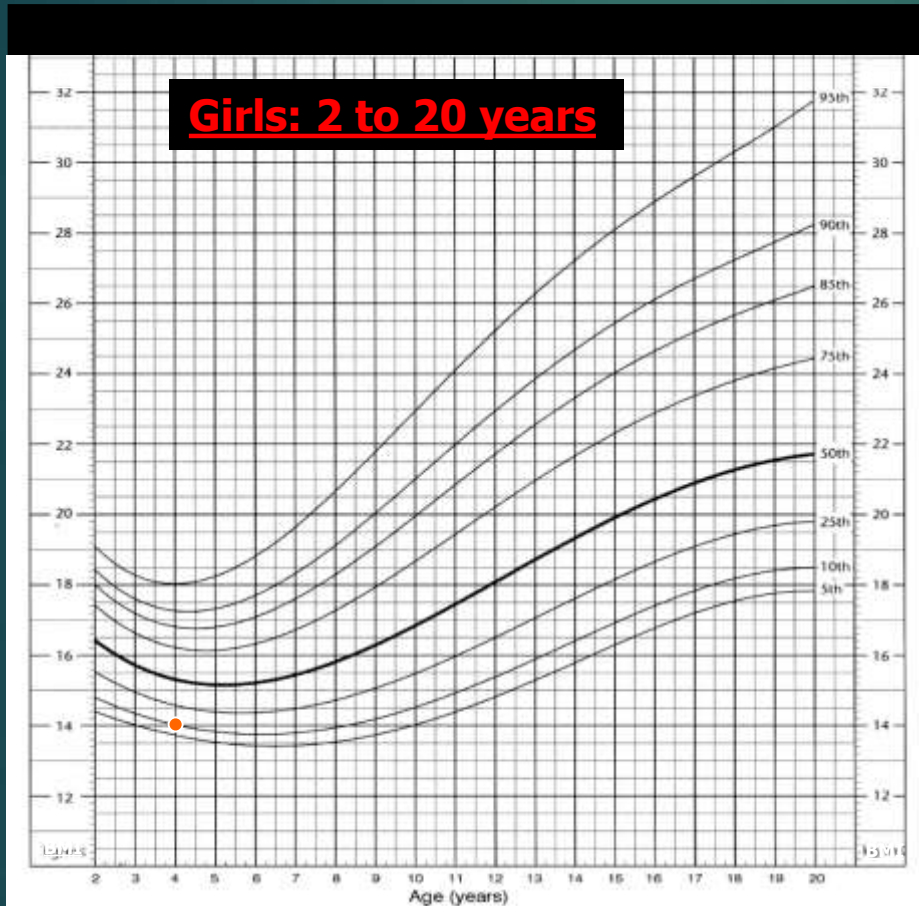
Weight=18.6 kg  
(41 lb)

BMI=18.3

BMI-for-age=  
>95<sup>th</sup> percentile  
overweight



# Plotted BMI-for-Age



## Measurements:

Age= 4 y 4 wks

Height=106.4 cm  
(41.9 in)

Weight=15.7 kg  
(34.5 lb)

BMI=13.9

BMI-for-age=  
10<sup>th</sup> percentile  
Normal

Thank  
You



PHOTO: GETTY IMAGES