Breast milk and infant nutrition

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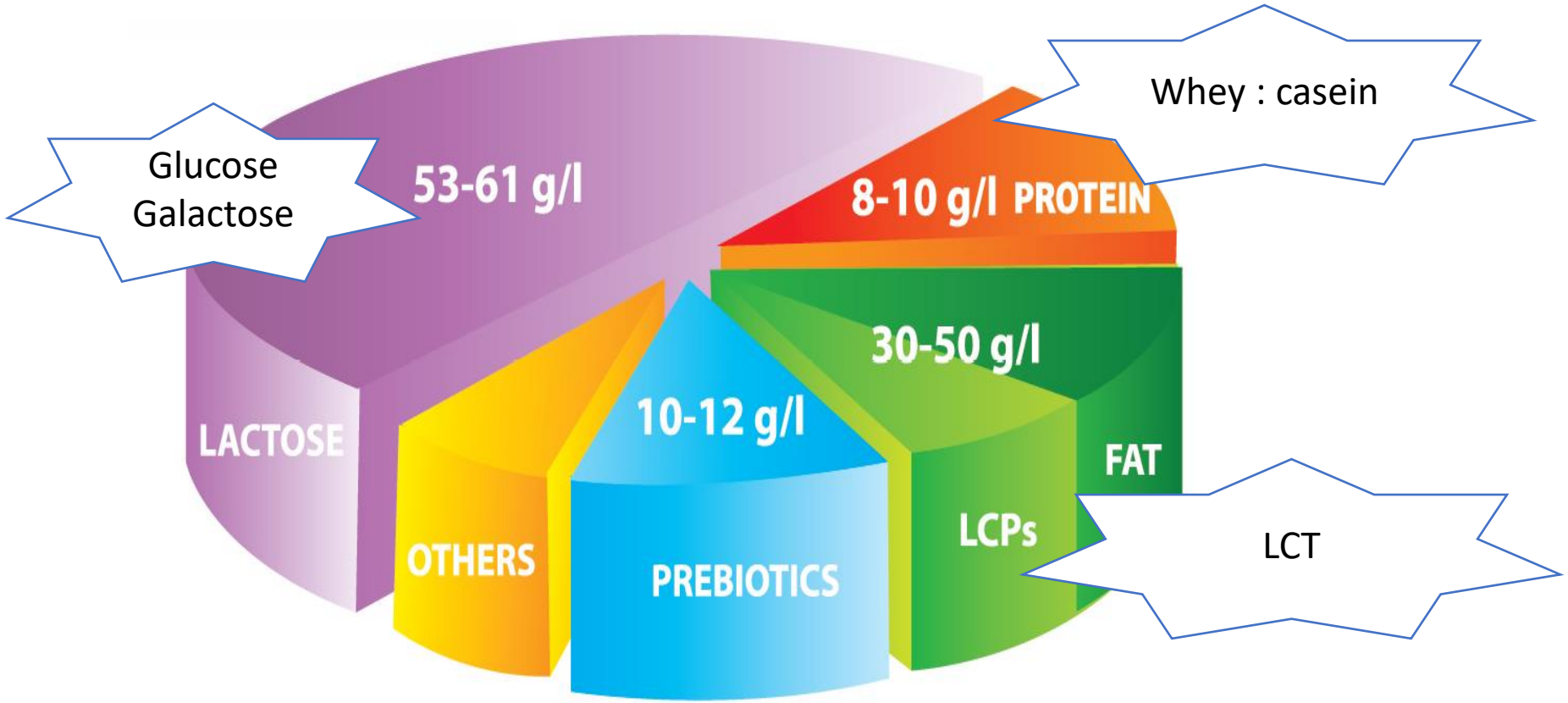
Contents

- Composition and benefits of breast milk
- Practical approach to formulas
- Cow’s Milk Protein Allergy : CMPA

