Pediatric Growth, Failure to Thrive, & Obesity

Structured Review & High-Yield Concepts

1. Fundamentals of Growth & Development

Growth is a highly regulated, dynamic process reflecting a child's overall health, nutritional status, and genetic potential. Growth velocity is pulsatile and a more sensitive indicator of health than a single measurement.

- **Growth parameters:** Weight for age, height/length for age, weight for length, BMI for age, head circumference (HC) for age.
- **Determinants:** Maternal nutrition, intrauterine environment (crucial for first 6 months), genetic potential, and endocrinal factors (GH, Thyroid, Sex steroids).

2. Expected Milestones: Weight & Height

Weight Progression

- Term neonates may lose up to 10% of their birth weight but typically regain it by 10-14 days.
- **0-3 months:** Gain ~30 g/day.
- **3-6 months:** Gain ~20 g/day.
- **6-12 months:** Gain ~10 g/day.
- **Prepubertal Children:** Gain ~2 kg/year. (Velocity < 1 kg/year warrants close monitoring).

> **MEMORY AID: WEIGHT MILESTONES**
>
> Remember the multiples: **"Double at 4, Triple at 12"**
>
> - Infants **double** their birth weight by **4 months**.
> - Infants **triple** their birth weight by **1 year (12 months)**.

Linear Growth (Length/Height)

Average birth length for a term infant is 50 cm. Normal velocity prepuberty is 5-6 cm/year. A child reaches 50% of their adult height by 24 to 30 months.

> **MEMORY AID: THE "RULE OF FIVES" FOR HEIGHT**
>
> Track normal length/height in centimeters using easy benchmarks:
>
> - **Birth:** 50 cm
> - **1 year:** 75 cm *(+25 cm)*
> - **4 years:** 100 cm *(+25 cm over 3 years)*
> - **8 years:** 125 cm *(+25 cm over 4 years)*
> - **12 years:** 150 cm *(+25 cm over 4 years)*

3. Measurement Rules & Body Proportions

Stature Measurement

- **< 2 Years Old:** Measure *recumbent length* using a measuring board (stadiometer) with the child fully supine.
- **> 2 Years Old:** Measure *standing height* (stadiometer). Heels, buttocks, shoulders, and head should touch the back wall.

Mid-Parental Height (MPH)

95% of normal individuals attain final heights within 2 standard deviations (±8.5 cm) of MPH.

- **Boys:** $(Father\ Ht + Mother\ Ht + 13) / 2$
- **Girls:** $(Father\ Ht + Mother\ Ht - 13) / 2$

Body Proportions (Upper/Lower Segment Ratio)

Measured using the pubic symphysis as the dividing line. The US:LS ratio changes as legs grow faster than the trunk during childhood.

- **Birth:** 1.7
- **7 to 10 years:** 1.0

> **MEMORY AID: US:LS RATIO ALTERATIONS**
>
> **Increased Ratio (Short Limbs):** Achondroplasia, untreated hypothyroidism.
> **Decreased Ratio (Long Limbs/Short Trunk):** Marfan syndrome (arachnodactyly), severe scoliosis.

4. Failure to Thrive (FTT)

Definition: When a child does not meet the expected rate of growth, or crosses 2 major centiles downward over 6-12 months. FTT primarily impacts weight first, distinguishing it from constitutional short stature.

Type	Weight	Height	Head Circ. (HC)	Typical Etiology
Type I (Wasted)	↓	Normal / ↓ (Late)	Normal	Malnutrition, inadequate caloric intake/ absorption (e.g., neglect, Celiac, CF)
Type II (Stunted)	↓	↓	Normal	Endocrine (Hypothyroidism, GH deficiency), Bony dystrophy, Constitutional
Type III (Symmetric)	↓	↓	↓	Chromosomal (Down, Turner), Intrauterine infections (TORCH), CNS anomalies

> **MEMORY AID: FTT TYPES SEQUENCE**
>
> Think of the body's priority to protect the brain. When resources drop, parameters fall in this order:
> **1. Weight fades** (Type 1: Diet/GI)
> **2. Height halts** (Type 2: Endocrine/Bones)
> **3. Head shrinks** (Type 3: Genetic/Neuro/TORCH)

Red Flags in FTT (Require deeper medical evaluation)

- Cardiac findings (murmur, edema, JVD)
- Dysmorphic features or Organomegaly
- Failure to gain weight *despite* adequate verified caloric intake
- Recurrent infections (respiratory, UTI), vomiting, or diarrhea

5. Refeeding Syndrome

A potentially fatal clinical complication resulting from fluid and electrolyte shifts during aggressive nutritional rehabilitation of severely malnourished patients.

- **Pathophysiology:** Upon refeeding, insulin release causes rapid cellular uptake of phosphate, magnesium, and potassium.

- **Management:** Gradual institution of enteral feeding, close electrolyte monitoring, and prompt replacement.

> **MEMORY AID: REFEEDING SYNDROME**
>
> **"Phos Falls Fast"**
> **Hypophosphatemia** is the hallmark. Also watch for drops in **Potassium (K)** and **Magnesium (Mg)**, leading to life-threatening cardiac arrhythmias and neuro problems.

6. Pediatric Obesity

Imbalance between calorie intake and expenditure. Secondary causes must be ruled out (e.g., Cushing's, Hypothyroidism, Prader-Willi, Bardet-Biedl).

Definitions (Based on BMI centile > 2 years)

- **Overweight:** > 85th to 95th centile
- **Obese:** > 95th centile
- **Severely Obese:** > 99.6th centile

Appetite Regulation Hormones

Obesity relates closely to dysregulation in the gut-brain-adipose axis.

- **Promote Hunger:** Ghrelin (from stomach), Neuropeptide Y (NPY), Agouti-related peptide (AgRP), Orexin.
- **Promote Satiety:** Leptin (from adipocytes), Cholecystokinin (CCK), GLP-1, Peptide YY, Alpha-MSH.

> **MEMORY AID: HUNGER HORMONES**
>
> **Ghrelin** makes your stomach **G**rowl (Stimulates Appetite).
> **Leptin L**eaves you full (Promotes Satiety).

Comorbidities to Screen For

- Type-2 Diabetes (Acanthosis nigricans, osmotic symptoms)
- Obstructive Sleep Apnea (snoring, daytime somnolence)
- Orthopedic (Slipped Capital Femoral Epiphysis - SCFE, Blount disease)
- PCOS, NAFLD, Metabolic Syndrome, and psychosocial distress (bullying, depression).