Weight, Weight Please Tell Me –The Diagnosis and Management of Infants with Failure to Thrive

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- **I have nothing to disclose except that I was a Mets fan until 1979 when I switched to the Cubs**

Outline

- Definitions of FTT
- IUGR
- Taking a history
- Medical evaluation
- Feeding disorders
- Interactive case

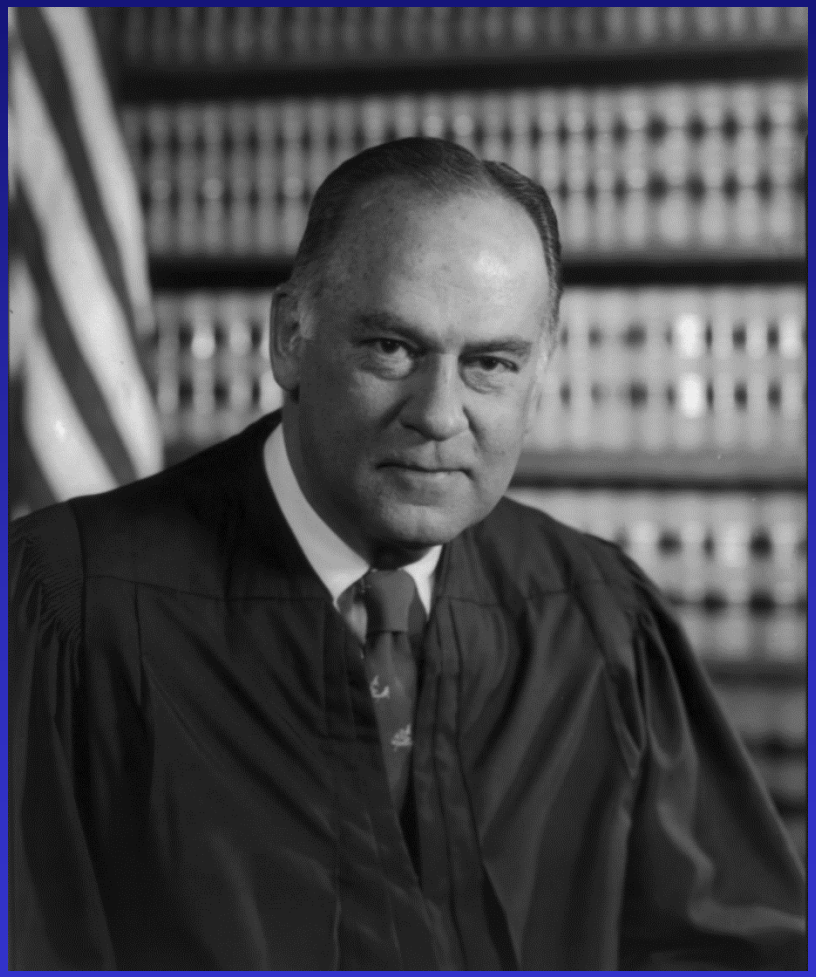
Inadequate Definitions of FTT in the Literature

- "Weight persistently below the 3rd percentile for age."
- "A syndrome characterized by failure of physical growth, malnutrition,and retardation of motor and social development."
- "Growth failure brought on by maternal deprivation in an insufficiently nurturing environment".

Imprecise Terminology in the Literature

- Failure to thrive
- Non-organic failure to thrive
- Psychosocial failure to thrive
- Maternal deprivation syndrome
- Deprivational dwarfism

“I know it when I see it”



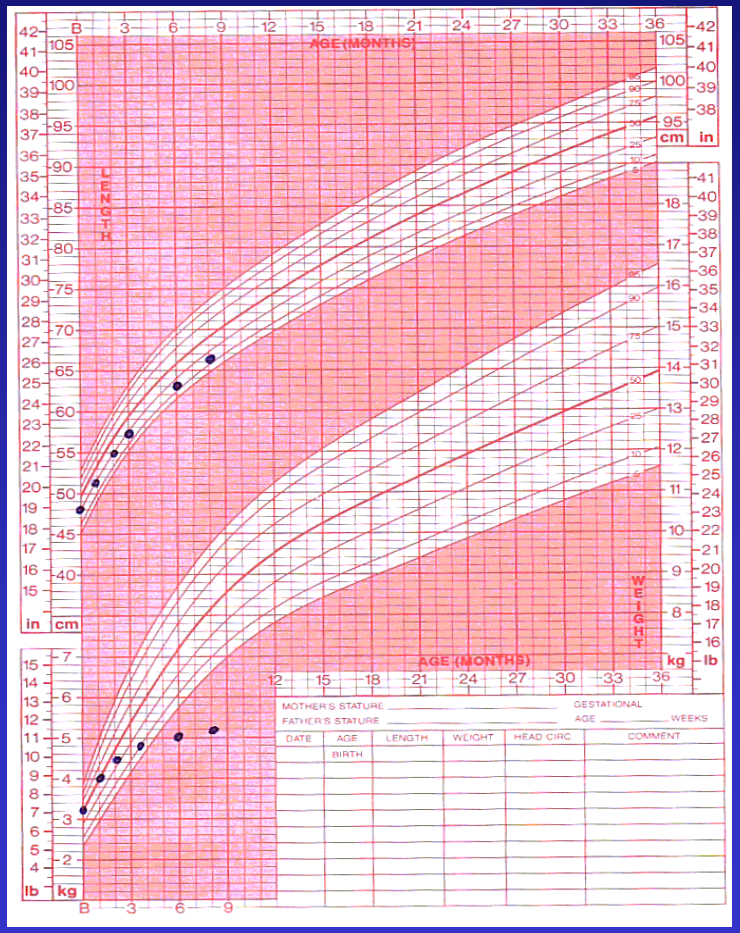
Preferred Terminology for "FTT"

Dynamic definitions*

- Failure to gain weight
  - Crossing 2 major percentiles on growth chart **or**
  - Loss of >10% body weight
- Failure to grow, i.e. linear growth
- Failure to grow and gain weight