Composition of breast milk



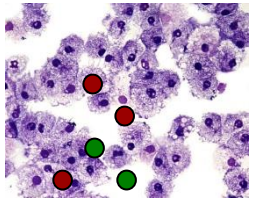
Composition of breast milk

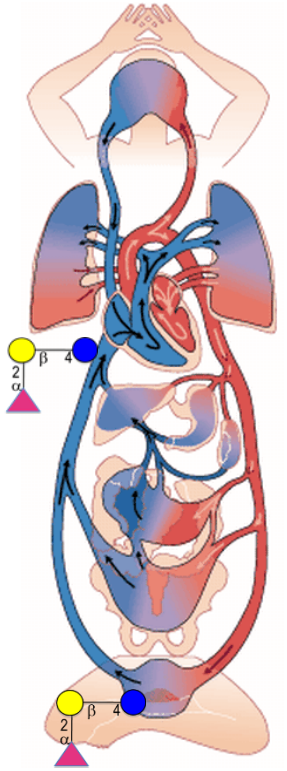
Antimicrobial factors	Hormones	Cytokines and anti-inflammatory factors
Secretory IgA, IgM, IgG	Feedback inhibitor of lactation	Tumor necrosis factor
Lysozyme	Insulin	Interleukins
Complement C3	Prolactin	Interferon-γ
Leukocytes	Thyroid hormones	Prostaglandins
Lipids and fatty acids	Corticosteroids, ACTH	α1-antichymotrypsin
Antiviral mucins, GAGs	Oxytocin	α1-antitrypsin
Lactoferrin	Calcitonin	Platelet-activating factor: acetyl hydrolase
Nucleotides	Parathyroid hormone	Human milk oligosaccharides
Human milk oligosaccharides	Erythropoietin	

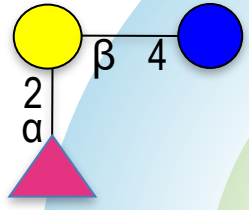
Digestive enzymes	Transporters	Growth factors	Others
Amylase	Lactoferrin (Fe)	Epidermal (EGF)	Casomorphins
Bile acid-stimulating esterase	Folate binder	Nerve (NGF)	δ-sleep peptides
Bile acid-stimulating lipases	Cobalamin binder	Insulin-like (IGF)	DNA, RNA
Lipoprotein lipase	IgF binder	Transforming (TGF)	Carotenoids
	Thyroxine binder	Taurine	
	Corticosteroid binder	Polyamines	

Prentice A. Constituents of human milk. United Nations University website. http://archive.unu.edu/unupress/food/8F174e/8F174E04.htm. Accessed February 26, 2016.

Human Milk Oligosaccharides HMO







Benefits of breast milk

- Immunity and protection against infection:
  - Antibodies in the milk
  - Cytokines
  - Normal flora growth factors

The Power of Human Milk

Saving Lives

Diarrhea

Children who are breastfed have a substantially lower risk of suffering and dying from infectious diarrhea as well as respiratory infections.

The Power of Human Milk

Saving Preterm Lives

Necrotizing Enterocolitis

Preterm infants who receive human milk are at six- to ten-fold lower risk to develop necrotizing enterocolitis.

The Power of Human Milk

Benefits for Life

The Power of Human Milk

Good for Mothers

Breastfeeding Reduces Infant Risks of Major Infectious and Inflammatory Diseases

- Severe lower respiratory tract infections (LRTI)
- Acute gastroenteritis (AGE)
- Acute otitis media (AOM)
- Necrotizing enterocolitis (NEC): preterm
- Sudden infant death syndrome
- Atopic dermatitis
- Childhood asthma
- Childhood leukemia
- Type 1 diabetes

Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries
Evidence Reports/Technology Assessments, No. 153. Investigators: Ip, Chung, et al, Agency for Healthcare Research and Quality (US); April 2007.

