

# Failure to Thrive: Overview of Diagnosis and Management

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## 1. Introduction

Failure to thrive (FTT) is a common and potentially serious growth problem identified in the first three years of life, affecting 5% to 10% of children seen in the primary care setting (Schwartz, 2000). It accounts for 5% to 10% of referrals to (Daniel et al., 2008) and 1% of hospital admissions in tertiary care centers (Berwick et al., 1982).

Although FTT is relatively common, there seems to be no consensus regarding its definition (Raynor & Rudolf, 2000). The term is most often used to describe persistently inadequate linear growth and/or weight gain within the first three years of life (Schwartz, 2000). FTT is a sign or finding rather than a diagnosis since it simply represents an abnormal growth pattern in young children. The underlying condition causing FTT might be difficult to determine, requiring a thorough history and physical examination with special attention to dietary and psychosocial factors. It requires close monitoring by the primary physician.

Poor growth or poor weight gain in children may be due to a variety of medical or psychosocial problems. Therefore, monitoring growth is an invaluable tool for primary care physicians and should be done vigilantly at every well-child visit. Growth charts are useful in comparing a child to appropriate standards for age, sex and ethnic background. If any abnormality in the growth pattern is detected, necessary measures should be undertaken to ensure appropriate evaluation for and treatment of any underlying condition.

Long-term FTT without significant underlying organic etiology has been shown to negatively impact neurodevelopmental outcome (Hufton et al., 1977). Studies have shown that five to eight years after a FTT diagnosis these children show disorders of personality trait, have decreased educational attainment and demonstrate lower IQ's despite having average anthropometric parameters at the time of evaluation (Hufton, et al., 1977). Therefore, early diagnosis and intervention are believed to be key factors in improving outcome in children with FTT (Casey et al., 1994). In the absence of effective treatment, children with FTT may develop irreversible cognitive and behavioral disorders that seem to correlate with the severity and duration of the FTT. However, other studies have reached the opposite conclusion. In a review and analysis of thirteen studies, there seemed to be no significant difference in the IQ of patients with failure to thrive compared to the general population (Wright et al., 1998). This discrepancy in outcome is probably due to the lack of large, randomized, controlled studies in children with FTT.

## 2. Normal growth in children less than three years of age

Evaluation of growth in children at well-child visits is an invaluable tool. Regular measurements of length/height and weight are vital, especially during the first three years of life, to facilitate early detection and treatment of any physical, nutritional or psychosocial factors that might negatively impact a child's growth and overall health.

Normal growth patterns may vary in different groups of children. Ethnicity, gestational age (premature infants should be corrected for their gestational age until age two years), birth weight and length, familial growth pattern (i.e. constitutional growth delay) and breast fed versus formula fed are some of the factors that should be considered to avoid unnecessary testing or referrals to pediatric subspecialists.

Effective growth monitoring requires accurate, consistent anthropometric measurements and meticulous plotting on the appropriate growth chart. Growth charts exist for age (length for ages 0-36 months; height for ages 2-20 years) and gender, as well as syndrome-specific charts. In the first three years of life, a length chart should be used for infants/toddlers measured in a recumbent position. For children between the ages of two and three who are able to cooperate with a standing measurement as well as children over the age of three, a 2-20 year height chart should be used.

Effective growth monitoring requires precise and consistent measurements by properly trained health care providers. The most common reason for an unexpected deviation in a child's height is an error in measuring technique (Pinyerd-Zipf & Amer, 2004). Use of the wrong growth chart or incorrect plotting of data can lead to an unnecessary evaluation of incorrectly perceived poor growth or failure to recognize a significant change in a child's growth pattern.

All children under the age of two and those from two to three years who are unable or unwilling to cooperate with a standing height should have a recumbent length measured. The preferred method is to utilize an infantometer (Figure 1) which has a fixed headplate and a moveable footplate. Measuring between two marks on exam table paper is often inaccurate and should be avoided. In general, children are transitioned from measuring a recumbent length to a standing height somewhere between the age of two and three years,



Fig. 1. Infantometer

once the child is able to cooperate with a standing measurement. Ideally both a recumbent length and a standing height should be performed at the time of this transition for comparison, as a standing height is usually slightly less than a recumbent length.

A stadiometer for measuring height requires a vertical board with a metric rule, preferably affixed to the wall (Figure 2). A horizontal headpiece can be brought down into contact with the superior part of the child's head. A flexible or "floppy" arm attached to a vertical rule can be unreliable for serial height measurements, as is standing a child against a tape measure or yardstick attached to the wall and using a ruler or piece of cardboard or plastic against the top of the head.