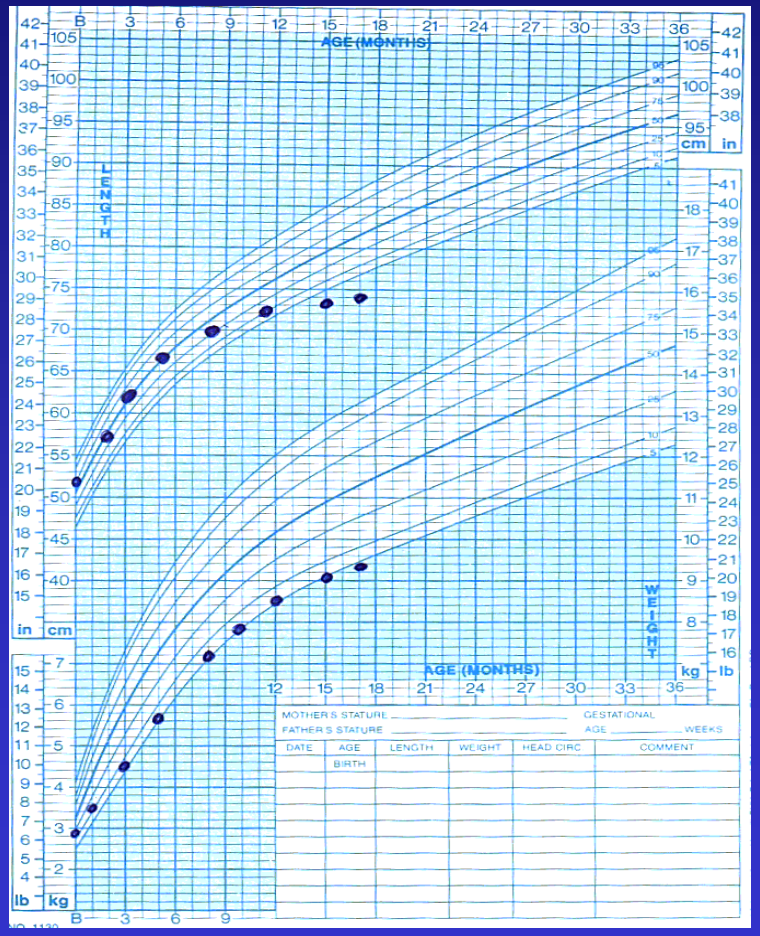
*Looking at weight, length over time

Failure to Gain Weight



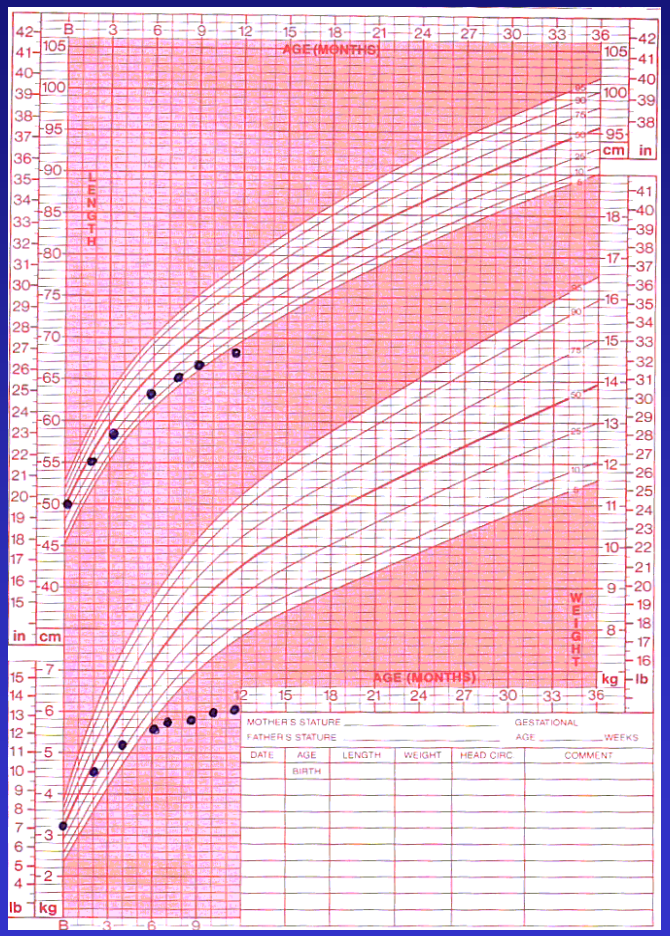
- Crossing %'s in weight
- Linear growth relatively unaffected

Failure to Grow



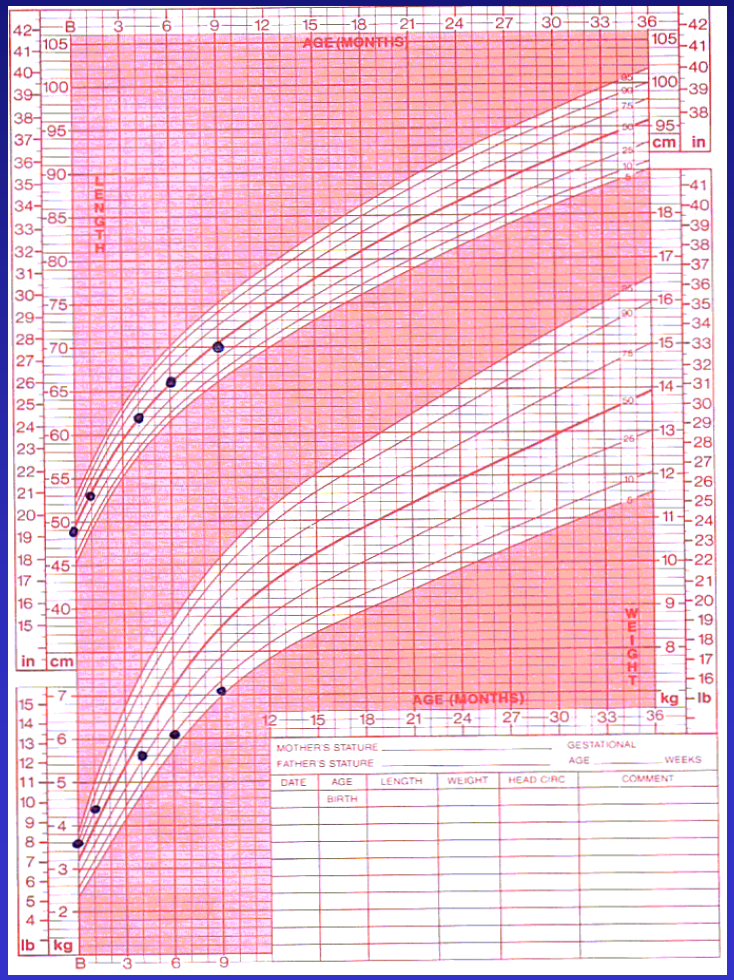
- Crossing 2 or more length %'s
- Relative sparing of weight %

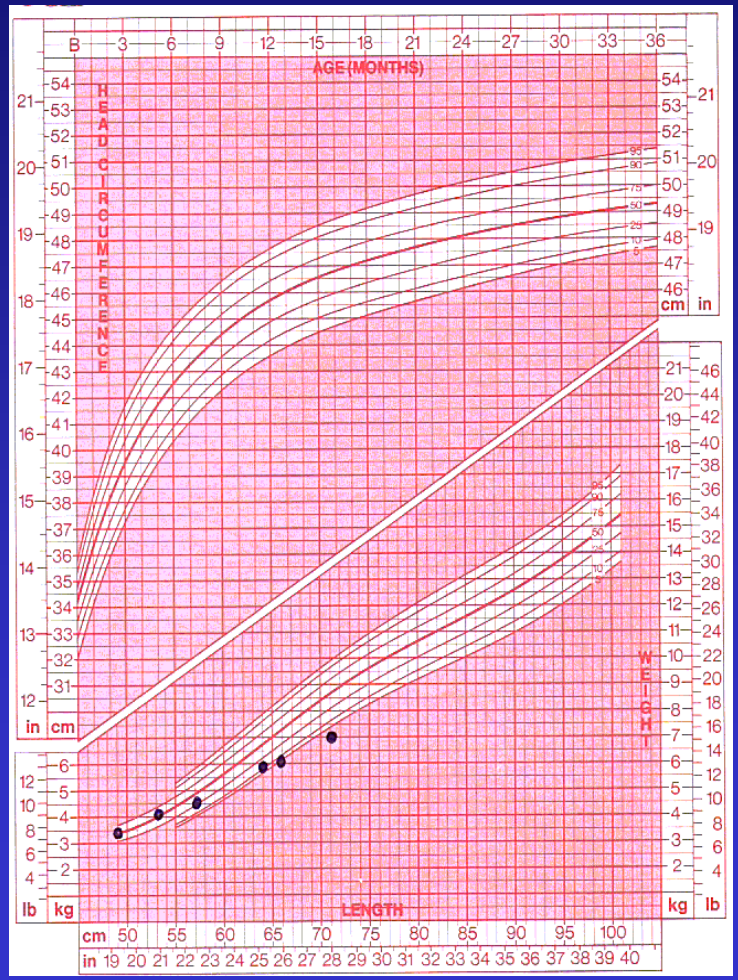
Failure to Gain Weight and Grow



- Marked falloff in weight %'s
- Moderate falloff in length %'s starting sometime after weight falloff
- Normal velocity of weight gain or growth never achieved (no paralleling the curve)
- Contrast with curves of "**constitutional delay**" chart

