Falling Off the Curve – Failure to Thrive

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8:00 – 8:45 am

Dr. Robert Rothbaum is Centennial Professor of Pediatrics and clinical director of the Division of Pediatric Gastroenterology and Nutrition at Washington University School of Medicine. Dr. Rothbaum earned his bachelor’s degree from Brown University in 1972 and his medical degree from the University of Chicago in 1976. He then completed his pediatric training at St. Louis Children’s Hospital. Following a pediatric gastroenterology fellowship at Children’s Hospital in Cincinnati, he joined Washington University’s faculty in 1982 and rose to the rank of professor in 1999. The elected president of St. Louis Children’s Hospital, Rothbaum created the interactive online Total Parenteral Nutrition (TNP) calculator, used in medical settings as distant as the Middle East, and wrote the hospital’s diet manual, which has been widely adopted elsewhere. He is founding medical director of the Crohn’s and Colitis Summer Camp, which annually attracts more than 60 children with inflammatory bowel diseases from throughout the Midwest. Nationally, Dr. Rothbaum has been a major force behind collaborative efforts to study children with Crohn’s disease and ulcerative colitis.

Disclosures: None
Falling off the Growth Curve

Objectives

- Review variations in patterns of weight gain and growth.
- Identify patterns of weight gain and growth that point towards a particular diagnosis.
- Discuss and decide upon pertinent evaluation for variations in weight gain and growth.

Failure to thrive is really failure to gain weight as expected.

- Anthropometrics
  - Weight < 5% for age
  - Weight for height < 70%
  - Lack of weight gain for two months
  - Crossing two major percentile lines for weight or length
  - Inadequate weight gain or growth over time relative to standard growth curve, considering genetics and age
Six month old infant with slow weight gain. Normal exam.

Anthropometrics
- Weight < 5% for age
- Weight for height < 70%
- Lack of weight gain for two months
- Crossing two major percentile lines for weight or length
- Insufficient weight gain or growth over time relative to standard growth curve, considering genetics and age

Failure to gain weight = insufficient net energy balance to promote weight gain
- Inadequate intake of nutrients and energy
- Insufficient digestion and absorption
- Increased energy utilization, leaving insufficient energy for weight gain

Failure to gain weight with or without failure to grow
- Change in growth percentiles in infancy
  - 8 weeks to 2 years
  - 25% of infants change one or more major percentile lines
  - Genetic influences predominate over intrauterine factors
- “Catch-up growth”
  - Former premature infant
    - Need to correct for gestational age (Olsen growth charts)
  - IUGR
    - Have rapid growth initially but usually end up being shorter and lighter than their peers during childhood
  - SGA
    - Exhibit catch-up growth in first 6–24 months, with only 14% being short at age 18 years
- “Catch-down growth”
  - LGA babies or those with above-expected birth weight
  - Initial fall in percentiles, then follow curve
Low nutrient intake is the leading reason for slow weight gain.

- Inadequate nutrients available.
  - Low breast milk volume
  - Poverty/Lack of support
- Insufficient formula offered.
  - Misreading of infant’s cues
  - Misinterpretation of behaviors
  - Post-partum depression
- Inability to take sufficient formula.
  - Anatomic abnormalities
  - Neurologic abnormalities
  - Chronic respiratory or cardiac disease

Monitoring successful nursing

- Feeds 8 to 12 times per day.
- Swallowing evident during feeding.
- > 6 wet diapers per day.
- Stools usually 3-6 times per day.
- Weight gain at expected rate.

- If concerned, then
  - Assess maternal status and medication.
  - Have an expert observe feeding, if available.
  - Offer expressed breast milk after nursing.
  - Offer standard formula after nursing.
  - “This is not a contest to win.”

Infant feeding: Tolerable gastric volume

- Insufficient formula offered.
  - Misreading of infant’s cues
  - Feeding liquids other than BM or formula
  - Disorganized household without sufficient support
  - Post-partum depression: 10 to 20% of women affected.

How to determine intake?
- What is being given?
- Historical estimate?
- Prospective recording?

Day 1 (24 hours / age): approx. 1 tablespoon
Day 3 (72 hours / age): ½ to 1 oz.
Day 8-10 ( < 2 weeks): 1 ½ to 2 oz.
1 week – 1 month: 2 to 4 oz.
1 month – 3 months: 4 to 6 oz.
3 months – 6 months: 6 to 7 oz.
6 months – 9 months: 7 to 8 oz.
9 months – 12 months: 7 to 8 oz.

Estimate gastric volume = 3% of body weight.
Initial physical exam findings affecting ability for sufficient intake.

- Inability to take sufficient formula.
  - Anatomic abnormalities
    - Cleft lip or palate
    - Nasal obstruction
    - Tight frenulum
    - Esophageal disorder
  - Neurologic abnormalities
    - Disorganized suck and swallow
    - Frequent cough or gagging
    - Irritability
    - Abnormal tone
    - Chronic respiratory or cardiac disease

- Evaluation
  - Observation of feeding
  - Parent and child

- Further exam
  - Respiratory rate and effort
  - Cardiac exam for murmur, gallop, and peripheral pulses
  - Detailed neurologic and developmental exam

Insufficient digestion and absorption limits availability of energy.

- Intestinal mucosal disorder = celiac disease or post-infectious mucosal injury
- Exocrine pancreatic insufficiency = CF
  - Newborn screen
  - 1.7% CF patients False negative
- Celiac disease
  - Screening = serum IgA and tTG IgA or IgG Ab
  - Diagnosis = Endoscopy and small bowel biopsy
- Cholestatic liver disease = rare

Increased energy utilization complicates primary underlying disorder.

