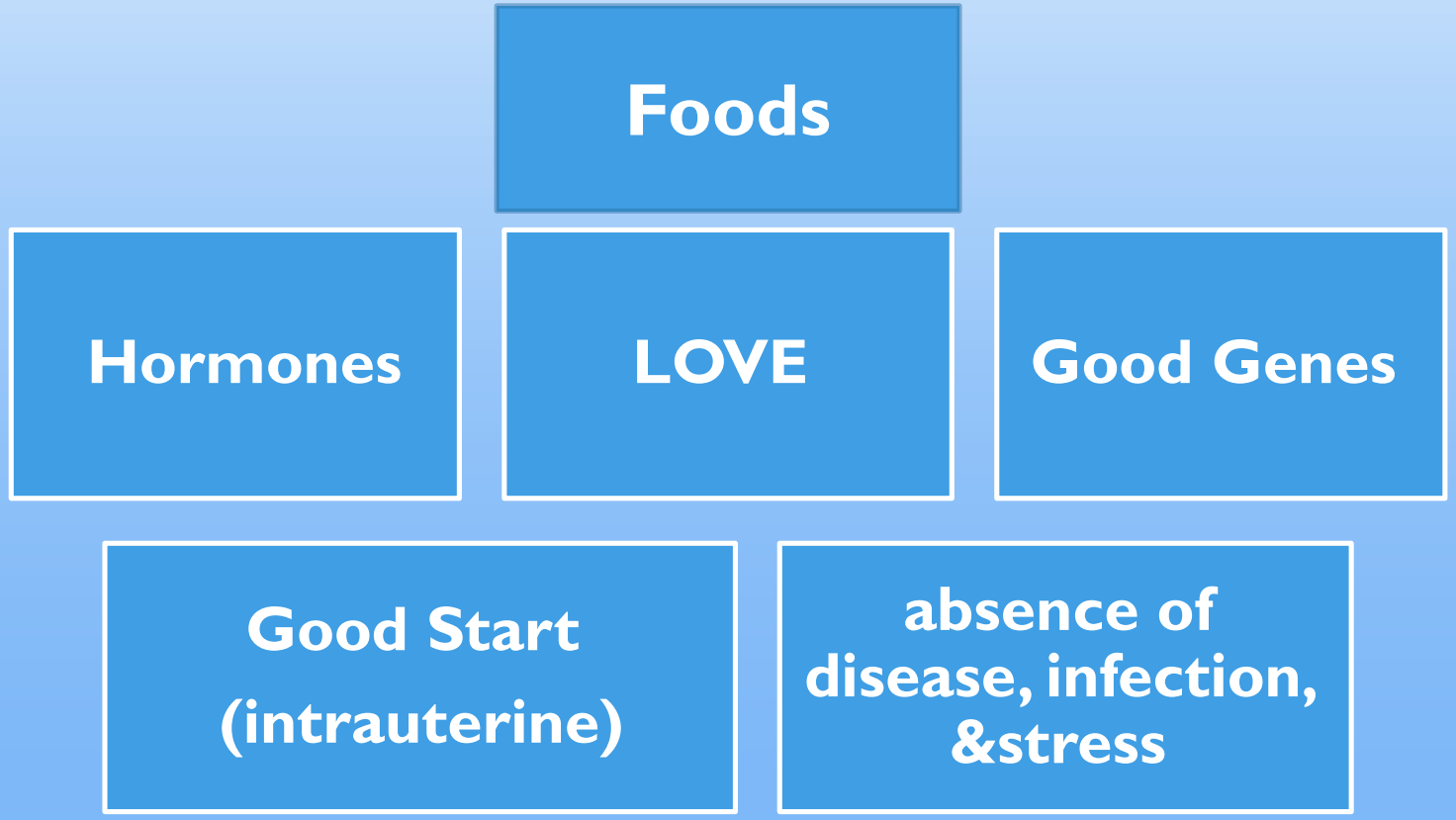
د. العايد عنده سلايدز بس ما عندي مصدر للنوتس، ود. العمير كتبت معه نوتس بس ما عنده سلايدز. لذا:

FAILURE TO THRIVE

Slides: IBRAHIM AL AYED
PROFESSOR OF PEDIATRICS
PEDIATRICIAN & GENERAL CONSULTANT

Notes: Dr. AlOmair

What does a child need to grow ?



Notes: Thrive = grow في نقص بس عنده الوزن زايد لأن أحياناً الوزن زيادة من مصطلح شمولية أكثر
Thrive is much more comprehensive الطول أو المنتاليتي

Failure to thrive is failure to develop normal weight and standards of growth usually in the first 2 years of life

GROWTH GUIDELINES

WEIGHT-

- Babies lose 200 grams weight in the first 10-14 days of life.
- Birth weight is regained by the 14th day.
- During the first 3 months, the average gain is about 1 kg/month (about ½ to 1 oz/ day).
- Birth weight doubles at about 4 months, triples at 12 months, quadruples at 24 months.
- By six month, the average gain per month is 0.5kg.
- During the second year, the average gain per month is 0.25 kg.
- After age 2, the average annual increment is 2.3 kg (5 lb) until the adolescent growth spurt.

Notes: The rate of weight gain is maximum in the first 2 years of life, and has a linear relationship with nutrition, while hormonal influences are later (pre-pupertal and pubertal)

GROWTH GUIDELINES

HEIGHT –

- Average birth length is 50cm (20 in).
- By the end of the first year, birth length increases by 50%. 25 cm in the first year
- Birth length doubles by 4 years. (10 cm per year)
- Birth length triples by 13 years. Average annual growth is 5 cm (2 in) or better per year.

Steep growth in early life = high velocity and sharp increase .Then we plateau with slower growth as our age increase

GROWTH GUIDELINES

A nice rule of thumb for head circumference is the 3 & 9 rule.