Weight for Length

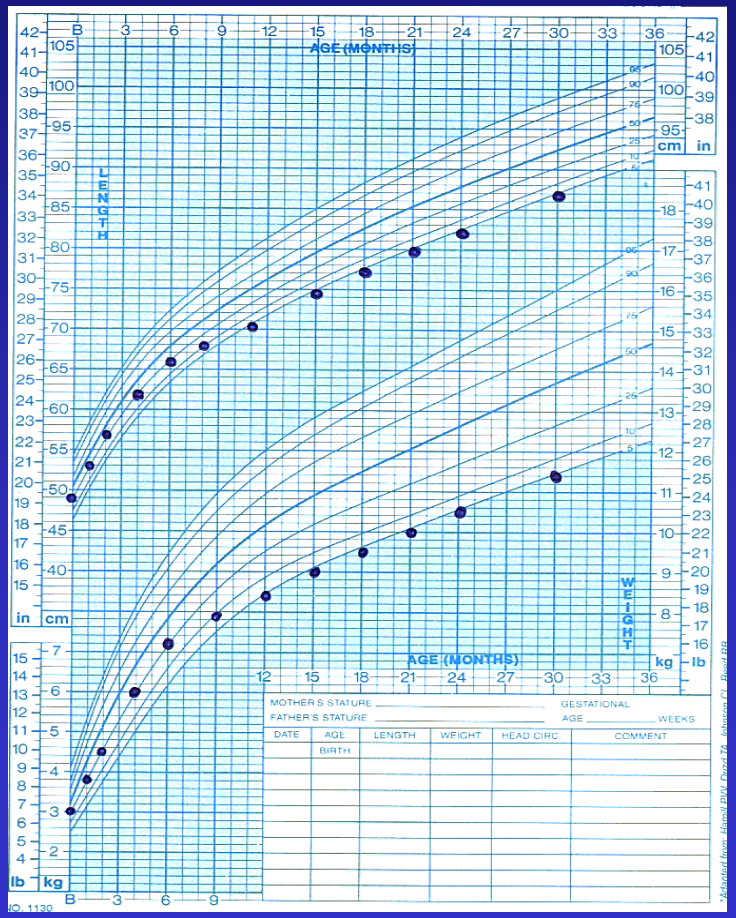




Pseudo-Failure to Thrive

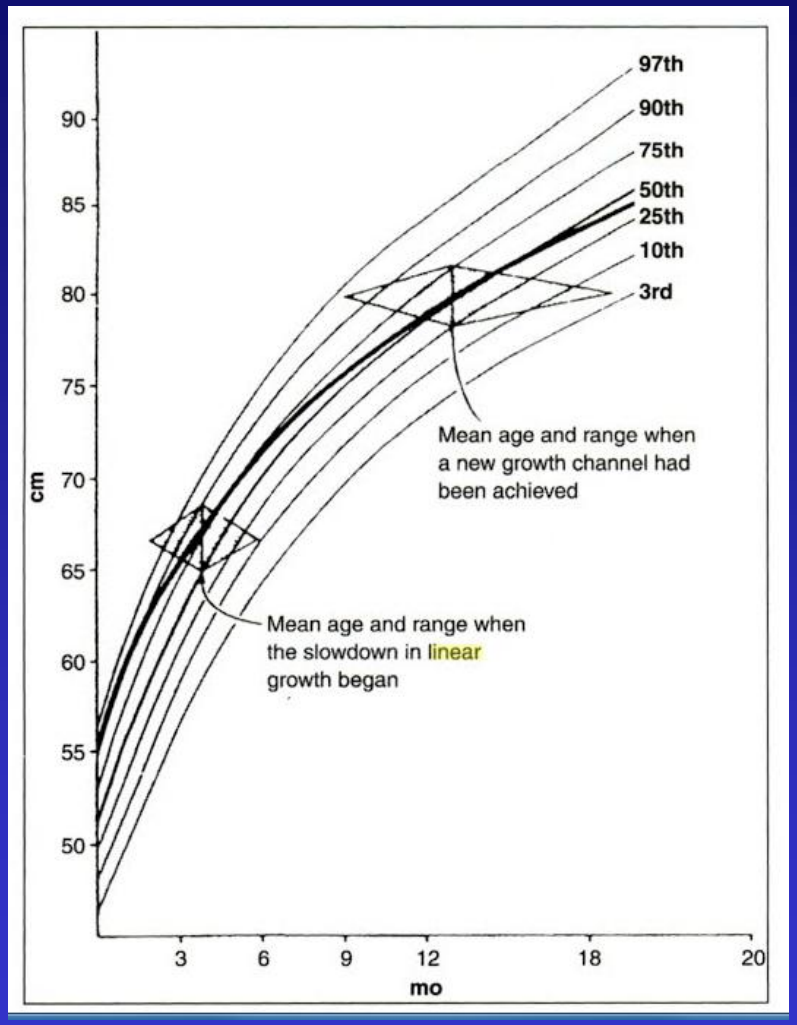
- "Catch-down" growth and weight gain
  - Genetic short stature
  - Constitutional delay of growth
- Normal leanness
- Common variables in pseudo-FTT
  - Normal physical exam
  - Normal diet
  - Normal development

Constitutional Delay of Growth/ Genetic Short Stature



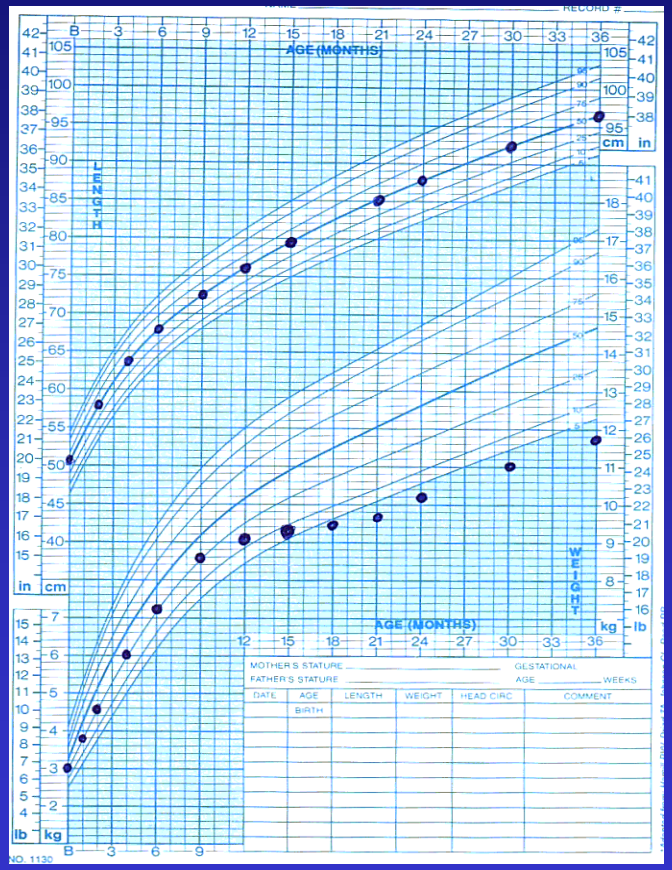
- Symmetric crossing of %'s
- Occurs between 6-36 months
- Eventual normalization of growth and weight gain velocity (paralleling the curve)
- Final height is often in lower part of parental target height range
- Delayed growth spurt may adversely affect growth of spine, perhaps contributing to a limited final height

Resetting of Growth Rate of 16 Healthy Infants



Smith et al. J Pediatr 1976;89:225-30

Normal Leanness



- Weight/length <5%
- Normal physical exam
- Normal growth velocity
- Normal diet
- Normal development

IUGR and "Catch-up Growth"