(Bartick & Reinhold, Pediatrics, 2010)

Mother- Baby Bonding

Benefits of breast milk to the mother

- Helps with mother weight loss
- Helps uterine contraction post delivery
- Helps with to get rid of pregnancy hormones
- Act as contraceptive : Lactation induced amenorrhea LAM

Other Benefits of breast milk

- Available 24/7
- Cheaper!
- No need for preparation : bottle/ water

Table 42-3 CONDITIONS FOR WHICH HUMAN MILK HAS BEEN SUGGESTED TO HAVE A PROTECTIVE EFFECT

- Acute disorders
  - Diarrhea
  - Otitis media
  - Urinary tract infection
  - Necrotizing enterocolitis
  - Septicemia
  - Infant botulism
- Chronic disorders
  - Insulin-dependent diabetes mellitus
  - Celiac disease
  - Crohn's disease
  - Childhood cancer
    - Lymphoma
    - Leukemia
  - Recurrent otitis media
  - Allergy
- Obesity and overweight
- Hospitalizations
- Infant mortality

Adapted from the Schanler RJ, Dooley S: *Breastfeeding handbook for physicians*, Elk Grove Village, IL, 2006, American Academy of Pediatrics.

BREAST IS BEST

Patterns of milk supply

Colostrum milk

Table 42-5 PATTERNS OF MILK SUPPLY

DAY OF LIFE	MILK SUPPLY
Day 1	Some milk (~5 mL) may be expressed
Days 2-4	Lactogenesis, milk production increases
Day 5	Milk present, fullness, leaking felt
Day 6 onward	Breasts should feel "empty" after feeding

Adapted from Neifert MR: Clinical aspects of lactation: promoting breastfeeding success, *Clin Perinatol* 26:281–306, 1999.

INFANT FORMULAS

Infant formulas

- Can be classified according to their content:

- Protein content
- Carbohydrate content
- Fat content

How to think about formulas

Formula type	Prtn content	CHO content	fat content

Infant Formulas – Protein Content

- Divided into 4 classes of formulas
  - Cow's milk based formulas
    variable prtn content
    variable whey: casein ratio
  - Soy formulas
  - Casein hydrolysate formulas
    Extensive Vs partial
  - Amino acid based formulas

Indiana University School of Medicine
Department of Educational Technology

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Protein Content of Infant Formulas

Protein Source	Examples	Indications	Price*
Cow's Milk	Enfamil with Iron Enfamil Lipil Similac with Iron Similac Advance Carnation Good Start Good Start Supreme Enfamil Gentlease Enfamil AR Store Brands	Normal GI tract; Enfamil AR used for gastroesophageal reflux	$
Soy	Prosobee Isomil Alsoy Store Brands	Cow's milk protein allergy, Lactose malabsorption, or Galactosemia	$
Casein Hydrolysate	Nutramigen Alimentum Pregestimil	Cow's milk and/or soy allergy; Alimentum and Pregestimil are also used for malabsorption	$$
Amino Acids	Neocate Elecare	Severe protein allergy not responsive to casein hydrolysate formula	$$$-$$$$

S26
Nan
Bebelac
Seha
Similac
Ronlac
AR formulas
"Sensitive" / LF/

Primilac CMA
Bebelac HA
Nan HA

* Each $ = approximate cost of standard cow's milk based formula

As you move down this table from cow's milk to soy to hydrolysate to amino acid based formulas, the formulas become less antigenic; formulas within a class are similarly antigenic to one another. When choosing a formula to treat milk protein allergy, you should progress down the table. It is not beneficial to change to a different formula