In the recumbent position, the head is held against the fixed headplate. The infant/toddler is gently stretched, legs together, toes pointing upward, as the footplate is moved against the bottom of the feet. The heels, back of the knees, buttocks and shoulders should be against the bottom platform. Ideally two people are needed to ensure an accurate measurement. The parent/care provider can assist in positioning the child.



Fig. 2. Stadiometer

Shoes, bulky clothing, hats and hair accessories should be removed. The child should stand erect, weight evenly distributed, feet flat on the floor, heels together against the baseboard or wall. If possible the head, shoulders and buttocks should touch the vertical surface. The child's eyes should be in a straight horizontal line with the middle of the ear. Slight upward traction can be applied under the child's chin to avoid "turtling" of the neck when the fixed headpiece of the stadiometer comes in contact with the top of the child's head.

The weight measurement is usually less biased than a height or length measurement, however, infants and toddlers should be weighed naked for accuracy and continuity. If a toddler or child is uncooperative with a weight measurement, the parent or caregiver can be weighed alone and then holding the child, with the difference calculated as the child's weight.

Published in 2000, the CDC growth charts are used for monitoring the growth of infants and children (Figures 3-6). Primary care providers should ensure that recumbent measurements of children are plotted on the boy or girl birth to 36 months length- for- age chart (Figure 3), while a standing height should be plotted on a boy or girl 2-20 years stature for age (Figure 4).

Plotting anthropometric measurements on the incorrect growth chart (for example: height on the length chart or plotting height and weight on a chart for the incorrect gender) or not recording and plotting measurements accurately can cause the physician to believe that the child’s growth is impaired, potentially leading to unnecessary testing and / or referral to a pediatric subspecialist.

Growth is a process. In evaluating growth in children, growth velocity or weight gain over a period of time is more important than attained length, height or weight percentiles. A single measurement of length, height or weight is of limited use.

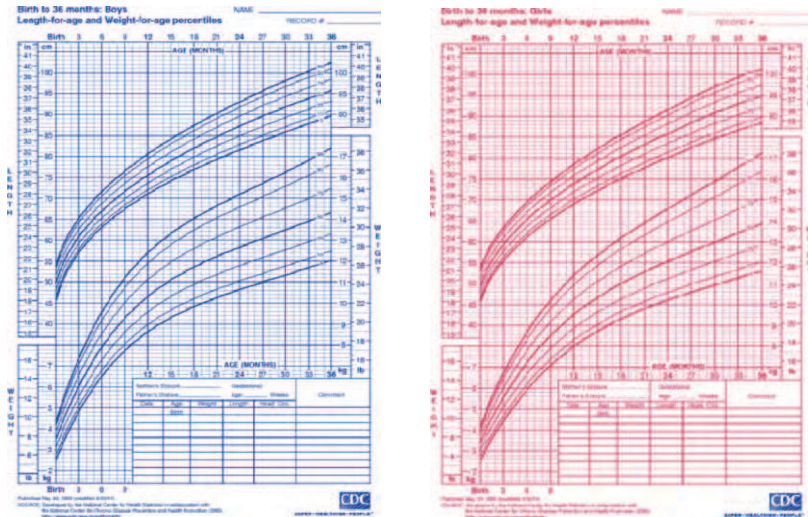


Fig. 3. Boy and girl length-for-age and weight-for-age charts for birth to 36 months