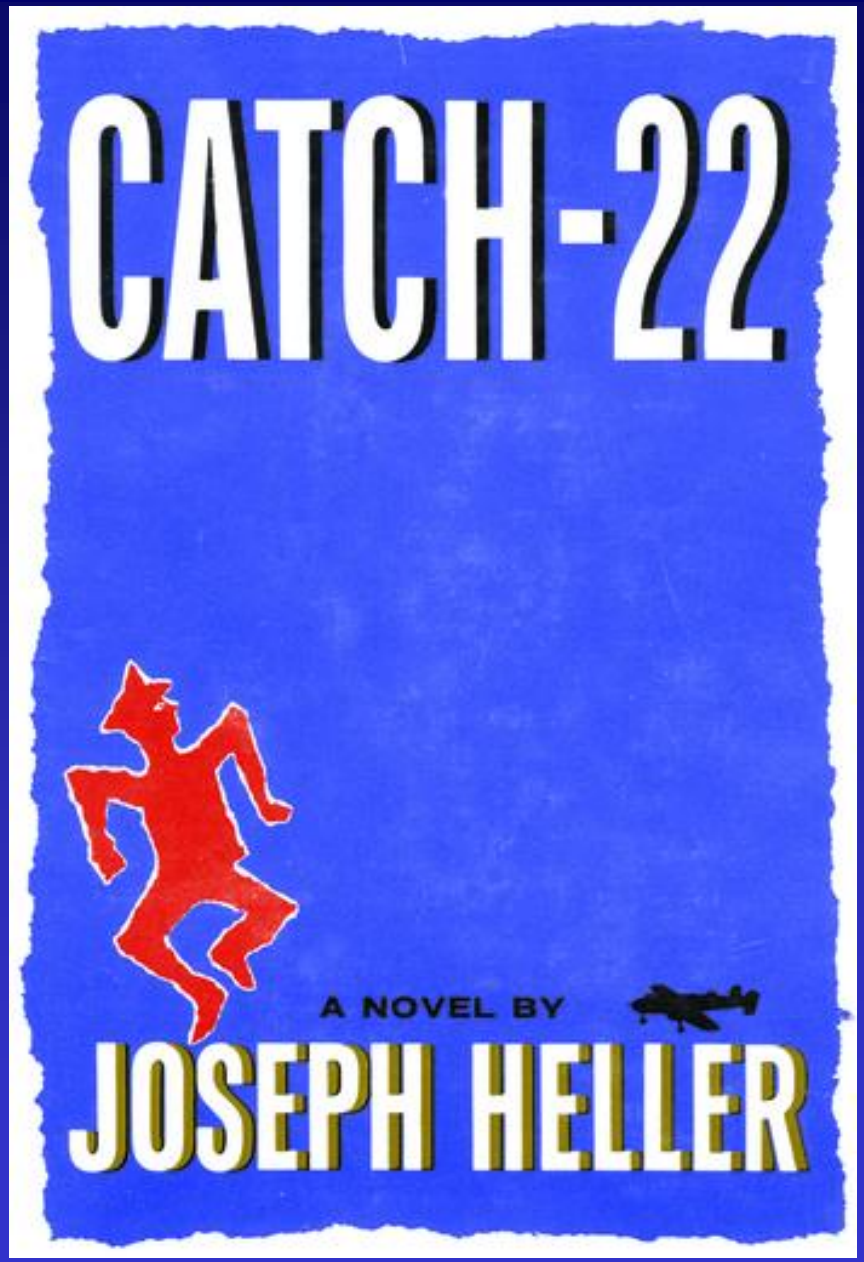
"Food" for thought- the good news

- Early studies showed most LBW (including SGA) babies exhibit catch-up growth (weight or length) in 1st 6-12 months
- If catch-up growth doesn't occur, ½ will remain short as adults
- Significantly increased risk of subnormal intellectual and psychological performance in SGA born adults
  - Most important predictor of disability was absence of catch-up growth
- Short-term benefits on resistance to infection and survival, particularly in developing nations

IUGR and "Catch-up Growth"

"Food" for thought- the bad news

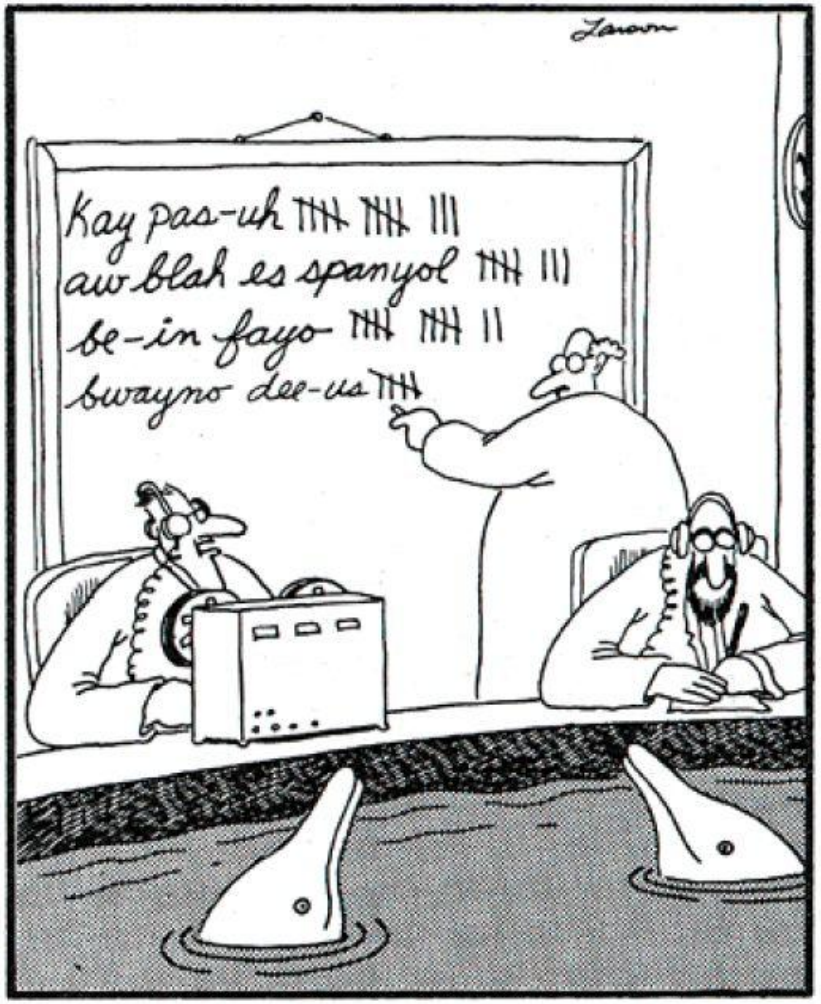
- Early rapid growth linked to subsequent obesity
  - Similar in SGA and normal birth weight infants
- SGA children at risk for increases in central and intraabdominal fat
- Clear evidence that rapid weight gain increases insulin resistance and development of subsequent metabolic syndrome
- Markers of adult metabolic syndrome in SGA infants
  - Higher IGF-1, cortisol, neutrophil count


CATCH-22
A NOVEL BY
JOSEPH HELLER

Healthy catch-up Growth?

- Growth hormone rx in SGA children
  - Beneficial gains in long-term height and cognitive function
  - No change in body composition, i.e. central fat and insulin resistance
- Theory: increased dietary protein in SGA infants may lead to predominant lean mass catch-up growth
- Genetic polymorphisms predispose certain SGA infants to insulin resistance
  - Ability to target who needs tight caloric control

“The history tells all”



“Matthews ... we're getting another one of those strange 'aw blah es span yol' sounds.”

Obtaining a History

- Chief complaint
  - Is it on the mark or are the parents' concerns different from those of the MD's?
- Birth history
  - Birth weight
  - Resuscitation efforts
    - Evidence of perinatal asphyxia
  - Perinatal course- feeding problems, jaundice

Feeding History

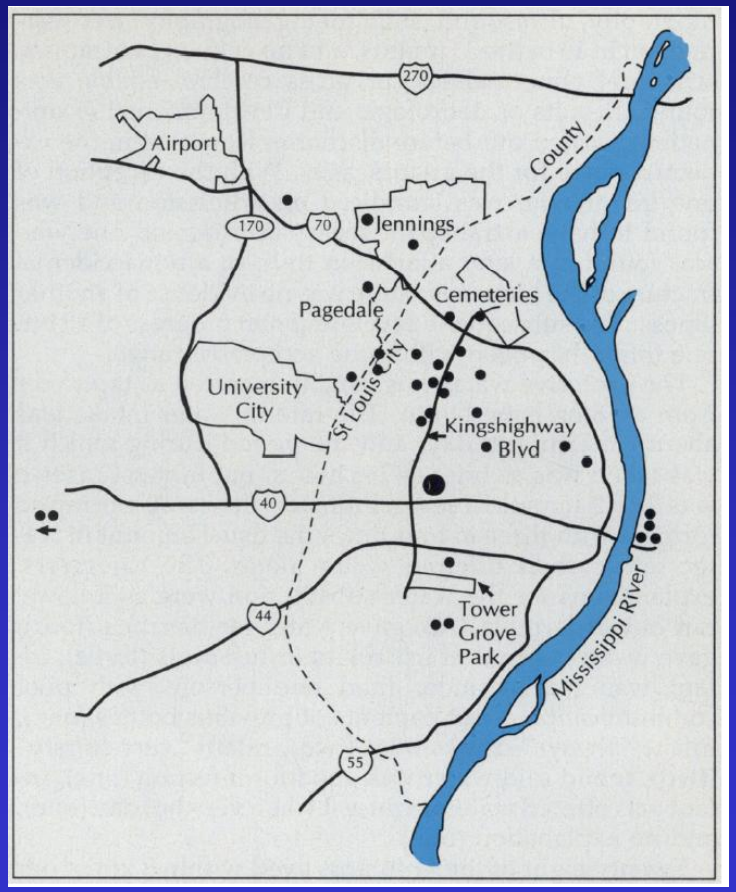
Formula intake

- Amount offered per feeding
- Amount left over per feeding
- Feeding frequency
- Length of time per feeding
  - Anything over 15-20 minutes counterproductive
- Preparation technique