- A newborn has a head circumference of 35 cm,
- a 3 month has a circumference of 40 cm,
- a 9 month has a circumference of 45 cm,
- a 3 year old has a circumference of 50 cm,
- and a 9 year old has a circumference of 55 cm.

Head circumference increase in the first1-2 years and then plateau, we may become obese but our head doesn't change much after 4 years

Failure to thrive (FTT) - definition

FTT could be defined as an:

- Infant's growth deviated from an established pattern of age-appropriate growth.
- Regardless of the anthropometric indicator and cut off value selected, accurate interpretation of the growth data is dependent up serial measurements and not one point in time.

5-10% of children have FTT

You should be careful not to mark anyone with FTT except after measuring height, weight and occiput to frontal head circumference, and then plotting it in the growth chart and it is under the normal percentile.

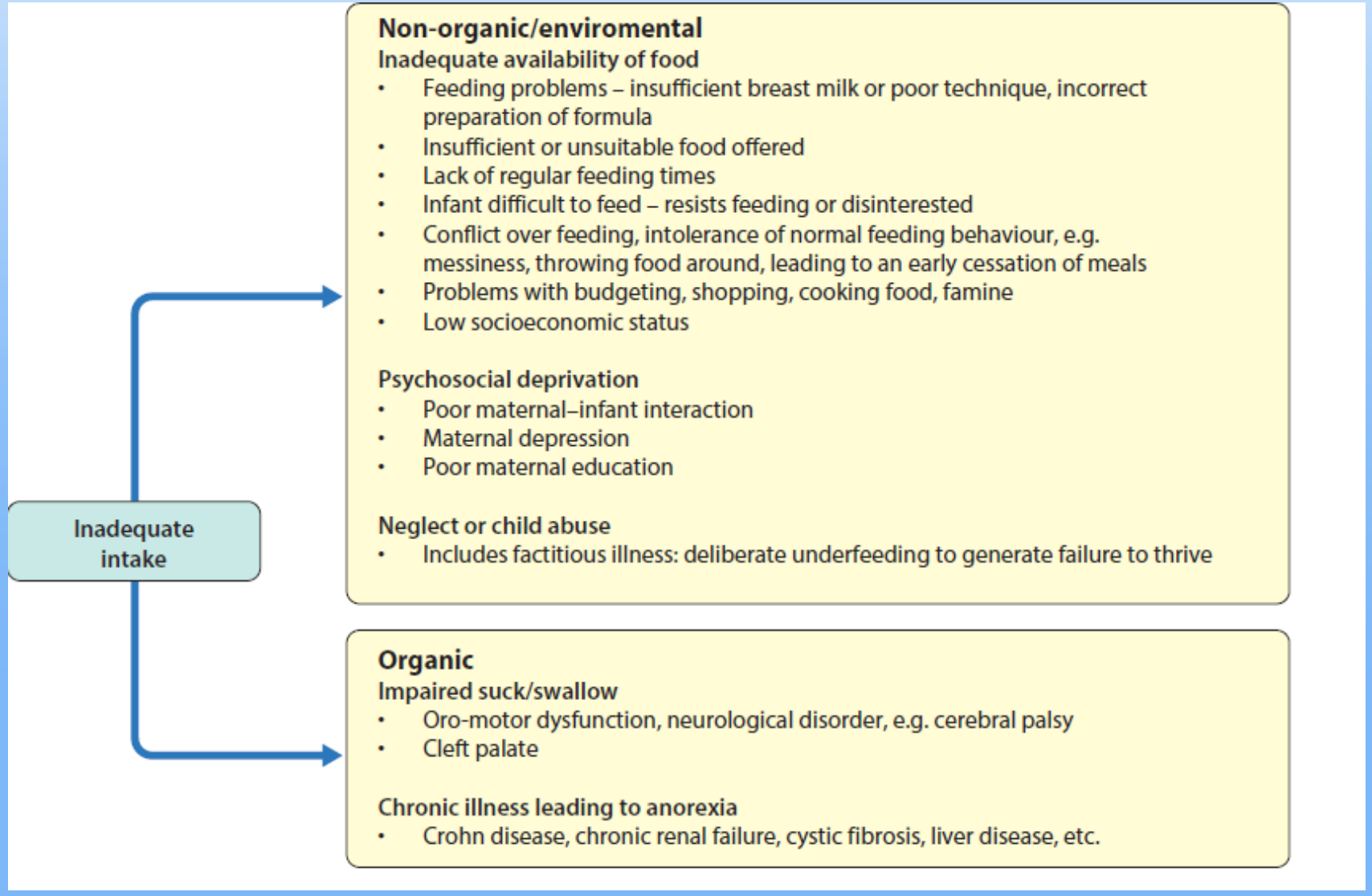
FTT

- Height or weight below the 5th percentile which is 2 SD below normal percentile
- Or
- Crossing 2 percentiles e.g. moving from 98th percentile to the 25th , still within normal however he's deteriorating and needs investigation
- Diagnosed on 3-4 serial measurements each below the standards > Admit and investigate. Because sometimes the kid may have transient FTT on one measurement due to UTI, if taken again may be normal or even obese.
- Relate to midparental height (average of mother height and father height) إذا هم قصار نقول لهم من شابه أباه فما ظلم

Old classification of causes:

- **Nonorganic** = environmental: mouth esophagus and intestines and metabolism are okay but there is decrease in intake due to poverty, neglect, sick mother (e.g. psychiatrically sick) or psychosocial deprivation, housemaid, Insufficient breast milk, incorrect feeding technique, dilute milk formula e.g. by ignorance, Insufficient food etc..
- **Organic** :Vomiting, Malabsorption, Failure to utilize nutrients as in syndromes, Acidosis, Carbohydrate intolerance, increased metabolism and increased needs due to tumor or hyperthyroidism

Causes of FTT (illustrated)



Causes of FTT (illustrated)