Infant Formulas – Carbohydrate Content

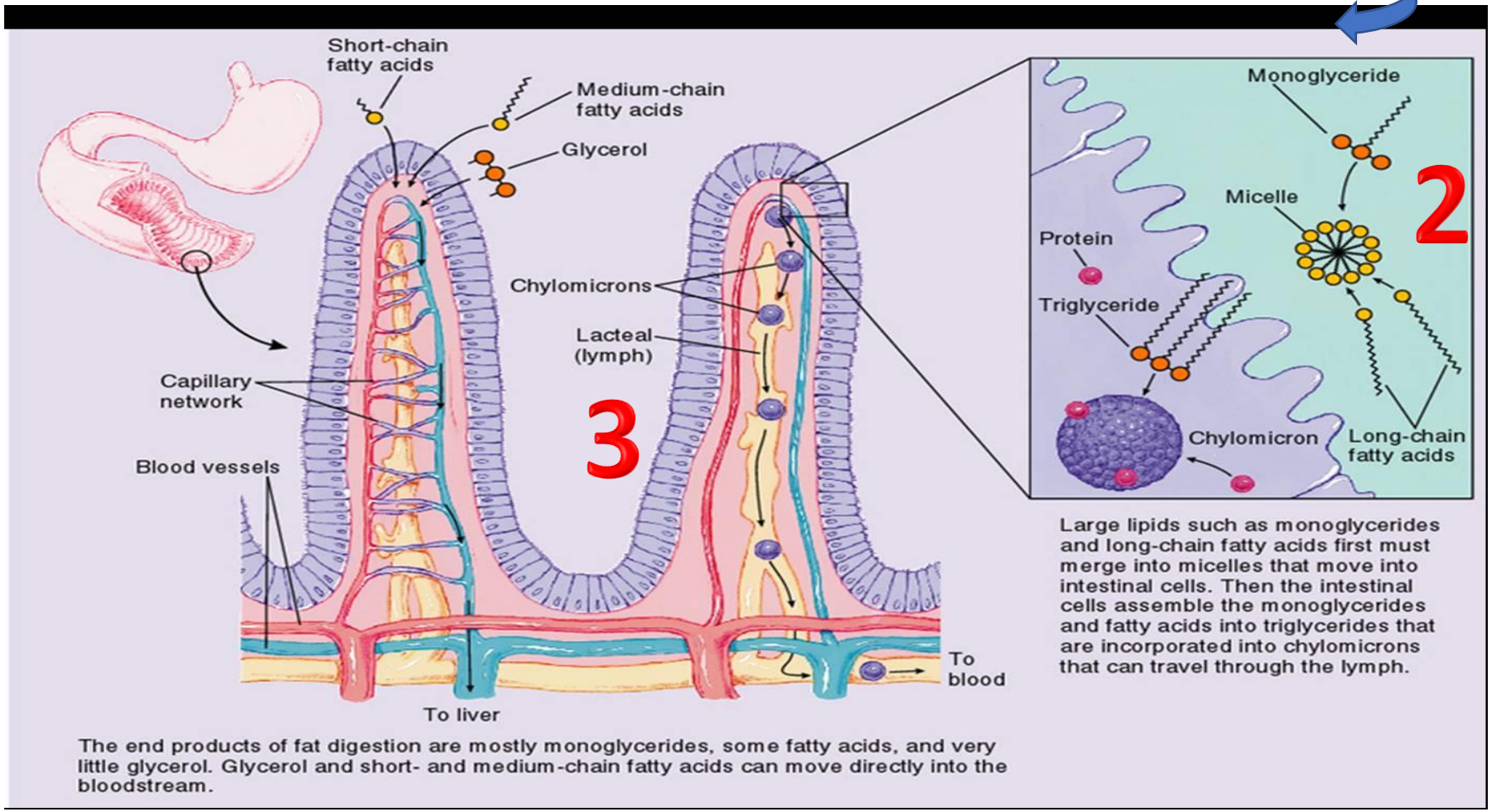
- Main types of carbohydrates in formulas
  - Lactose
  - Sucrose
  - Glucose polymers :

- What type of formula should be used in patients with galactosemia? Why?
  - formulas that do not contain lactose

Infant Formulas – Fat Content

- Main types of fats in formulas
  - Long chain triglycerides (LCTs)
  - Medium chain triglycerides (MCTs)

Absorption of MCT vs LCT



- When are MCTs beneficial?
  - Impaired fat absorption or lymphatic abnormalities
- Which formulas contain MCTs?
  - Alimentum (33%), Pregestimil (55%) , Alfare 38%
  - Elecare (33%)
  - Portagen (87%), Vital HN (45%)