Oral Water Intoxication in Infants

An American Epidemic

James P. Keating, MD, MSci(Epidem); Gregory J. Shears, MD; Philip R. Dodge, MD



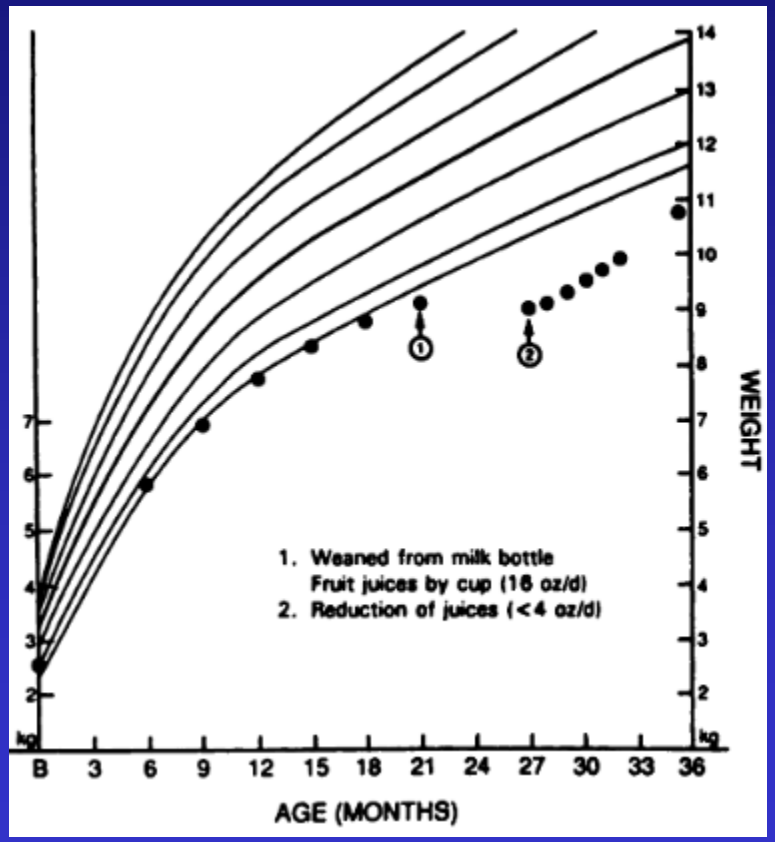
From: Keating JP, Shears GJ, Dodge PR. AJDC 1991;145:985-90

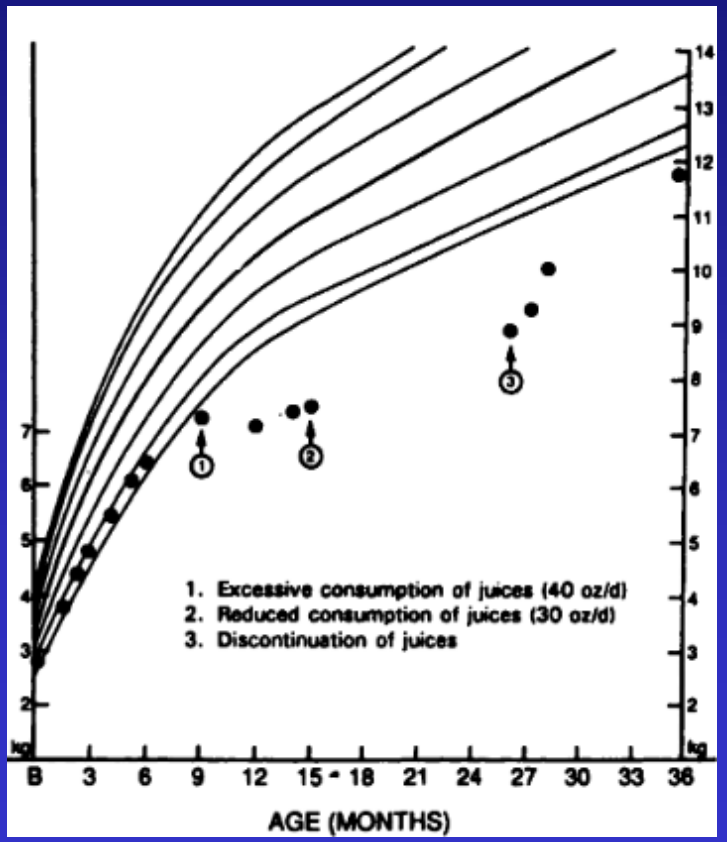
Feeding History

- Solid food and juice
  - Abnormal intake
    - Low cholesterol “health diet”
    - Excessive fruit juice
  - Timing of introduction of certain foods
    - Gluten, sucrose

Excess Fruit Juice Consumption as a Contributing Factor in Nonorganic Failure to Thrive

Melanie M. Smith, MNS, RD and Fima Lifshitz, MD





Pediatrics 1994;93:438-443

Congenital sucrase-isomaltase deficiency presenting with failure to thrive, hypercalcemia, and nephrocalcinosis

John W Belmont*[1,2], Barbara Reid[2], William Taylor[5], Susan S Baker[6], Warren H Moore[4], Michael C Morriss[4], Susan M Podrebarac[2], Nancy Glass[2,3] and I David Schwartz[5]

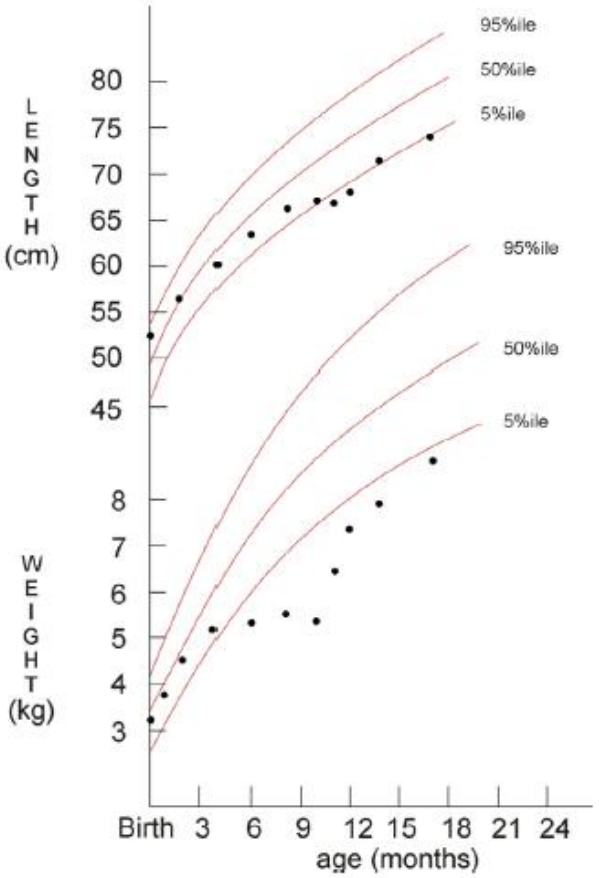


Figure 3
Growth response to dietary intervention

From: BMC Pediatrics 2002;2:4/25

Feeding History

- Observe feeding technique, if possible
  - Who performs most feedings?
  - Feeder-infant interactions
- Symptoms associated with feedings
  - Choking, coughing, sputtering
  - Tachypnea; sweating
- Gastrointestinal symptoms
  - Stool pattern
  - Vomiting/spitting up

Vomiting + FTT Doesn't Always Equal GERD

- Symptoms with GERD + FTT
  - Chronic cough, recurrent pneumonias
  - Recurrent wheezing, ?apnea
- Syndromes with FTT and vomiting
  - Pyloric stenosis
  - Disorders of rotation
  - Hydrocephalus
  - Hydronephrosis/UTI
  - Aminoacidurias, organic acidurias
  - Rumination

Does GERD cause FTT?