Infants with CHD do have increased energy requirements above controls.

However, control needs are less than usually predicted.

So, increased needs of CHD infants lead to total need of about 100 kcal/kg/day.

However, losses via vomiting may complicate net delivery of nutrients.

Thus, energy delivered may need to reach above 100 kcal/kg/day.

Congenital heart disease

Increased energy utilization complicates primary underlying disorder.

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Increased energy utilization complicates primary disorder.

Work of breathing contributes to resting energy expenditure (REE).

REE increased in infants with chronic lung disease by about 20% due to increased work of breathing.

However, total daily energy expenditure (TDEE) may not be increased, due to reduction in physical activity energy expenditure (developmental delay, in bed, etc.)

Thus, any elevation of total daily energy expenditure is modest, if even present.

Intake may be irregular due to cough or respiratory distress or anorexia.

Other entities considered to affect energy consumption: Burns Infection, surgery, trauma:

CF infants have increased REE and TDEE by about 25%.

Other entities considered to affect energy consumption:

Assessment of the infant who is not gaining weight as expected

- Dietary analysis
- Feeding observation
- Physical exam for disease
- Laboratory exams
  - CBC
  - CMP
  - Celiac serologic exams
  - 1.4% infants with useful finding, previously suggested by history and exam
- Radiology depends on associated symptoms
  - Cardiorespiratory = CXR
  - Vomiting = pyloric ultrasound or ugi series
  - Head ultrasound for rapid head growth or neurologic findings
- Hospitalization?
  - Indications
  - Goals

Hospitalization

- Indications
  - Severe malnutrition and monitoring for refeeding syndrome
  - Specific system problem identified
  - Concern for psychosocial circumstances
  - Marked parental anxiety or dysfunction
- Goals
  - Observation of feeding ability and behaviors
  - Solicit necessary resources for support
    - WIC
    - Social work
    - Nursing
  - Consider resources for home program
  - Weight gain
Prognosis of Failure to Thrive

- At age 8 years
  - Three groups: Adequate growth, FTT-Control, FTT-Home Intervention
  - Gradual improvement in weight and height over preschool years, but residual deficit in height and weight at age 8 years (5 cm and 4 kg) with and without home intervention for FTT. Associated with maternal height.
  - BMI: AG > FTT-HI > FTT-Control
  - IQ not different between FTT and non-FTT children from similar socioeconomic backgrounds. Arithmetic skills: AG > FTT-HI > FTT-Control
  - More behavior problems and less developed work habits in school
    - FTT-Control > FTT-HI > AG

Early Intervention and Recovery Among Children With Failure to Thrive: Follow-up at Age 8

Adolescence

Failure to grow has different causes than failure to gain weight.

- Growth in length falters.
- Weight is appropriate for length.

Etiologies
- Endocrine disorders
  - Growth hormone
  - Hypothyroidism
- Skeletal dysplasia
- Syndromic diagnosis
- Genetics

Considerations for short stature

- Endocrine disorders
  - Hypothyroidism
  - Growth hormone deficiency
- Skeletal dysplasia
- Syndromic diagnoses
- Genetics
  - Familial short stature
  - Constitutional delay of growth and development
- Free T4 and TSH
- Growth hormone. Find endocrinologist.
- Disproportionate habitus or extremities
- Skeletal survey
- Dysmorphic facial and other anomalies. Genetics input. IUGR. Follow specialized growth curve.
- Family history
Genetic predispositions to short stature

In children with sleep disordered breathing, does T and A lead to improved weight gain and growth?

First described in individual patients in the 1980's.

Children, mean age around six years, who have acceleration of weight gain and growth after T and A for sleep disordered breathing.

Most of the children are not below usual growth parameter before the surgery. Difficult to document failure to grow or slowing of growth from current literature.

The change in Z scores for height and weight are modest.

Mechanism: altered sleep patterns lead to changes in growth hormone secretion.

<table>
<thead>
<tr>
<th>Change in Growth Parameters in Mid-Childhood</th>
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<tbody>
<tr>
<td>Decrement in weight percentile followed by decrease in height percentile.</td>
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<tr>
<td>Suggests decrease in energy intake.</td>
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<tr>
<td>Possible symptoms: Diarrhea Abdominal pain</td>
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<td>Exam: Thin habitus Pallor Fullness in RLQ Perianal findings</td>
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<tr>
<td>Labs: Microcytic anemia Hypoalbuminemia Elevated fecal calprotectin</td>
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<td>Next step: Consider upper and lower endoscopy</td>
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What else might be going on?

• Another acquired disorder:
  Renal, respiratory or cardiac disease: Evident from exam.

• Stimulant medication side effect?
  – Reduction in intake and weight
  – Reduction in height velocity
  – Transient effects reversed over time or with stopping medication
  – Normal adult height and weight

Falling off the Curve

Objectives

• Review variations in patterns of weight gain and growth.
  – Benign changes in percentiles in first year
  – Consideration of pre-existing conditions, e.g. IUGR or SGA

• Identify patterns of weight gain and growth that point towards a particular diagnosis.
  – Failure to gain weight is caused by net energy deficiency
    – Most common reason is low intake
    – Malabsorption can be considered but is not as common.
    – Failure to grow results from endocrine, genetic, syndromic, or skeletal disorders.
    – In later childhood, consider non-GI disorders and medication effects.
    – Inflammatory bowel disease often begins early in the second decade

• Discuss and decide upon pertinent evaluation for variations in weight gain and growth.
  – History and exam provide most valuable information.
  – For infants, observed feeding can provide insight.
  – Focused lab tests on likely diagnoses.