COW'S MILK PROTEIN ALLERGY

CMPA

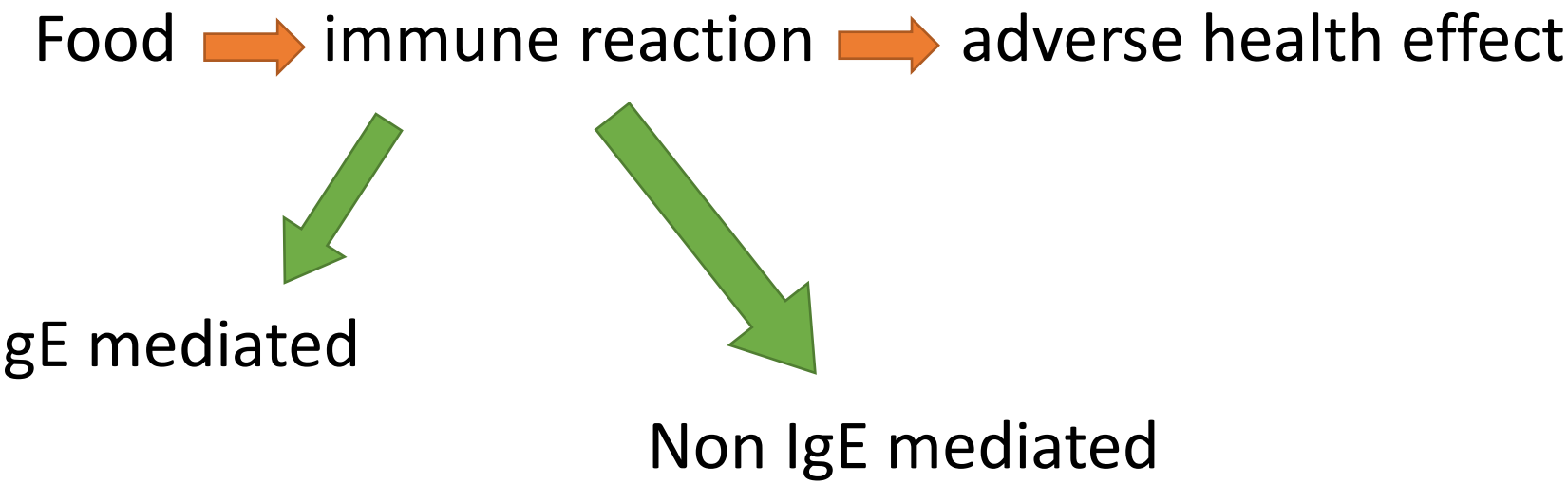
CMPA

- What is it?
- How to diagnose?
- How to treat?

Cow’s milk protein allergy

Food allergy :

- Adverse health effect
- Arising from a specific immune response
- Occurs reproducibly following exposure to a given food



CMPA

- The leading cause of food allergy in infants and young children younger than 3 years.

- GI tract manifestation alone can be diagnosed in all age groups

- Nonspecific!

CMPA

- There is no single diagnostic test

- Risk for both :

over- and underdiagnosis

&

over- and undertreatment

MEDICAL POSITION PAPER

Diagnostic Approach and Management of Cow's-Milk Protein Allergy in Infants and Children: ESPGHAN GI Committee Practical Guidelines

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Epidemiology of CMPA

- Infants : prevalence 2% - 3%
- Children 6 years and older : < 1%

Clinical manifestations

❖Immediate / early reactions:

Occurs minutes – 2 hours after ingestion

IgE- mediated

❖Delayed / late reactions:

Occurs 48 hrs – up to 1 week

Non- IgE mediated

Some food allergen can have both reactions

Clinical manifestations

- Involve different organ systems:

  ✓skin , GI tract , and respiratory tract

  ✓The involvement of >2 systems increases the probability of CMPA

TABLE 1. Some symptoms and signs related to CMPA

	Infants and toddlers	Older children	Immediate reaction (within min–2 h after ingesting CMP)
Digestive	Dysphagia	Dysphagia	Vomiting
	Frequent regurgitation	Food impaction	
	Colic, abdominal pain	Regurgitation	
	Vomiting	Dyspepsia	
	Anorexia, refusal to feed	Nausea, vomiting	
	Diarrhea ± intestinal protein or blood loss	Anorexia, early satiety	
	Constipation ± perianal rash	Diarrhea ± intestinal protein or blood loss	
	Failure to thrive	Constipation	
	Occult blood loss	Abdominal pain	
	Iron-deficiency anemia	Occult blood loss	
		Iron-deficiency anemia	
Respiratory	Runny nose	Runny nose	Wheezing or stridor
	Wheezing	Wheezing	Breathing difficulties
	Chronic coughing (all unrelated to infections)	Chronic coughing (all unrelated to infections)	
Skin	Urticaria (unrelated to infections, drug intake, or other causes)	Urticaria (unrelated to infections, drug intake, or other causes)	Urticaria
	Atopic eczema	Atopic eczema	Angioedema
	Angioedema (swelling of lips or eyelids	Angioedema (swelling of lips or eyelids)	
General	Anaphylaxis	Anaphylaxis	Anaphylaxis
	Shock-like symptoms with severe metatobolic acidosis, vomiting, and diarrhea (FPIES)		FPIES