- Definitions
  - GER: passage of gastric contents into the esophagus; a physiologic process
    - More than 60% of infants spit up on a daily basis; as many as 25%of infants spit up 4 or more times per day
    - Predictably improves over time with no intervention
  - GERD: reflux of gastric contents causing troublesome symptoms/complications, e.g. FTT

Does GERD cause FTT?

*My opinion

- GERD as a cause of FTT primarily seen in:
  - Medically complex children
  - Children with feeding disorders secondary to painful GERD

Feeding Dysfunction and Eosinophilic Esophagitis

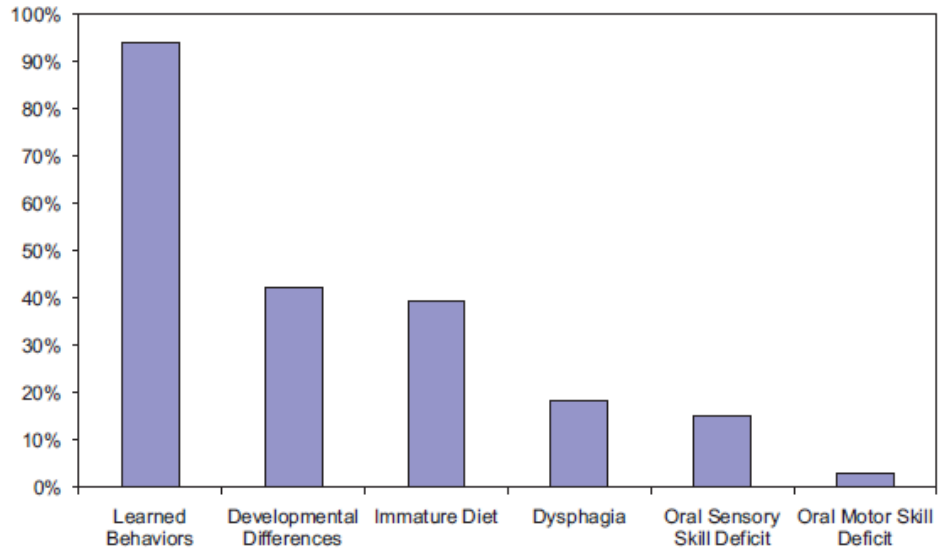


FIGURE 1
Learned feeding behaviors are the predominant form of FD seen in pediatric patients with EGID.

TABLE 3 Patients Demonstrated a Variety of Learned FDs

Learned FD	% of Patients
Low variety intake	90.9
Food refusal	87.9
Requires prompting to eat	87.9
Poor acceptance of new foods	84.8
Low volume of intake	81.8
Unstructured mealtimes	81.8
Inconsistent patterns of eating	78.8
Grazing	78.8
Easily distracted from eating	60.6
Prolonged feeding times	57.6
Holding food in mouth	27.3
Spitting food	27.3

Mukada et al. Pediatrics 2010; 126:e672-677

Feeding History

Assessment of caloric intake

- Infant caloric intake
  - Formula- 20 calories/oz
  - Solids
    - Fruits/vegetables ~ 10-20 calories/oz
    - Meats/desserts ~ 25-30 calories/oz
- Toddler caloric intake
  - Prospective 3 day diet record

Feeding History

Mothers at Risk for Milk Insufficiency

- Severe medical illnesses or psychic stressors
- Undiagnosed retained placenta
- Previous breast surgery especially procedures which involve periareolar breast incisions
- Previous excisional biopsies, breast abscess drainage, breast reduction surgery or augmentation mammoplasty
- Minimal or no breast enlargement during pregnancy (marker for breast hypoplasia)

Breastfeeding and FTT

Maternal factors

- Warning signs of decreased milk supply
  - Inadequate or brief feedings
  - Inadequate letdown reflex
  - Lack of:
    - Contralateral leakage while feeding
    - Engorgement, satiety
- Prolonged exclusive nursing (>6 months)
  - Introduction of solid foods necessary >6 months

Breastfeeding and FTT

Infant factors

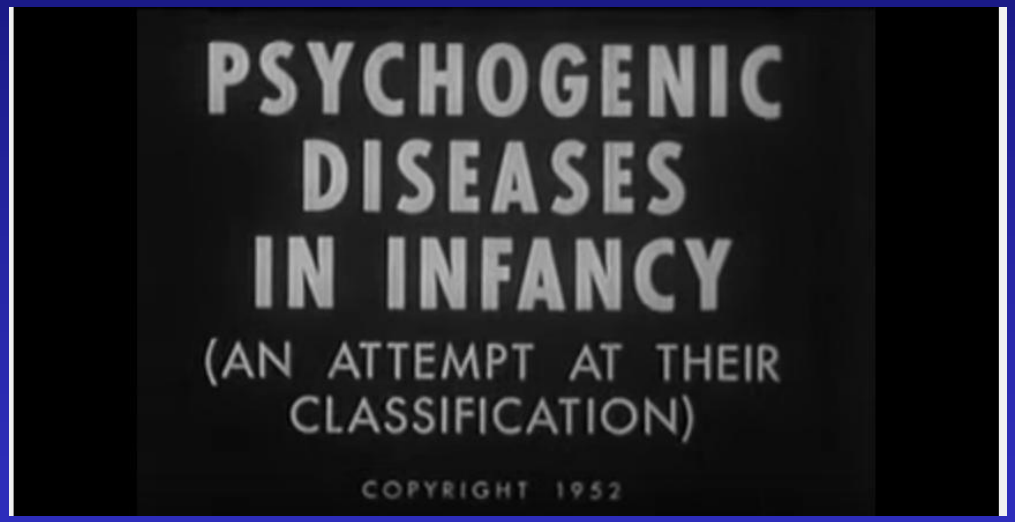
- SGA or premature infants
- Abnormality of oral structures
- Neurologic disease
- Cardiopulmonary disease
- Prolonged sleepiness leading to decreased feeding
- “California baby”

Further History in FTT

- Review of systems
  - Snoring, mouth breathing
  - Affect, i.e. irritability, apathy
- Developmental history
  - Regression
- Family history
  - Consanguinity
- Social history
  - Marital relationship, family support
  - Food availability
  - Evidence of infant or spousal abuse

What's Love Got to Do with It?

Rene Spitz and Anaclitic Depression



https://www.youtube.com/watch?v=VvdOe10vrs4

Physical Examination

- Review growth chart
- General appearance and affect
  - Dysmorphic features
  - Abnormal posturing
  - “Watchful, wary gaze” or avoidance of eye contact
  - Signs of neglect or abuse
- Neurologic exam
- Complete physical exam

Basic Elements of Nutritional Assessment

- Diet
  - History
  - Prospective diet record
    - Inpatient vs. outpatient?
- Physical examination
- Anthropometric assessment
  - Weight, height, head circumference
  - Weight/height
- Biochemical parameters

Laboratory Evaluation

- Rarely helpful, although surprises may occur
- Nutritional assessment
  - Iron stores- Hgb and MCV
  - Protein stores- albumin
  - Vitamin D status- Ca, Phos, alkaline phosphatase
- Other laboratory investigation
  - Electrolytes
  - Bicarbonate
  - BUN, creatinine
  - Urinalysis
  - SGPT
  - ? Sweat test
  - ? TTG
- Let **history** and PE dictate need for other studies

MD Gestalt

- Inadequate caloric intake
  - Etiology clear
    - Breastfeeding failure, neurologic disease
    - Caloric supplementation
      - Hypercaloric feedings
      - Nasogastric feedings
  - Etiology unclear
    - Nutritional rehabilitation as outpatient if family appropriate; if not, inpatient evaluation
    - Further evaluation may be required

MD Gestalt

- Adequate caloric intake (seemingly)
  - Etiology clear
    - e.g. upper airway obstruction
    - Remedy as outpatient
  - Etiology unclear
    - Further evaluation required
    - Inpatient admission may be necessary

Indications for Inpatient Evaluation

- Findings or possibility of child abuse
- Signs of serious neglect
- Chaotic family environment
- Obviously disturbed parent-child interactions
- Severe malnutrition
- Infant feeding disorder
- Failed outpatient management