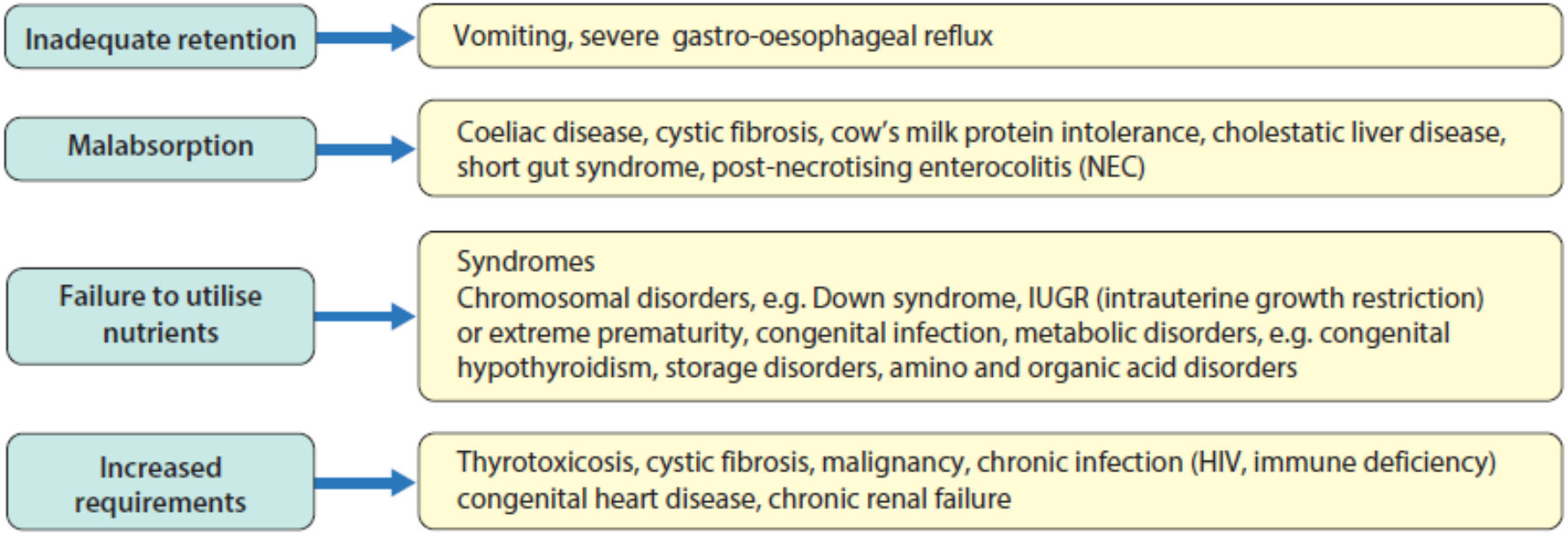


Figure 12.8 The main causes of failure to thrive.

Failure to thrive

Most pathological explanations for failure to thrive can be broken up into of the following groups:

- Inadequate caloric intake
- Inadequate absorption
- Increased metabolism
- Defective utilization

Failure to thrive

- Inadequate caloric intake
  - Incorrect preparation of formula (too diluted, too concentrated).
  - Unsuitable feeding habits (food fads, excessive juice)
  - Behavior problems affecting eating
  - Poverty and food shortages
  - Neglect
  - Disturbed parent-child relationship
  - Mechanical feeding difficulties (oromotor dysfunction, congenital anomalies, central nervous system damage, severe reflux)

Failure to thrive

- Inadequate absorption
  - Celiac disease
  - Cystic fibrosis
  - Cow's milk protein allergy
  - Vitamin or mineral deficiencies (acrodermatitis enteropathica, scurvy)
  - Biliary atresia or liver disease
  - Necrotizing enterocolitis or short-gut syndrome

Failure to thrive

- Increased metabolism
  - Hyperthyroidism
  - Chronic Infection (human immunodeficiency virus or other immunodeficiency, malignancy, renal disease).
  - Hypoxemia (congenital heart defects, chronic lung disease)

Failure to thrive

- Defective utilization
  - Genetic abnormalities (trisomies 21, 18, and 13)
  - Congenital infections
  - Metabolic disorders (storage diseases, amino acid disorders).

FTT – Illingworth Clinical Wisdom

- Proper measurement of weight and height is an essential part of the supervision of a child's well-being.
- Measurements of the weight and height must be accurate-taking into account, for instance, the common inaccuracy of weighing scales.
- Figures for comparison must be valid ones. Secular changes and differences between one country and another must be recognized.
- Single measurements are better than nothing, but serial measurements on a centile chart are far more important. Changes in position on the centile chart, especially if there is a slowing of growth velocity, are of the greatest importance.

* *The normal child R.S. Illingworth*

FTT – Illingworth Clinical Wisdom

- Children have different growth rhythms – often a familial feature. Some have slow or rapid periods of growth; some grow slowly at first and then have an unexpected spurt of growth.
- The assessment of a child's growth demands a thorough knowledge of the normal, the normal variations and the reasons for the variations, so that one considers whether action is necessary.
- Accurate assessment can only be based on the basis of a careful history and examination, consideration of all the factors which may have affected growth and interpretation of the results.

* *The normal child R.S. Illingworth*

FTT – Illingworth Clinical Wisdom

- Maximum growth is not necessarily the optimum. Far more important than the child's continued but unchanging variation from the average on the centile chart is his well-being, abundant energy, freedom from infection and freedom from lassitude.
- The average is not the same as the normal. Variation from the usual growth is often merely a familial feature, or only reflects the size at birth. What is abnormal for one child is not necessarily abnormal for another. But the greater the variation from the average, the less likely is the child to be 'normal'.
- A child may be very different from the average weight and height of his fellows, and yet be normal.

* *The normal child R.S. Illingworth*

FTT - History

- Generally, children who fail to thrive have nutritional inadequacies.
- The history and physical examination initially should focus on these problems, with special attention to feeding disorders and vomiting.
- Review of specific dietary practices, formula preparations, and feeding techniques, including caregiver/child interaction, is imperative.