CMPA = cow's-milk protein allergy; FPIES = food protein–induced enterocolitis syndrome.

Diagnosis of CMPA

- Based on History and physical exam

Specific IgE and skin prick test SPT

- Children with GI manifestations of CMPA are more likely to have negative specific IgE test results compared with patients with skin manifestations.

- Negative test result does not exclude CMPA

- Positive result indicates sensitization to CMP only. Oral challenge test is needed to confirm diagnsosis.

Treatment for CMPA:

- In breast-fed infants:

➡ the mother should start a strict CMP free diet.

- Non–breast-fed

➡ infant should receive an extensively hydrolyzed protein-based formula

Rx CMPA

- Amino acids–based formulae : for certain situations.

- Soy protein formula, if tolerated, is an option beyond 6 months of age.

- Nutritional counseling and regular monitoring of growth are mandatory in all age groups requiring CMP exclusion.

Reevaluation

- Patients should be reevaluated every 6 to 12 months to assess for tolerance to CMP.

- This is achieved in >75% by 3 years of age and >90% by 6 years of age.

- Inappropriate or overly long dietary eliminations should be avoided. Such restrictions may impair the quality of life of both child and family, induce improper growth, and incur unnecessary health care costs.

Failure To Thrive
FTT

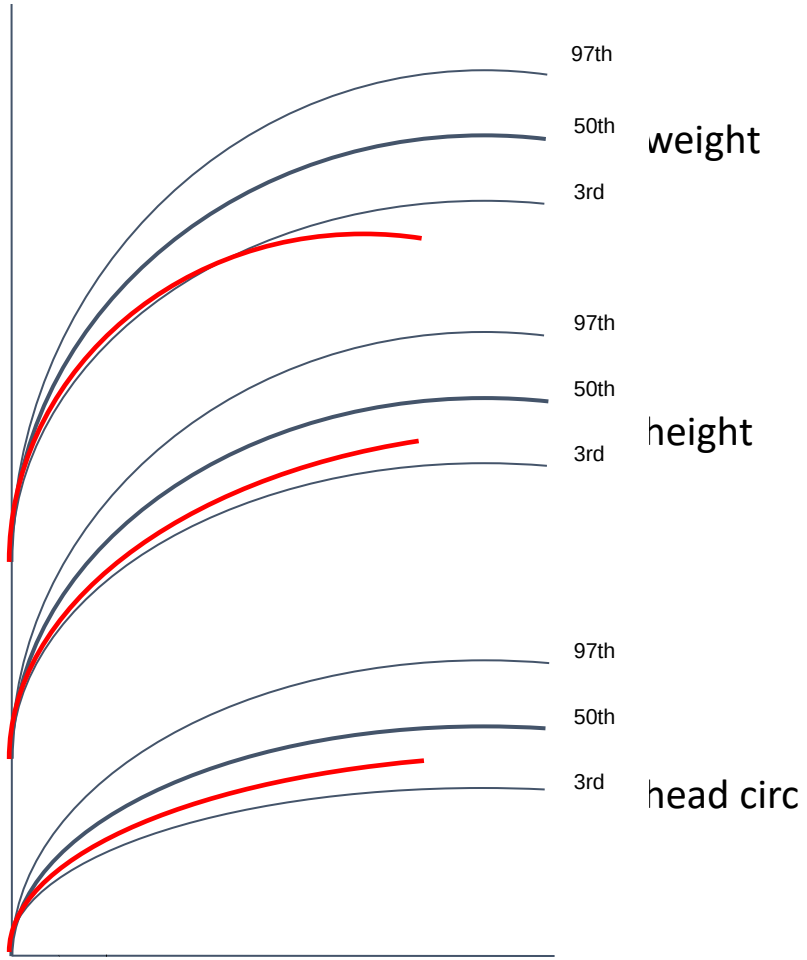
Failure To Thrive
FTT

- The inability to maintain the expected rate of growth over time.