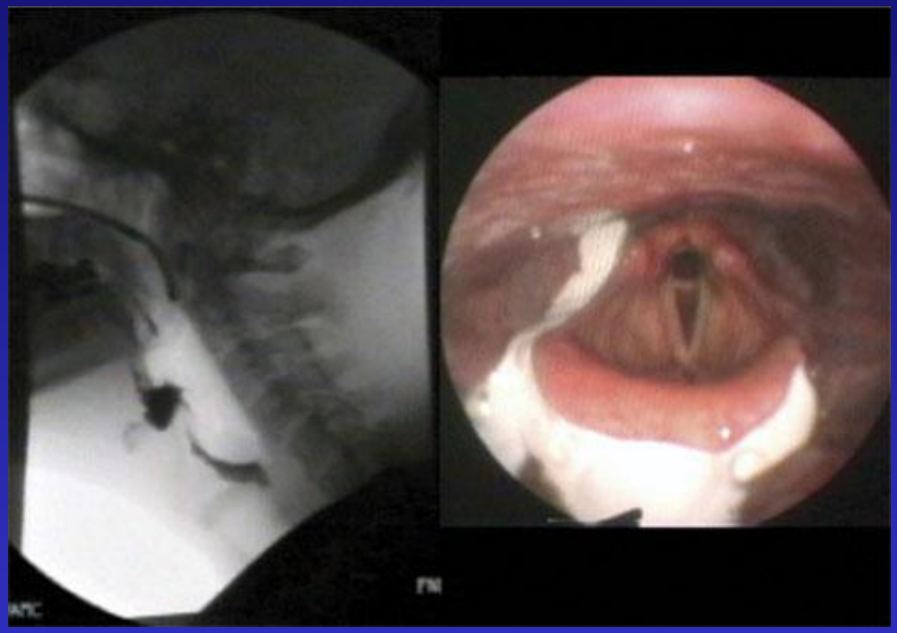
Organic Infant Feeding Disorders

- Neurologic dysfunction
  - Neuromuscular diseases, e.g. myotonic dystrophy
  - CMS malformations
  - Genetic/chromosomal abnormalities
- Cardiopulmonary disease
  - Can’t breathe and eat at same time
- Craniofacial abnormalities
  - Cleft palate
  - Pierre-Robin sequence
- GERD
  - Learned aversive response to feedings
- Isolated immaturity of suck/swallow

Assessment of Infant Dysphagia

- Videofluoroscopic swallow study (VFSS)
  - Allows for assessment of swallow in all of the swallowing stages
  - Barium impregnated fluids and solids of varying consistency
- Fiberoptic endoscopic evaluation of swallow (FEES)
  - No barium, radiation exposure
  - Provides images of larynx and hypopharynx before and after (but not during) the pharyngeal swallow
  - Detects structural and physiologic swallowing abnormalities
- VFSS and FEES complementary

FEES



VFSS

FEES

Infant Feeding Disorders and Non-Organic FTT

- Parent-child malinteractions
  - Improper positioning
  - Parental distractibility
  - Parental overattention
  - Unresponsiveness to infant signals
- Abnormal infant behaviors
  - Inattentive, withdrawn
  - Tactile hypersensitivity (sensory integration disorder)
  - Rumination

Infant Feeding Disorders and Non-Organic FTT

Treatment

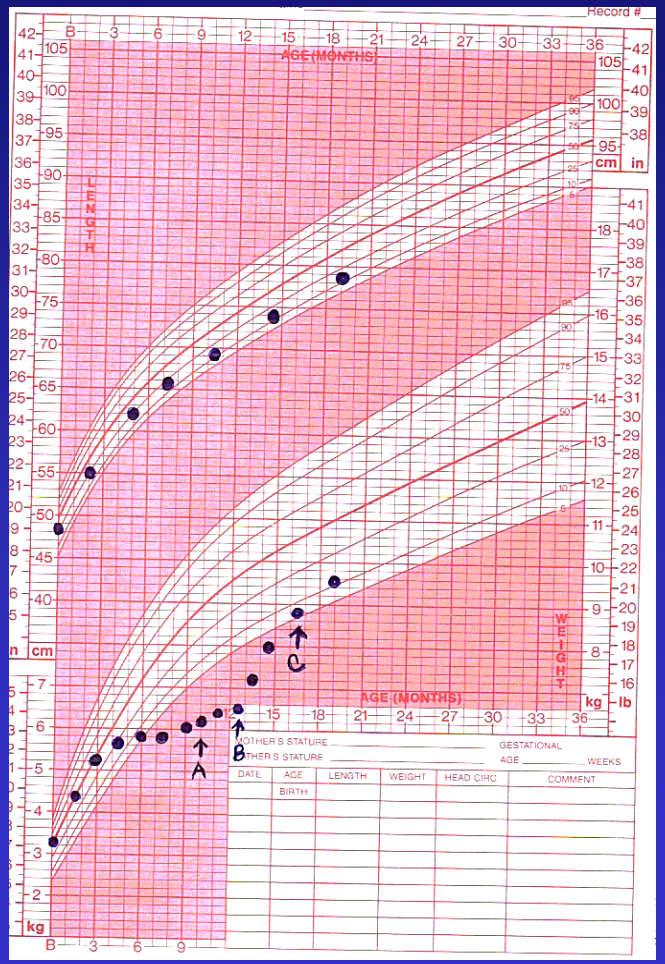
- Multidisciplinary team
  - Pediatrician
  - Dietician
  - Behavioral psychologist
  - Speech therapist
- Nutritional support
  - Provide enough calories for “catch-up growth” while re-teaching the infant how to eat
  - Usually requires continuous nighttime ng feeding ~ 50-70% of estimated caloric needs
  - Balance nighttime feeds, daytime intake, and weight gain

Nutritional rehabilitation

"Catch-up growth"

- Infants with FTT, regardless of the etiology, occasionally require more than normal caloric intake to achieve growth
  - 150-200 calories/kg/day
  - Hypercaloric formula- 24 or 27 calories/oz
  - Nasogastric feedings
    - Severe malnutrition
    - Feeding disorder coupled with behavior modification
  - May not see weight gain for 1-2 weeks

Supplemental Nasogastric Feeding



- 4th child, exclusively nursed
- Signs of upper airway obstruction
- Complete nasal airway obstruction on x-ray
- **A**-1st visit; adenoidectomy 1 week later
- **B**- Nighttime ng feedings started with behavior modification
- **C**- Nighttime ng feedings discontinued

Stretching the Boundary

- Zinc supplementation
  - 1 mg/kg/day elemental Zinc
- Periactin
  - 0.25- 0.5 mg/kg/day b.i.d.

My Favorite, All-Time FTT Case

- **Birth history**: Infant boy was the 7 lb 12 oz product of a full-term pregnancy to a 31 year old G1P1 mother. The pregnancy was uncomplicated save for some 1st trimester bleeding. It was a spontaneous vaginal delivery without any perinatal problems. Apgars $9^{1}/9^{5}$
- **Family history**: Negative
- **Developmental history**: He fixes and follows, turns his head from side to side, and lifts his head all the way. He has a social smile.

Case- Physical Examination

- He was a scrawny, emaciated boy who was vigorous and very alert
- Pulse 136, RR 32, BP 90/60, Temperature 37.4E C. Weight 3.8 kg (5th%), length 58 cm (50th%), HC 39 cm (50th%)
- HEENT examination unremarkable. No adenopathy. Lungs clear. S_1S_2 normal with no murmurs or gallops.
- Abdomen soft, non-tender without masses or organomegaly. Back straight. GU examination is normal. Testes are descended bilaterally. His has decreased muscle mass in all extremities.
- Neurologic examination: somewhat decreased truncal tone. Deep tendon reflexes 2+ bilaterally. Strength nl

What additional information is required?

Case- Additional History

- He is on a soy formula because his mother was “milk allergic” as a child.
- His mother uses a powder formula and reconstitutes it appropriately using tap water.
- He drinks about 5-6 ounces every 3-4 hrs for a total of 30-36 ounces daily. He wakes up at least once each night and drinks a full bottle.
- He drinks 5-6 ounces in 10-15 minutes without any associated symptoms
- You are able to observe a feeding that goes very well without incident.
- Baby has yet to be offered any solid foods.