History

- History should go back to perinatal period, e.g. placental insufficiency due to diabetes, preeclampsia, hypertension or kidney disease,
- birth injury that may lead to global developmental delay with mental retardation and growth problems, and most importantly microcephaly because their brain failed to growth.
- Neonatal period: premature babies in the NICU with hypocalcemia, hypoglycemia, infections, mechanical ventilation, pulmonary problems that impedes their growth with time.

HPI

- Lose of appetite e.g. new leukemia
- Diarrhea e.g. celiac
- Vomiting e.g. acute (food poisoning) chronic (neurological)
- Abdominal pain in older children
- Fever
- Sickness
- Polyuria, Polydipsia = endocrine disease
- Jaundice = Liver disease
- Cough = respiratory disease
- Immunodeficiency = repeated admissions

History

- **Feeding history** لقينا أمهات تحط ملعقة بوردة حليب على ٣٠٠ مل ماء بيصير مخفف ٣ أضعاف عشان كذا ما ينمو المفروض الملعقة ل ٦٠ مل ماء. ف ما يأخذ الا ربع الكاربوهيدرات اللي يحتاجها
- **Family history:** Needless to say if a patient with family history, parental height, death in siblings (metabolic or immunological), endocrine disease or thalassemia.
- **Social hx.** Industrialized western with alcohol and substance abuse and impaired family structure, Poverty, maternal health, number of siblings, employment, current stress (e.g. prison, marital disharmony)
- Premature need special attention, but if they don't have organic cause they eventually catch up السرعة تتسارع أكثر للتعويض عشان يلحق بالركب
- Developmental history: Brain disease, genetic neurometabolic system, Secondary CNS FTT.
- اذا الطفل يلعب ومرتاح ما نقلق

Physical examination

- Weight and height change from last visit
- Mid upper arm circumference
- Skin fold thickness
- Dysmorphic features e.g. single palmar crease, low set ears, small chin, depressed nasal bridge.
  > often chromosomal disease
- Other signs: Harrison sulcus in severe asthma or immunodeficiency > chronic respiratory illness
- Signs of neurological disease: Squint, small head, convulsions, weakness
- Signs of neglect or child abuse (discuss with social worker to address their issues)

Physical examination (cont.)

- Edema = renal
- Hair color = zinc
- Heart murmur and hepatomegaly = cardiac
- Mental status (Cerebral palsy)
- wasting in CP or cancer
- Rash or bruising: HIV, Cow's milk allergy, Cystic fibrosis

FTT – Labs & Assessment

- It is cost-effective and appropriate to limit the laboratory evaluation, but it is reasonable to consider diagnostic studies that have further implications for health, such as
  - sweat chloride determination (celiac) MCQs!,
  - blood lead level, or
  - parameters of immune function,
  - or to employ other special testing (eg., tuberculin skin testing or HIV status) in children at risk.
- Results of the history may guide the selection of further studies such as
  - stool analysis for malabsorption and oval/parasites,
  - metabolic profiles, and
  - radiographic procedures.
- Psychological and development assessment should be undertaken once any acute medical condition has been identified and addressed.

Investigations (illustrated)

Box 12.3 Investigations to be considered in 'failure to thrive'

Investigation	Significance of an abnormality
Full blood count and differential white cell count	Anaemia, neutropenia, lymphopenia (immune deficiency)
Serum creatinine urea, electrolytes, acid–base status, calcium, phosphate	Renal failure, renal tubular acidosis, metabolic disorders, William syndrome
Liver function tests	Liver disease, malabsorption, metabolic disorders
Thyroid function tests	Hypothyroidism or hyperthyroidism
Acute phase reactant, e.g. C-reactive protein	Inflammation
Ferriaztin	Iron deficiency anaemia
Immunoglobulins	Immune deficiency
IgA tissue transglutaminase antibodies	Coeliac disease
Urine microscopy, culture and dipsticks	Urinary tract infection, renal disease
Stool microscopy, culture and elastase	Intestinal infection, parasites, elastase decreased in pancreatic insufficiciency
Karyotype in girls	Turner syndrome
Chest X-ray and sweat test	Cystic fibrosis

FTT

- FTT is best considered a physical sign of undernutrition and not a clinical syndrome caused by "organic" or "nonorganic" factors
- Infants and young children may cross major percentile lines on growth curves during a normal course of growth. Therefore, documentation of weights or lengths falling off of growth channels is not, by itself, proof of FTT.

FTT

- It is unclear how many children have adverse neurodevelopmental outcomes from FTT.
- Extensive laboratory screening is of little utility in the evaluation of FTT.
- Certain children who appear to have FTT may be biologically programmed to be smaller and thinner than most children. Insulin resistance may be a mechanism, and aggressive nutritional intervention may put these children at risk of developing metabolic syndrome

Management

- Multidisciplinary:
  - Social worker
  - Dietary clinic
  - Health visitor
  - Pediatric dietician e.g. for children with short gut syndrome after resection of bowel
  - Psychologist for family and baby
  - Nursery

Management (cont.)