- Growth is assessed by plotting the patient's growth parameters over subsequent visits and comparing the growth rate to normal population growth rates for age.

- One set of measurements can not assess rate of growth and therefore is not sufficient to diagnose failure to thrive

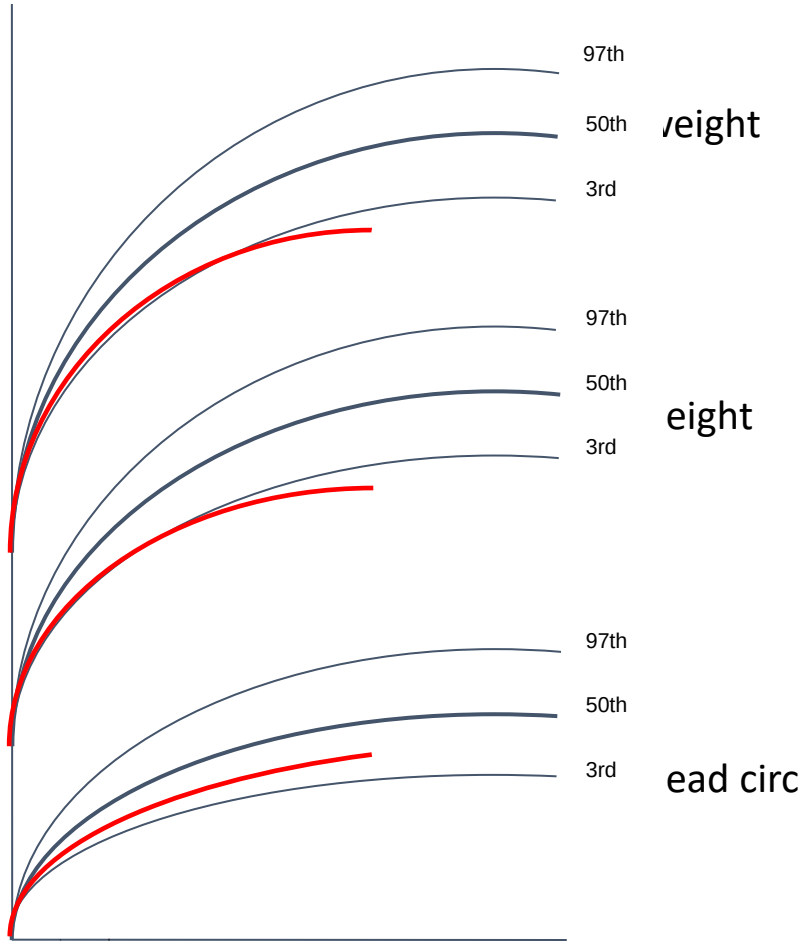
Failure to Thrive



- List the three main causes of this type of growth pattern

- Type I failure to thrive
  - Inadequate caloric intake
  - Excessive loss of calories
  - Increased metabolic demands