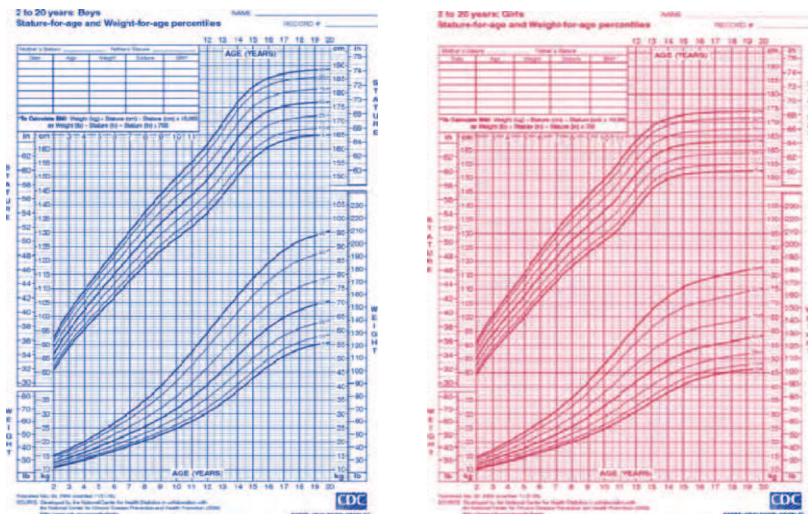


Fig. 4. Boy and girl stature-for-age and weight-for-age charts for 2-20 years

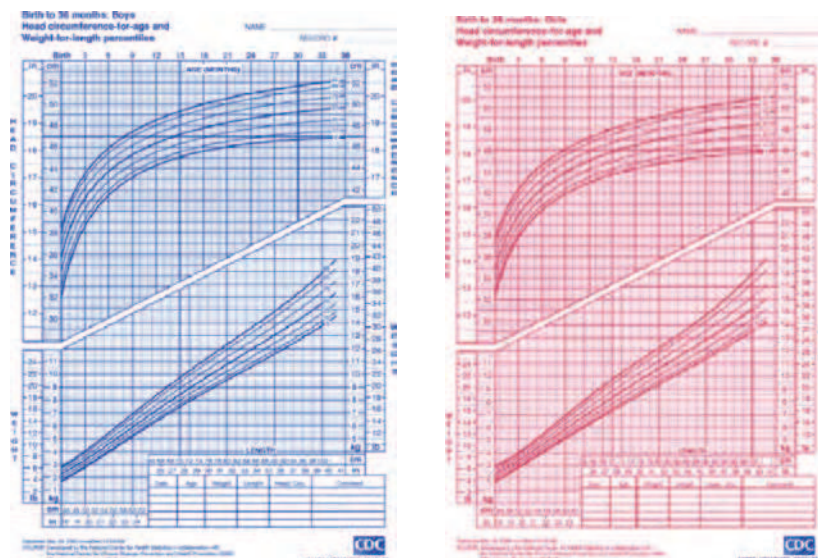


Fig. 5. Boy and girl head circumference/weight-for-length percentiles birth to 36 months

Weight for length is also a useful piece of information for children 36 months and younger, assisting with assessment of nutritional status (Figure 5). If a standing height is obtained, then a BMI chart with percentiles for age can be used for children two years of age and older (Figure 6).



Fig. 6. Boy and girl body mass index-for-age (BMI) charts for 2-20 years (CDC)

In 2006, the World Health Organization (WHO) released new international growth charts for children ages birth to 59 months. The CDC now recommends using the WHO growth charts for children  $\leq 24$  months of age (Figures 7 and 8) and to continue using CDC charts for children older than 24 months of age (Grummer-Strawnet al., 2010).

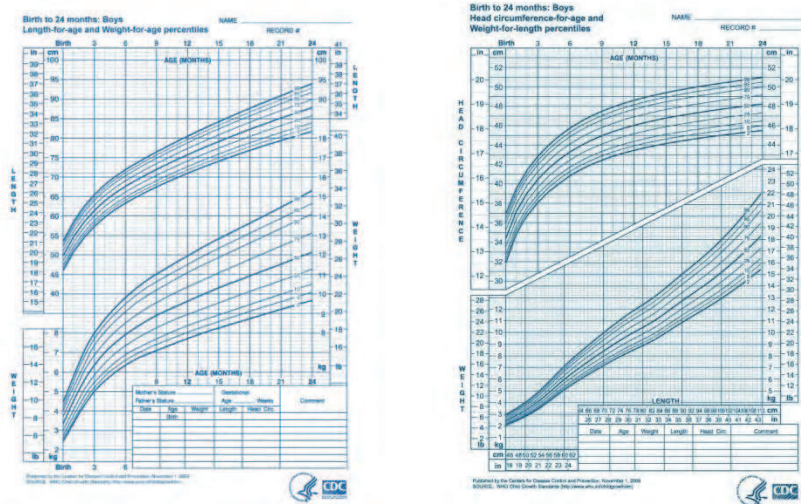


Fig. 7. WHO charts for boys birth to 24 months: length-for-age and weight-for age percentiles and head circumference-for-age and weight-for length percentiles



Fig. 8. WHO charts for girls birth to 24 months: length-for-age and weight-for age percentiles and head circumference-for-age and weight-for length percentiles

Fewer children will be diagnosed as having FTT if the WHO charts are used for exclusively breast fed infants. Slower growth among breast fed infants between the ages of three and eighteen months represents a normal growth variant. This slower growth rate should not be used to discourage mothers from exclusively breastfeeding their infants. There are numerous advantages to breastfeeding including increased protection from infectious disease.