- 90-95% are clinic cases, because inadequate intake is the most common cause
- Admission only for < 6 months for severe FTT. Nutrition including IV if necessary, and if the baby is growing it means no organic disease but circumstantial / social cause
- TPN very very rare, the most important indication is necrotizing enterocolitis > major resection > very short bowel > severe FTT> TPN for a number of months or a year
- Observe and correct mother's skill in feeding

- Full-term baby gains 30 gram \ day > in the first 10 days-14 lose 20 kg > gain 210 a week > around 1 kg by a month > doubles by 5 months, triples by 1 year.
- **Daily caloric requirement:** 110 calorie/kg/day in the first year MCQs!
- **Daily water requirement** in the first year 150 ml/kg, according to the surface area

Outcome

- FTT is a description not a diagnosis
- Non organic: a lasting deficit is common and these children tend to remain underweight. In contrast, impairment of development is only short term. "they pick up because the brain is normal"
- Organic: Severe cyanotic congenital heart disease

Growth chart examples

- **Acquired Hypothyroidism:** no decrease in weight but stunted **height** (Platea then out of 5th percentile)
- **Celiac:** Change in **weight** at 9th month- 1year (gluten sensitive enteropathy)
- **Syndromes** maybe even overweight but **short**
- **Cystic fibrosis:** > infection > admitted > another infection > another admission > **waxing and waning but consistent FTT with no effect on height**
- **Hormonal: short but fatty** (prader willi syndrome)
- **Neglect, poverty or neglected/chronic diarrhea** in an alert normal-looking baby (normal neurologically but has gut disease) = skin and bone, no muscle on girdles, no fat, wrinkles in the skin, comparatively big head, pure GI disease
- **Marasmus** (calorie and protein insufficiency) > hypoproteinemia > abdominal distension with gasses due to disaccharidase deficiency

Table 1: Classification of Under nutrition

Nutritional States	Wt./Age	Ht.	Wt. Ht.
Acute	↓	N	↓
Chronic	↓	↓	N
Acute or Chronic	↓	↓	↓

AVERAGE GAINS IN WEIGHT AND LENGTH IN THE FIRST FIVE YEARS OF LIFE

Age	↑Weight	↑Length
0 – 1 week	↑10% loss	
1- 2 weeks	Birth weight regain	
2 weeks – 5 months	150 – 200 grams/week	
5 months	Birth weight doubled	1.3 x birth length
5 months – 1 year	Wt. gain velocity declines	
1 year	Birth weight tripled	1.5 x birth length
1 – 2 years	2 -3 kg/year	11 – 12 cm./year
2 – 5 years	2kg/year	Birth length doubled at about age 4.

A staging system for malnutrition

	Weight for age[1]	Height for age [2] (stunting)	Weight for height [3] (wasting)
Normal	> 90% of median	>95% of median	> 90% of median
Mild malnutrition	75% - 90%	90% - 95%	81% - 90%
Moderate malnutrition	60% - 74%	85% - 89%	70%- 80%
Severe malnutrition	<60%	<85%	<70%

What is normal growth?

AGE	Median daily weight gain (grams)	Recommended daily allowance (kcal/kg/d)*
0-3 months	26-31	108
3-6 months	17-18	108
6-9 months	12-13	98
9-12 months	9	98
1-3 years	7-9	102
4-6 years	Approximately 6	90

*National Research Council, Food and Nutrition Board; Recommended Daily Allowance. Washington, DC. National Academy of Sciences, 1989.

Why isn't this baby growing?

Age on onset	Diagnostic considerations
Before birth (IUGR, prematurity)	Especially in "symmetric" IUGR, consider prenatal infections, congenital syndromes, teratogenic exposures (anticonvulsants, alcohol, etc.).
Neonatal	Incorrect formula preparation; failed breastfeeding; neglect; poor feeding interactions; metabolic chromosomal, or anatomic abnormally (less common).
3-6 months	Underfeeding (possibly associated with poverty); improper formula preparation; milk protein intolerance; oral-motor dysfunction; celiac disease; HIV infection; cystic fibrosis; congenital heart disease.
7 -12 months	Autonomy struggles; overly fastidious parent; oral-motor dysfunctions; delayed introduction of solids; intolerance of new foods.
After 12 months	Coercive feeding; highly distractible child; distracting environment; acquired illness; new psychosocial stressor (divorce, job loss, new sibling, death in the family, etc.)

Medical causes of inadequate intake that may be overlooked

Infectious: Giardiasis other parasites (e.g., nematodes), Chronic UTI, Chronic sinusitis
Mechanical: Adenoid hypertrophy, Dental lesions, Vascular slings, GE reflux with esophagitis
Neurologic: Oral-motor dysfunction (gagging, tactile hypersensitivity).
Toxic/metabolic: Lead toxicity, Iron deficiency, Zinc deficiency
Gastrointestinal: Celiac disease, Malabsorption (various causes), Chronic constipation.

Diagnostic red flags for FFT

History	Diagnostic consideration	Investigation
Spitting, vomiting	Gastroesophageal reflux	Upper GI series, Ph probe, esophagoscopy
Abdominal distension, cramping, diarrhea	Malabsorption (e.g., cystic fibrosis, celiac disease, lactase deficiency)	D-xylose test, stool fat, antigliadin titer or biopsy, sweat chloride.
Travel to or from developing country; homeless, overcrowded, or living in shelter	Parasitosis (especially giardia), TB, inadequate access to cooking facilities and refrigeration	Stool O & P, duodenal biopsy, string test, PPD
Snoring, periodic breathing during sleep, restless sleep, noisy or mouth breathing	Adenoid hypertrophy	Lateral neck film (soft tissues and airway)
Symptoms of asthma, bronchitis	Chronic aspiration, cystic fibrosis.	Chest film, radionuclide scan for aspiration, sweat chloride*
Polyuria, polydypsia, polyphagia	Diabetes	Blood glucose
Frequent (minor) infections	HIV, other immune deficiency	Serologic tests, immunoglobulins, * PPD with control for anergy*

* May be abnormal secondary to malnutrition

Take home message

Summary

Failure to thrive

- is a description, not a diagnosis
- weights of infants are only helpful if accurate and plotted on a centile chart
- is present if an infant's weight falls across two centile lines
- is likely to be present the further the weight is below the 2nd centile
- is mostly due to inadequate food intake
- is accompanied by abnormal symptoms or signs if there is organic disease
- most affected infants and toddlers do not require any investigations and are managed in primary care by increasing energy intake by dietary and behavioural modification and monitoring growth.

Case scenario -1

- Baby has FTT based on parents, doctors disagree. He is slim however looks normal. Measured weight and plotted on chart and he's normal.
- 1.5 year baby, the mother complains that he has low appetite and difficulty in feeding (subjective). Exclude anemia and do PE > We found an active toddler / no abnormality. Parents were shown the growth chart and were reassured.