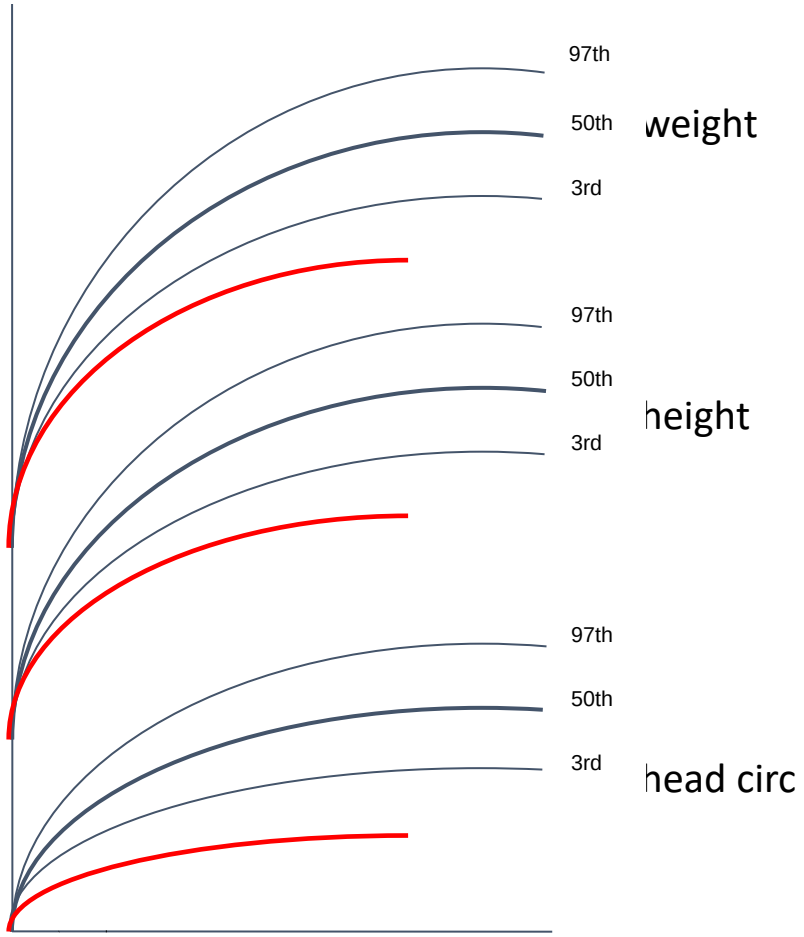
Failure to Thrive



- List three causes of this type of growth pattern

- Type II failure to thrive
  - Constitutional growth delay
  - Genetic short stature
  - Hypothyroidism
  - Growth hormone deficiency
  - Hypopituitarism
  - Chronic malnutrition

Failure to Thrive



- List three causes of this type of growth pattern

- Type III failure to thrive
  - Congenital infections
  - Chromosomal abnormalities
  - Prenatal exposure to toxins

Type I Failure to Thrive

- Inadequate caloric intake
  - Inappropriate feeding regimen/schedule
  - Formula prepared incorrectly
  - Decreased appetite or feeding dysfunction/refusal
- Excessive loss of calories
  - GER or vomiting
  - Diarrhea/malabsorption
- Increased metabolic demands
  - Hyperthyroidism, diencephalic syndrome

Nutritional Assessment

- History
  - Intake, losses, past growth, parental heights
- Anthropometrics
  - Height/length, weight, head circumference, BMI
  - Skinfold thickness, mid-upper arm circumference
- Physical Exam
  - Decreased fat stores, muscle wasting, edema
- Lab
  - Visceral proteins, CBC, K, mag, phos, zinc

Nutritional Status

- Wasting
  - Weight:length ratio or BMI <3rd percentile
  - Often seen in type I failure to thrive
  - Indicative of acute malnutrition
  - Typically responds to nutritional support
- Stunting
  - Height <3rd percentile for age
  - Often have a normal weight:length ratio or BMI
  - Chronic malnutrition may progress to stunting

Nutritional Rehabilitation

- How do you decide between enteral and parenteral support?
  - Use parenteral route when, and only when, enteral support is not possible or not adequate to meet the nutritional needs of the patient
- What type of enteral support should you use?
  - Use most physiologic method tolerated by patient
  - Most physiologic to least physiologic:
    - Increasing caloric density→ oral supplements→ gastric bolus→ gastric continuous→ jejunal continuous

Complications of Nutritional Support

- What are risk factors for developing the refeeding syndrome?
  - Moderate to severe malnutrition
- What are the laboratory findings?
  - Hypokalemia, hypomagnesemia, and hypophosphatemia
- How do you avoid this complication?
  - Advance feedings and/or TPN slowly
  - Carefully monitor and supplement K, Mag, Phos

Complications of Nutritional Support

- Discuss complications that may be seen with enteral support
  - Tube malposition
  - Irritation or infection of tube site
- Discuss complications that may be seen with parenteral support
  - Infection
  - Metabolic derangements
  - Mechanical complications

THE END

Questions?