Case- Social History

- The parents are married and are both attorneys.
- The mother was planning on going back to work in 2 more weeks but is now reconsidering, given how poorly her son is doing. She is the primary caretaker.
- Neither set of grandparents are in town, nor is there any extended family nearby.

What to do now?

Case- Laboratory evaluation

- **Electrolytes**: Sodium 135 mEq/L, Potassium 2.7 mEq/L, Chloride 85 mEq/L, Bicarbonate 39 mEq/L
- **Renal function**: BUN 20 mg/dL, Cr 0.6 mg/dL
- **Arterial blood gas**: 7.50/ pCO2 47mm Hg/ pO2 110 mm Hg/ Base excess 13
- **CBC**: Normal
- **LFT's**: ALT/AST- normal; albumen 4.5 mg/dL
- What is this called?
  - Hypokalemic hypochloremic metabolic alkalosis

Hypokalemic Hypochloremic Metabolic Alkalosis

Pick your ion!!

- Sodium
- Potassium
- Chloride
- Bicarbonate

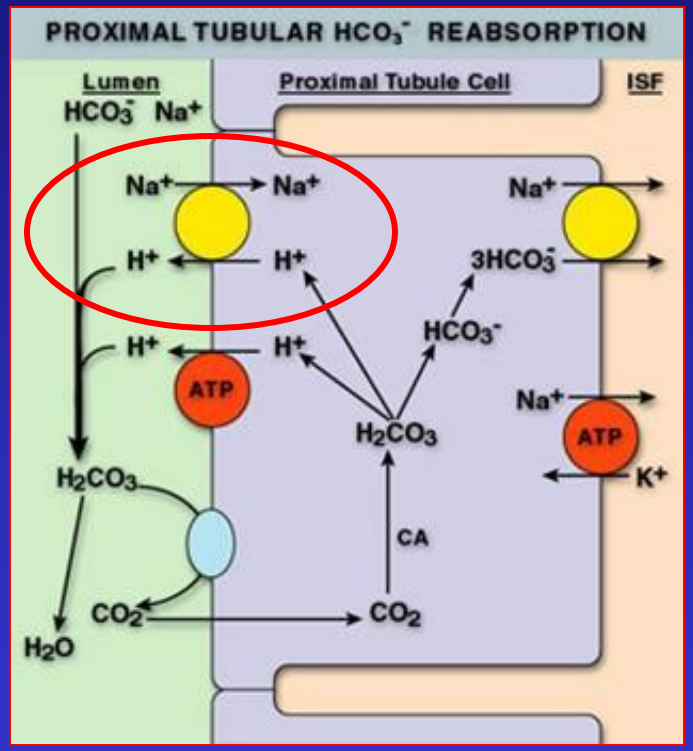
Hypokalemic Hypochloremic Metabolic Alkalosis

Pick your ion!!

- Sodium
- Potassium
- **Chloride**
- Bicarbonate

Hypokalemic Hypochloremic Metabolic Alkalosis

"Contraction alkalosis"



- Na^+ conserved in proximal tubule
  - Exchanged for H^+
  - Aciduria
- Na^+ conserved in distal tubule
  - Exchanged for K^+
  - Kaliuresis

One test and one test only!?

- **135/ 2.7/ 85 / 39**
- **Urine Chloride**

Hypochloremia

- We have multiple holes through which we can lose Cl^-
- Low urine chloride
  - Vomit
    - Pyloric stenosis
  - Stool
    - Congenital chloride losing diarrhea
  - Sweat
    - Cystic fibrosis
- High urine chloride
  - Bartter's syndrome

Case- Further Laboratory Evaluation

- Urine Chloride <5 mEq/L
- Sweat Chloride- normal
- Further history: His mother absolutely denies any history of diarrhea, vomiting, or surreptitious laxative or diuretic use.
- In hospital, he eats ~ 170 calories/kg/day without any abnormal losses.
- On 3rd day of admission, 2 other children from 2 separate pediatric practices are admitted with similar symptoms, both having hypokalemic hypochloremic metabolic alkaloses.

BRIEF CLINICAL AND
LABORATORY OBSERVATIONS

Articles in this section should require 3 Journal pages or less; the text 1,000 words or less. A combined total of 2 illustrations or tables with up to 10 references will be accepted. An abstract is not necessary.

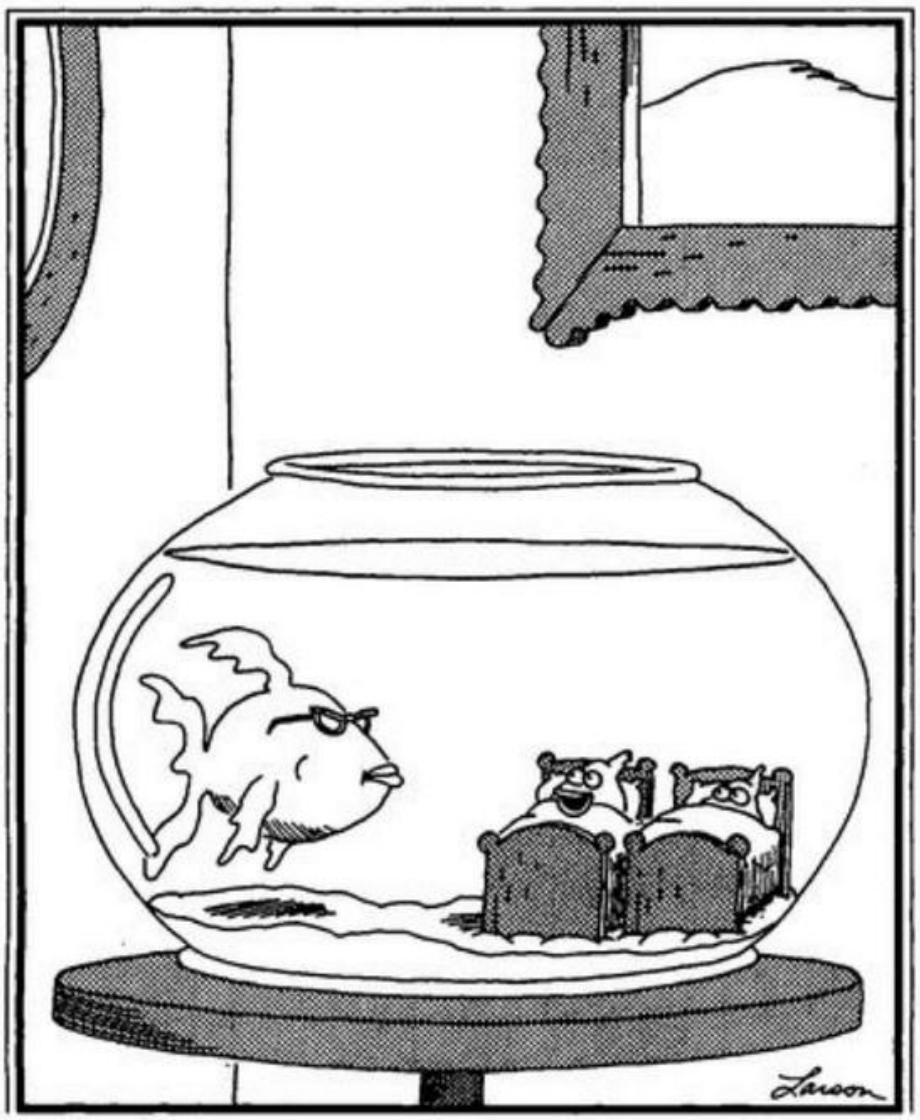
Soybean formula (Neo-Mull-Soy) metabolic alkalosis in infancy

Eduardo H. Garin, M.D.,* Dennis Geary, M.B., B.Ch., B.A.O., and George A. Richard, M.D.,
Gainesville, Fla.

A NEUROBEHAVIORAL SYNDROME AFTER FAILURE TO THRIVE ON CHLORIDE-DEFICIENT FORMULA

Thomas A. Kaleita
Marcel Kinsbourne
John H. Menkes

- **Analysis of the formula reveals chloride content ~5 mEq/L rather than 18 mEq/L.**



"Mom! Theron's dried his bed again."