Case scenario -2

- 9 month female baby, the nurse was concerned she has FTT.
- PE showed active baby sucking fest.
- UA CBC CXR all normal.
- Impression of nurse and social worker: parents left baby unattended at their home.
- Alcohol consumption and substance abuse
- Dx: neglect!

Case scenario -3

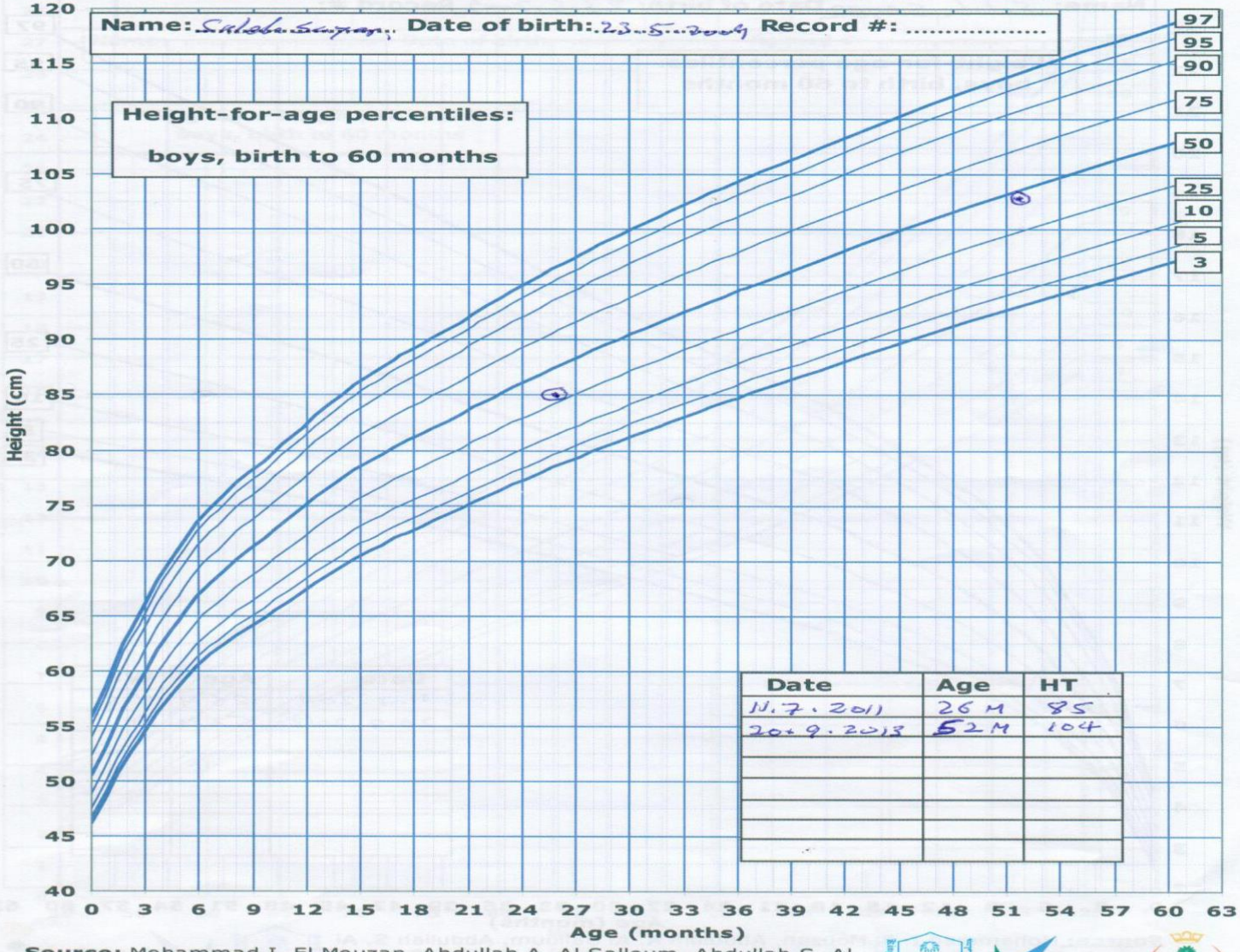
- Cerebral palsy; at uterus or during birth (asphyxia, traumatic instrument) > Central neurological damage to motor system > Poor weight gain.
- Hx. : Cord prolapse during labor > neonatal asphyxia > hypoxic encephalic damage
- Growth parameters: All below 3rd percentile (global FTT)
- PE: Spastic quadriplegia, hyperreflexia, pseudobulbar palsy, Persistence of primitive reflexes (usually disappear after 4 months), Poor coordination between sucking and swallowing reflex > difficulty with feeding.

Case scenario -4

- Transient FTT in 3 month female.
- HX.: breast feed didn't exceed 50 gram/week in the past 3-4 months! (should be 210 per week)
- Birth weight was ideal (3 kg)
- UA: 25000 WBC, 1000 RBC! (should be 0), Pus > UTI
- Culture : E.coli sensitive to ampicillin
- Renal US: dilated pelvicalceal system
- MCUG: grade 4 vesicoureteral reflux (+hydronephrosis)
- Rx.: Prophylactic Abx. Until reflux improve as they grow. Only few continue to have recurrent UTI and stone which affect renal function.

The Growth Charts for Saudi Children and Adolescents

Endorsed by The Health Services Council of Saudi Arabia No. 29 (24/6/2007)



Source: Mohammad I. El Mouzan, Abdullah A. Al Salloum, Abdullah S. Al Herbish, Peter J Foster, Mansour M. Qurashi, Ahmad A. Al Omar. The 2005 Growth Charts for Saudi Children and Adolescents (No. AR-20-63). King Abdulaziz City for Science and Technology 2009, Riyadh, KSA.