On the other hand, the rapid, upward crossing of weight percentiles on the WHO charts might be an early indication of obesity (Grummer-Strawnet et al., 2010).

### 3. Definition of FTT

FTT has been a recognized condition for centuries. However, its precise definition remains unclear and often controversial. In order to verify the presence of FTT many physicians use weight gain over a period of time as the only anthropometric measurement, but others utilize two or more parameters.

In a cross-sectional review of studies published between 2002 and 2004, weight-for-age of less than the 10<sup>th</sup> percentile, height-for-age of less than the 5<sup>th</sup> percentile or weight-for-height of less than the 10<sup>th</sup> percentile were the most commonly used anthropometric measurements to define FTT (Olsen, 2006). Although using weight only to define FTT may be adequate in most cases, utilizing additional anthropometric measurements (such as weight-for-length, especially before the age of two years) is also helpful in determining the underlying problem. A study of 6090 Danish infants used seven different anthropometric measurements to define nutritional FTT and concluded that one single anthropometric parameter was inadequate to identify the condition and therefore more than one measurement should be used (Olsen et al., 2007).

### 4. Etiological classification of FTT

FTT is a sign or finding rather than a diagnosis and can be caused by several different conditions. Steps to identify the underlying cause should be undertaken when a child presents with FTT.

There are different definitions for the etiologies of FTT. The most commonly used etiologic classifications are nonorganic (inadequate nutrition in the absence of underlying organic disorders) or organic (underlying disease process such as endocrine, gastrointestinal, cardiac, genetic, metabolic, pulmonary, renal, hematologic or infectious). (Table 1)

Although organic FTT may have multiple etiologies, the majority of children have a nonorganic cause of their poor growth and/or weight gain (Mitchell et al., 1980).

#### 4.1 Nonorganic FTT and psychosocial dwarfism (emotional deprivation syndrome)

The majority of cases of FTT presenting in a primary care setting are nonorganic with no underlying disease (Mitchell et al., 1980). Parental/caregiver nurturing is as important as nutrition for adequate growth and development in children. Neglected infants and toddlers have been known to stop growing, gaining weight and achieving normal developmental milestones. This was described in the 1940's (Talbot et al., 1946) and later in more detail as a form of hypopituitarism, commonly known as emotional deprivation or psychosocial dwarfism (Powell et al., 1967). This type of hypopituitarism is reversible as the home environment of the child improves (Albanese et al., 1994).

<p><b>Nonorganic FTT</b>  <b>Neglect/abuse</b> (psychosocial dwarfism)  <b>Hyper vigilance</b> (extreme parental attention)  <b>Poor nutrition</b> (inexperienced or poorly educated parents/caregivers, poverty)</p> <p><b>Organic FTT</b></p> <p><b>Gastrointestinal:</b> Gastroesophageal reflux, pyloric stenosis, malabsorptive conditions such as celiac disease, lactose intolerance, chronic liver disease, protein-losing enteropathy or food allergies</p> <p><b>Pulmonary:</b> Cystic fibrosis, bronchopulmonary dysplasia, chronic hypoxia</p> <p><b>Endocrine:</b> hyperthyroidism, adrenal failure, diabetes mellitus, diabetes insipidus, hypopituitarism</p> <p><b>Neurologic:</b> degenerative brain disease, cerebral palsy, mitochondrial disorders</p> <p><b>Metabolic and genetic:</b> inborn errors of metabolism, genetic syndromes, chromosomal defects including Prader-Willi Syndrome</p> <p><b>Infectious:</b> parasites, tuberculosis, acquired immunodeficiency, congenital immune deficiency</p> <p><b>Renal:</b> chronic renal failure, renal tubular acidosis, nephrogenic diabetes insipidus, recurrent urinary tract infections</p> <p><b>Hematologic:</b> Fanconi's anemia</p>
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Table 1. Etiologic classifications of failure to thrive

Although the terms nonorganic FTT and psychosocial dwarfism are sometimes used interchangeably and the psychosocial family dynamics are similar in both conditions, the clinical features differ. The majority of children with nonorganic FTT are less than three years of age and often as young as eighteen months. They are often withdrawn and apathetic and weight loss or very poor weight gain is the most marked feature. Children with psychosocial dwarfism range between two and fifteen years of age and short stature is the most prominent feature. These children may steal and hoard food and display bizarre eating habits. In some cases a reversible hypopituitarism has been documented. Therefore, psychosocial dwarfism constitutes a subgroup of nonorganic FTT (Oates, 1984).