NB: The age is based on Gregorian calender.

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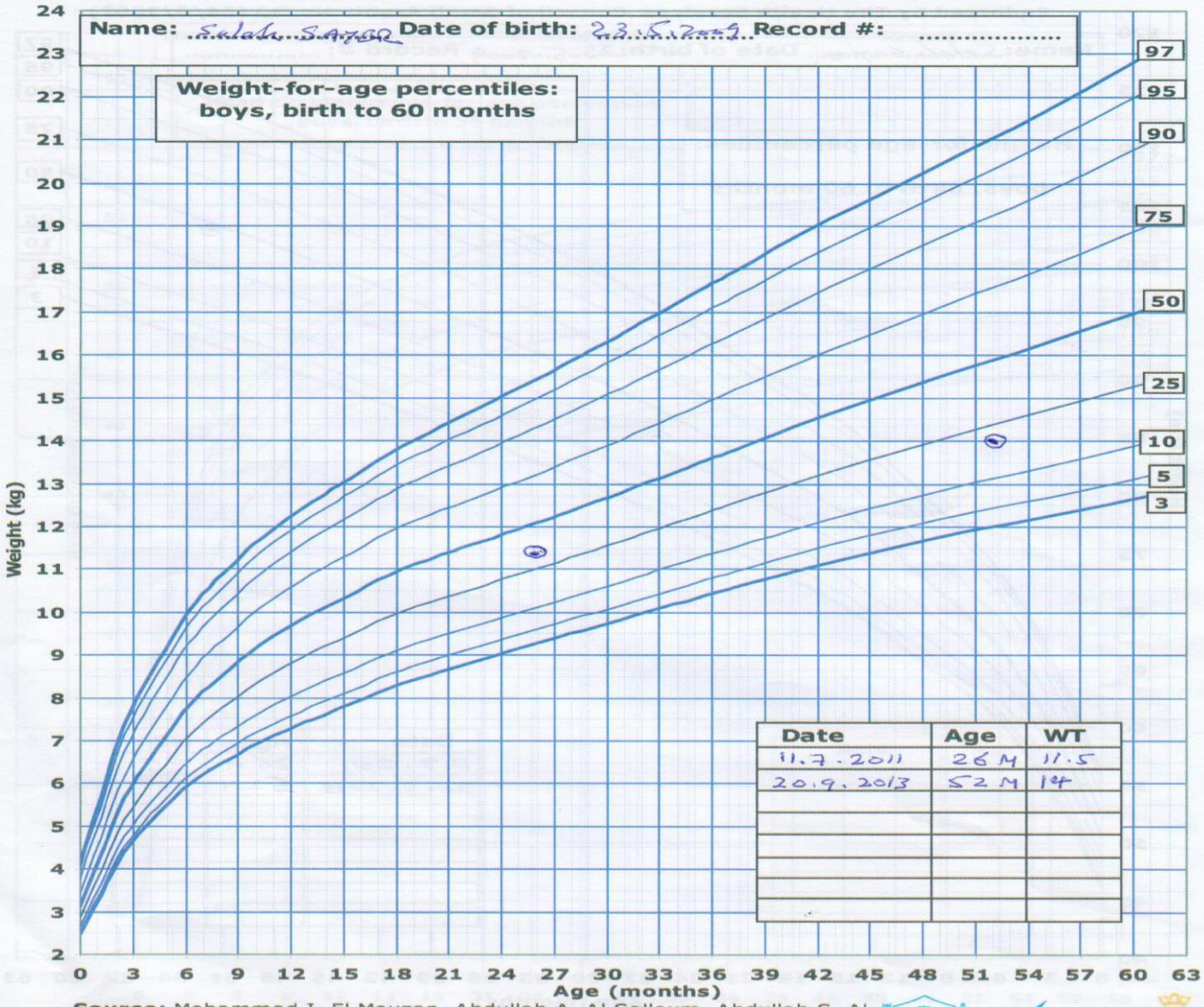