Behaviors that may be present in nonorganic FTT include inactivity, irritability, posturing, flat affect, rumination, excessive thumb sucking, disproportionate use of hands and fingers rather than arms, legs, and trunk, clenched fists, gross motor delay, crying when approached, wide-eyed expression, gaze aversion, lack of or decreased vocalization, lack of cuddling, poor eye contact, lack of response to a human stimulus and indifference to separation. Identification of these target behaviors may be valuable in diagnosing nonorganic FTT and providing early psychosocial assessment and intervention (Powell & Low, 1983).

A recent study of the neuroendocrine system in children with FTT included three groups: (1) a control group; (2) children suffering from attachment disorder (AD); and (3) children with non-organic FTT (NOFT) (Muñoz-Hoyos et al., 2010). In this study, the serum levels of



melatonin, serotonin,  $\beta$ -endorphins, adrenocorticotrophic hormone (ACTH) and tryptophan metabolites were measured both during the day and at night. There was a significant reduction in the levels of each of these markers in the group with AD and a more significant reduction in the group with NOFT. These findings suggest that AD and NOFT comprise a single process with a different evolutionary continuum of psychosocial dwarfism.

## 4.2 Organic FTT

Children suspected of having an organic FTT will require further evaluation and referral to the appropriate pediatric subspecialist for management once the underlying etiology has been identified. Primary care physicians are sometimes overly cautious, referring children with nonorganic FTT to pediatric subspecialties such as gastroenterology or endocrinology when these children could be managed by nutritional counseling and close follow-up alone. In a chart analysis of 97 patients referred for FTT by primary care physicians to a pediatric endocrinology clinic, the most common (52%) etiology was found to be nutritional deficiency or nonorganic FTT (Daniel et al., 2008). As these children were referred to a subspecialty clinic by their primary care physician for further evaluation, 52% having a nonorganic FTT is a surprisingly high number. These children could have been managed in the primary care setting with nutritional counseling and close monitoring. In the remaining 48% who had an organic FTT, endocrinologic etiologies included short stature due to low birth weight/small for gestational age (SGA), familial short stature and constitutional short stature. Gastrointestinal diseases included gastroesophageal reflux disease (GERD), multiple food allergies, celiac disease, selective immunoglobulin A deficiency and pyloric stenosis and were the third most common etiology (15.5%) for FTT in this study.

In order to reduce health care costs, pediatric subspecialty referral of children for FTT should be reserved for those with a proven underlying organic etiology. Differential diagnosis between nonorganic and organic FTT should be made by the primary care provider before referral to a subspecialty is considered.

## 5. Diagnostic evaluation of FTT

### 5.1 Initial evaluation and differential diagnosis of FTT

A child with FTT may present to the primary care physician crossing percentiles for weight and length as seen in Figure 9.

This growth chart may represent a child with an organic FTT such as celiac disease, a nonorganic FTT (psychosocial dwarfism) or a normal variant of growth such as constitutional delay (crossing percentiles and then following that channel until he/she enters puberty later than average). A growth chart alone cannot always provide enough data to determine whether the growth pattern is normal or abnormal. Further evaluation may be warranted to avoid unnecessary testing and increased parental anxiety for a child with a normal growth variant.

Assessing the length or height and weight of infants and toddlers during well-child visits is the standard of care. A comprehensive evaluation should include reviewing the past medical history, family history, feeding history, caloric intake, formula preparation, episodes of vomiting, family dynamics, number of caregivers; observing the interaction between the caregiver and the child and conducting a thorough physical examination. Each of these is crucial for an accurate appraisal of the child's growth pattern.

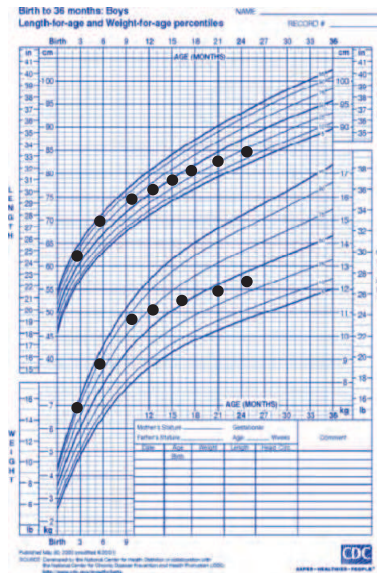


Fig. 9. A case of FTT

When a child is noted to have FTT, the health care provider should evaluate the child thoroughly, making certain to include the following:

- Prenatal and postnatal history
  - was the pregnancy unplanned?
  - gestational age
  - Apgar scores
  - birth weight and length
  - presence of feeding issues or any other neonatal problems (Table 2) (Ficicioglu et al., 2009, Tolia, 1995).
- Family history
  - history of neonatal or infant deaths
  - history of FTT, family members' growth patterns
  - parental heights/weights
- Past medical history (Table 2)
  - presence/absence of these findings may help differentiate between organic and nonorganic FTT (Ficicioglu et al 2009, Tolia 1995).
  - comprehensive dietary history (see Section 6.1, Nutritional counseling)
- Family dynamics and psychosocial factors
  - stressors in the family
  - is the parent/primary caregiver depressed?
  - is the parent/primary caregiver receiving adequate support from family/friends or does he/she feel overwhelmed?
  - socioeconomic status
  - level of education and parental/caregiver knowledge of infant feeding
  - family dietary patterns

- observation of the child's behavior and parent/caregiver's interaction (for the possibility of psychosocial dwarfism or deprivation syndrome).
- Physical examination
  - anthropometric measurements including head circumference
  - facial features, presence of dysmorphology
  - cardiac murmur
  - organomegaly
  - muscle tone and other neurologic findings
  - developmental milestones

<b>Neonatal</b>	<b>Infancy</b>
<ul style="list-style-type: none"> <li>• low birth weight/length</li> <li>• low apgar scores</li> <li>• respiratory distress in term baby</li> <li>• prolonged jaundice</li> <li>• cholestasis</li> <li>• hypoglycemia</li> <li>• poor feeding</li> <li>• hypotonia</li> <li>• sepsis</li> <li>• seizures</li> <li>• atypical face</li> </ul>	<ul style="list-style-type: none"> <li>• hypoglycemia</li> <li>• poor feeding</li> <li>• hypotonia</li> <li>• recurrent sepsis-like presentations</li> <li>• seizures</li> <li>• atypical face</li> <li>• micro or macrocephaly</li> <li>• recurrent infections</li> <li>• chronic diarrhea</li> <li>• recurrent vomiting</li> <li>• poor muscle tone</li> <li>• developmental delay</li> <li>• organomegaly</li> <li>• polyuria, polydipsia</li> </ul>

Table 2. Significant findings suggesting an underlying organic etiology for FTT

## 5.2 Evaluation of suspected organic FTT

Children with findings suggesting an organic cause of FTT (Table 2) should be evaluated for an underlying condition. Since the organic reasons for FTT are relatively uncommon, the battery of tests depends on the primary care physician's index of suspicion. In some cases basic screening tests may be required for a differential diagnosis prior to ordering more specific studies. Referral to a pediatric subspecialty without a working diagnosis is not cost effective and should be avoided.

Basic screening tests usually include a complete blood count, comprehensive metabolic panel and urinalysis. In most cases a thorough history and physical examination will direct a skilled physician toward the possibility of one or two underlying organic etiologies and the appropriate diagnostic testing for the suspected condition(s) can be ordered (Sills, 1978). No specific battery of tests is recommended for FTT but rather the working diagnosis should direct the physician to order the appropriate diagnostic tests. The primary care physician is best suited to sort out the possible reasons for the child's FTT.

In a study of 122 infants less than two years of age admitted to a tertiary care pediatric hospital for FTT, an average of 40 tests and imaging studies were ordered per infant and only 0.8% of all tests led to a diagnosis of the underlying cause of the FTT. In most cases, a careful history and physical examination was sufficient for a differential diagnosis of the

etiology of FTT (Berwick et al., 1982). An extensive work-up should be limited to cases of suspected organic FTT.

## 6. Management of FTT

Early identification of children with poor growth and weight gain and intervention with appropriate measures are important in determining the outcome of these children. Undiagnosed and untreated FTT may cause serious morbidity and mortality. Cognitive impairment and decreased IQ are potential serious consequences of long-standing, untreated FTT. Therefore, the role of the primary care physician in detecting and managing FTT is vital, especially since most (> 90%) of the FTT diagnosed in a primary care setting is nonorganic. Close follow-up of height/length and weight, either in a primary care physician's office or during home nursing visits, in conjunction with nutritional counseling will improve the majority of cases of FTT.

A randomized controlled study showed that, in FTT, a visiting nurse can significantly improve growth parameters compared to a control group who received no home nursing visits (Wright et al., 1998). Observation of the home environment and the child's behavior during daily routine by a trained health care professional will provide a more realistic picture of the family dynamics, psychosocial stressors and physical surroundings which may be affecting the child's growth and weight gain. Stress in the family, parental depression or abuse and neglect of the child requires prompt evaluation and effective intervention. Foster care placement should be considered in cases of suspected abuse and neglect.