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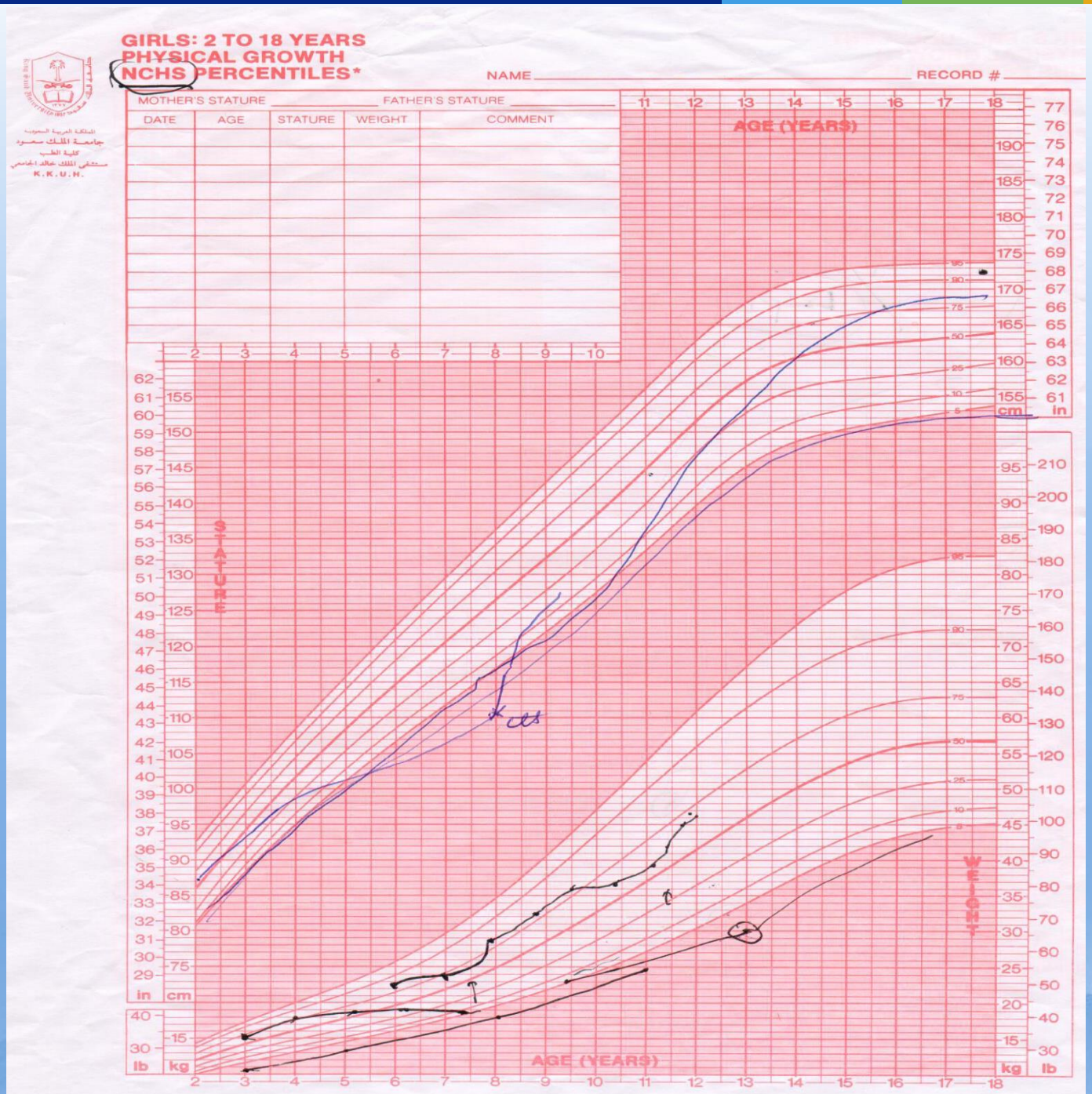
GIRLS: 2 TO 18 YEARS
PHYSICAL GROWTH
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THANK
YOU

FAILURE TO THRIVE

DR. IBRAHIM ALAYED

Q1: What factors influence / control growth?

Q2: How to know that a child is not growing normally?

Q3: What causes failure to thrive? How to classify it?

Q4: What specific points in history you need to know?

Q5: How to approach examination of a child who has growth failure?

Q6: What investigations you need to do on a child with failure to thrive?

Q7: How to treat children with failure to thrive?

Q8: Take home message.

1) A 2-month-old male infant is brought for a routine health supervision visit. His mother reports that he cries a lot. He feeds vigorously then regurgitates. The regurgitation is nonbilious and nonprojectile. Findings on physical examination are normal except for the fact that the infant's weight has fallen from the 60th to the 25th percentile for age.

Of the following, the MOST likely diagnosis is:

A. adrenal insufficiency
B. cystic fibrosis
C. gastro esophageal reflux
D. poor feeding technique
E. pyloric stenosis

2)A 6-month-old infant has a large ventricular septal defect complicated by congestive heart failure. His corrective surgery has been delayed because of 2 hospitalizations for bronchiolitis during which he lost weight. He is currently feeding 24 kcal/oz formula, but has not shown any weight gain, and his weight is now below the third percentile for his age. The baby has a good suck, but he takes no more than 60 to 75 mL every 4 hours.

Of the following, the BEST next step to increase this baby's energy intake is to

A. add microlipid to the current formula

B. add protein powder to the current formula

C. change to an amino acid-based formula

D. increase the caloric density of the current formula to 35kcal/oz

E. start total parenteral nutrition

3) You are examining a girl at her 1-year health supervision visit. Her weight, length, and head circumference all were at the 10th percentile at birth. There were no pregnancy, labor, delivery or nursery complications. Physical examination reveals her weight. Length, and head circumference are at the 5th percentile.

Of the following, this child's growth parameters MOST likely represent:

A. a chromosomal abnormality
B. a malabsorptive disorder
C. an endocrine disorder
D. inadequate caloric intake
E. normal growth

4) You review a recent clinical case of a 15-month-old boy followed in the well child clinic since 3 months of age. He has a chronic cough and has had 3 episodes of pneumonia in the past 12 months. He was brought in for evaluation of pale foul-smelling diarrhea. His mother described bulky and greasy stools, gassiness, and abdominal distention. Review of the growth chart demonstrated decreasing weight from the 38th percentile at birth to the 10th percentile.

Of the following, the cause of diarrhea in children with this disorder is

A. cow milk protein intolerance

B. disaccharidase deficiency

C. endocrine pancreatic insufficiency

D. exocrine pancreatic insufficiency

E. small bowel bacterial overgrowth

5) You are evaluating a 2-year-old child for failure to thrive. The dietary history suggests the boy's caloric intake is 100 kcal/kg per day, which is the recommended dietary allowance (RDA) for his age. He has not been vomiting, and he is passing one to two normal bowel movements per day. On physical examination, he appears to be an active, happy, thin toddler. His weight is 10.5 kg (5^{th} percentile), height is 85 cm (25^{th} percentile. There is mild eczema on the cheeks and antecubital fossae. The abdomen is not distended, and other finding are normal.

Of the following, the BEST explanation for this child not gaining weight is that he has:

A. a food allergy
B. caloric requirements that exceed the RDA
C. celiac disease
D. cystic fibrosis
E. reflux esophagitis

6) Both the weight and height parameters of a 6-month-old girl have dropped to substantially below the 5th percentile for age. Until 2 months of age, she had maintained growth at the 50th percentile. At that time, her mother returned to work and the grandmother assumed her care. She has received iron fortified formula since birth and currently ingests 6 oz every 4 hours.

Of the following, the best INITIAL step in management of this child is to:

A. determine how the formula is mixed
B. obtain a creatinine level
C. obtain a sweat test
D. obtain thyroid function studies
E. reassure the mother that this is a normal growth pattern