In some cases of organic FTT where the underlying condition prevents the child from getting adequate oral intake and in rare occasions of nonorganic FTT, tube feeding may be indicated. Weaning from tube feeding may be a long process even after the underlying etiology of the FTT resolves. The child may require prolonged feeding therapy, preferably managed by a specialized feeding clinic.

### 6.1 Nutritional counseling

Nonorganic FTT is the most common and therefore nutritional counseling is the most important component in the management of FTT. Both nonorganic FTT and organic FTT with additional nutritional deficits should be evaluated by a dietitian. Close monitoring of the child's weight gain and growth rate by the primary care physician is an important component of management.

Nutritional assessment of a child with FTT is not simply an evaluation of food intake but also family feeding practices. Food allergies may affect macro and micronutrient intake. Social and environmental factors such as family budget, caregiver ability to prepare meals and family beliefs about the makeup of a nutritious diet may prevent the child from receiving an adequate diet.

A nutritional analysis of the current diet is needed. A 24-hour food recall combined with a food frequency questionnaire can be used to collect information. The best tool to analyze intake is a 3 to 5 day diet diary with a record of all foods and beverages consumed. An interview of the person recording the food intake should be done to fill in the missing information. Often, fluids taken between meals are not recorded. Meals eaten at daycare or away from home need to include the amounts eaten, not just the foods provided. If there are whole food groups missing from the food record, substitution for the food group should be

questioned. Analysis of nutritional intake should provide average intake of calories, protein, and fat in the diet. When possible, a software program can be used that will give a comparison of all nutrients with Recommended Daily Allowance (RDA) for age. There are programs that will print the average intake using the Food Guide Pyramid servings eaten compared to recommended servings, or the percents of carbohydrate, protein and fat in the diet. These print outs can be used in the intervention and education for the parents. Evaluating family feeding practices will show if there are changes that can be made to help enhance food intake.

- Is the child allowed to carry a sippy cup or bottle all day?
- What is in the sippy-cup/bottle?
- Is there one meal a day that is eaten at a table with the whole family?
- Is there a table in the house where the family can have a meal?
- Do the adults in the family eat fruits and vegetables?
- What are the beverages in the house?
- Is it difficult for the parents to get the child to sit down for a meal?
- Is the toddler fed or allowed to feed himself?
- Do the children have to eat everything put on their plates?
- If the child does not eat at mealtime do they get sweets between meals? Some families are so concerned with a family history of obesity, heart disease or other medical condition that they restrict their child's diet to try to prevent these conditions.
- What is used to measure the formula and water? Check how the formula is prepared.

Food avoidances due to food allergies need to be evaluated to make sure the nutrients in the offending foods are being provided by other foods or supplements. If the child is allergic to milk, he/she must receive the protein, calories, calcium and vitamins A and D from another food source. Children may avoid foods because the food makes them "feel bad" but are unable to explain this to their parents. Food avoidance might also be a sign of a metabolic disorder. For example, children with hyperammonemia tend to avoid a high protein diet. All of the gathered information can be used to formulate a nutrition plan. Adequate calories and appropriate foods for age should be discussed with the family or care giver (Table 3).

Age (Month)	REE (kcal/kg/day) WHO	EER (kcal/day)	DRI (kcal/kg/day)	Protein (g/day)	Protein (g/kg/day)
0-3	52	610	102	9.1*	1.52
4-6	52	490	82	9.1*	1.52
7-12	55	720	80	11.0**	1.20
13-35	56	990	82	13.0**	1.05
36-48	64	1000	85	13.0**	1.05

Table 3. The estimated energy and protein requirements for birth to 48 months

(Bunting, et al., 2008.) \* Adequate Intake, \*\* Recommended daily allowance (RDA),

REE: Resting energy expenditure; EER: Estimated energy requirements; DRI: Dietary reference intakes

For catch up growth a child may need 20-30% more calories. Increasing calories should be done slowly for the severely malnourished child to prevent re-feeding syndrome. Re-feeding syndrome is characterized by several life-threatening presentations including biochemical changes, clinical manifestations and complications that can occur as a consequence of feeding a malnourished baby in a catabolic state too rapidly (Khan et al., 2010).

Formulas for catch up growth:

$$\frac{\text{kcal/kg/day} = \text{IBW in kg} \left( 50^{\text{th}} \text{percentile weight/height} \right) \times \text{kcal/kg/day (DRI for age)}}{\text{actual weight (kg)}}$$

IBW: Ideal body weight. (Bunting et al., 2008)

$$\frac{\text{kcal / kg / day} = 120 \text{ kcal / kg} \times \text{median weight for height (kg)}}{\text{actual weight (kg)}}$$

(Orrales & Utter, 1999)

Nutritional intervention should begin by discussing proper nutrition with the caregiver(s). This should include diet for age and appropriate feeding techniques for catch-up growth. It is necessary to add calories and protein to the diet. This may mean concentrating the formula or breast milk to 24-27 calories per ounce.

Nutritional supplements may be an acceptable way to add calories and protein to a toddler's diet. Milk can be fortified with dry skim milk powder or commercially available instant breakfast powders. Adding calories without increasing serving sizes can be done with the use of oil, margarine or butter.

## 6.2 Inpatient management

In the past, inpatient evaluation and management was the standard of care for FTT. However, it is now necessary only in the small number of children for whom outpatient management fails.

An inpatient evaluation of FTT may be necessary in suspected neglect or abuse or in psychosocial dwarfism. The child can be observed for caloric intake, daily weight change, interaction with the parent/caregiver and behaviors during feeding. Valuable information can be gathered during the period of hospitalization and a final decision can be made regarding possible foster care placement, especially if the child shows adequate weight gain and catch-up growth as an inpatient after failing outpatient management. Changing the home environment with foster care placement often resolves the FTT in these children.

Occasionally a case of FTT with a complex underlying etiology may require admission for an extensive evaluation. This constitutes a very small portion of cases, however (Berwick et al., 1982).

## 6.3 Referral to subspecialty clinics

Referral to a pediatric subspecialist should be reserved for FTT with an underlying organic etiology. Nonorganic (nutritional) FTT should be managed by a primary care physician to avoid the unnecessary expenditure of health care dollars, as well as the cost to families for travel, insurance co-pays and time away from their employment. Parents or caregivers often experience anxiety or feelings of guilt related to a child's poor growth or weight gain. This may be exacerbated by an unnecessary, extensive and often expensive work-up when, in most situations, the FTT may resolve simply with nutritional counseling and a period of close monitoring of weight gain and linear growth. When organic FTT is suspected by history and/or physical examination, evaluation based on the suspected etiology should be performed and then the corresponding pediatric subspecialty (gastroenterology, allergy and

immunology, pulmonary, cardiology, endocrinology, nephrology, hematology, neurology, infectious disease or genetic/metabolic disorders) should be considered based on the findings.

## 7. Conclusions

Failure to thrive is a common but potentially serious growth problem requiring early recognition, thorough evaluation and vigilant management to avoid possible long-term morbidity, especially in regard to a child's neurodevelopment. Although there seems to be no consensus regarding definition, the term FTT is most commonly used to describe persistently inadequate linear growth and/or weight gain within the first three years of life. Health care providers should be familiar with anthropometric measurements and normal growth patterns of children to avoid either misdiagnosis or unnecessary work-up of children with FTT. Unnecessary testing not only increases health care costs, but also can delay dietary or psychosocial intervention and contribute to parental/caregiver anxiety and guilt which may potentially exacerbate the problem.

FTT is a sign or finding rather than a diagnosis and may either have a nonorganic or organic etiology. Steps to identify the underlying cause should be undertaken when a child presents with FTT. The most common cause is inadequate caloric intake (nonorganic). In most cases of organic FTT, a thorough history and physical examination will direct a skilled physician to one or more possible etiologies and then the appropriate diagnostic testing for the suspected underlying condition(s) can be ordered.

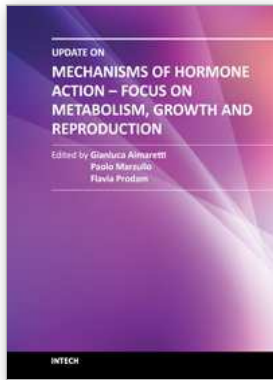
Majority of children with FTT have a nonorganic etiology and should be managed by a primary care physician with nutritional counseling and close monitoring of linear growth and weight gain. Extensive evaluation and referral to a pediatric subspecialist for children with FTT should be reserved for the limited number of children suspected of having an underlying organic disease.

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## **Update on Mechanisms of Hormone Action - Focus on Metabolism, Growth and Reproduction**

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The purpose of the present volume is to focus on more recent aspects of the complex regulation of hormonal action, in particular in 3 different hot fields: metabolism, growth and reproduction. Modern approaches to the physiology and pathology of endocrine glands are based on cellular and molecular investigation of genes, peptide, hormones, protein cascade at different levels. In all of the chapters in the book all, or at least some, of these aspects are described in order to increase the endocrine knowledge.

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