

REVIEW

Evaluation and Management of the Child With Failure to Thrive

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KEY WORDS: *failure to thrive;
growth deficiency; growth faltering;
undernutrition*

ABBREVIATIONS

FTT = failure to thrive
HIV = human immunodeficiency virus
MPH = mid-parental height
NFTT = non-organic failure to thrive

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ABSTRACT

BACKGROUND: Failure to thrive (FTT) is a common problem in pediatric practice, affecting 5-10% of children under five years of age in developed countries with a higher incidence in developing countries.

OBJECTIVE: To outline a simplified but detailed approach to determining the etiology of FTT and highlight the need for high-calorie diet for catch-up growth and a careful follow up.

METHODS: Data were collected using manual search for relevant journals at the University of Benin Medical Library, internet (medline) search and textbooks.

RESULTS: The majority of cases of FTT are due to a combination of nutritional and environmental deprivation secondary to parental poverty and/or ignorance. The key to diagnosing FTT is by accurately measuring and plotting a child's weight, height and head circumference overtime and comparing the results with the appropriate growth charts and then assess the trend. In the evaluation of the child who has failed to thrive, three initial steps are required to develop an economical treatment-centered approach: a thorough history including itemized psychosocial review, careful physical examination, and direct observation of the child's behavior and of parent-child interaction. Laboratory evaluation should be guided by history and physical examination findings only. Two principles that hold true, irrespective of etiology, are that all children with FTT need a high-calorie diet for catch-up growth and all children with FTT need a careful follow up. Social issues of the family must also be addressed.

CONCLUSION: A multidisciplinary approach is recommended when FTT persists despite intervention or when it is severe.

INTRODUCTION

Although the term failure to thrive (FTT) has been in use in the medical parlance for quite some time now, its precise definition has remained debatable.¹ Consequently, other terms such as "undernutrition"¹ and "growth deficiency"² have been proposed as preferable. "Growth faltering" refers to deviation from incremental growth rates in the reference population. Failure to thrive is a descriptive term applied when a young child's physical growth is less than that of his or her peers.³ The growth failure may begin either in the neonatal period or after a period of normal physical development.⁴ The term FTT is not, in itself, a disease but a symptom or sign common to a wide va-

riety of disorders which may have little in common except for their negative effect on growth.⁵ In this regard, a cause must always be sought.

Often, the evaluation of children who fail to thrive poses a difficult diagnostic problem. Some of the difficulties result from the numerous differential diagnoses, the definition used or misdirected tendency to search aggressively for underlying organic diseases while neglecting etiologies based on environmental deprivation.⁶ In addition, early accusations and alienation of the child's parents by the health-care provider will make the evaluation and management of the child who has failed to thrive more difficult.⁷

In general, factors that influence a child's growth include: (i) a child's nutritional status; (ii) a child's health; (iii) family issues; (iv) the parent-child interactions; and (v) genetic factors.^{3,8,9} All these factors must be considered in the evaluation and management of a child who has failed to thrive. This paper presents a simplified but detailed approach to the evaluation and management of the child with FTT.

DEFINITION

The best definition for FTT is the one that refers to it as inadequate physical growth diagnosed by observation of growth over time using a standard growth chart, such as the National Center for Health Statistics (NCHS) growth chart.¹⁰ All authorities agree that only by comparing height and weight on a growth chart over time can FTT be assessed accurately.¹¹ So far, no consensus has been reached concerning the specific anthropometric criteria to define FTT.¹¹ Consequently, where serial anthropometric records are not available, FTT has been variously defined statistically. For instance, some authors defined FTT as weight below the third percentile for age on the growth chart or more than two standard deviations below the mean for children of the same age and sex¹⁻³ or a weight-for-age (weight-for-height) Z-score less than minus two.¹ Others cite a downward change in growth that has crossed two major growth percentiles in a short time.³ Still others, for diagnostic purposes, defined FTT as a disproportionate failure to gain weight in comparison to height without an apparent etiology.⁶ Brayden *et al*² suggested that FTT should be considered if a child less than 6 months old has not grown for two consecutive months or a child older than 6 months has not grown for three consecutive months. Recent research has validated that the weight-for-age approach is the simplest and most reasonable marker of FTT.¹²

PITFALLS OF DEFINITIONS

One limitation of using the third percentile for defining FTT is that some children whose weight falls below this arbitrary statistical standard of normal are not failing to thrive but represent the three percent of normal population whose weight

is less than the third percentile.^{5,6} In the first 2 years of life, the child's weight changes to follow the genetic predisposition of the parent's height and weight.^{13,14} During this time of transition, children with familial short stature may cross percentiles downward and still be considered normal.¹⁴ This is more likely to occur in mating between tall mothers and short fathers. Most children in this category find their true curve by the age of 3 years.^{6,14} The pediatrician must, therefore, understand the phases of growth and close scrutiny of growth curves. When the percentile drop is great, it is helpful to compare the child's weight percentile to height and head circumference percentiles. These should be consistent with the position of height and head circumference percentiles of the patient.⁵ Another limitation of the third percentile as a criterion to define FTT is that infants can be failing to thrive with marked deceleration of weight gain, but they remain undiagnosed and, therefore, untreated until they have fallen below the arbitrary third percentile.⁶ These normal small children do not demonstrate the disproportionate failure to gain weight that children with FTT do.⁶ This approach attempts not only to prevent normal small children from being incorrectly labeled as failing to thrive, but also excludes children with pathologic proportionate short stature.¹⁴ Having excluded these easily distinguishable disorders from the differential diagnosis of FTT, simplifies the approach to evaluation of the child who has failed to thrive.⁶

A more encompassing definition of FTT includes any child whose weight has fallen more than two standard deviations from a previous growth curve.^{3,15,16} Normal shifts in growth curves in the first 2 years of life will result in less severe decline (i.e., less than 2 standard deviations).¹³

Some authors have even limited the definition of FTT to only children less than 3 years old.^{17,18} A precise age limitation is arbitrary. However, most children with FTT are under 3 years of age.^{6,8}

EPIDEMIOLOGY

In young children, FTT which does not reach the severe classical syndrome of marasmus is common in all societies.¹⁹ However, the true incidence of FTT is not known as many infants with FTT are not identified, even in developed countries.²⁰⁻²² It is estimated that FTT affects 5-10% of young children and approximately 3-5% of children admitted into teaching hospitals.^{3,5,23} Mitchell *et al*,²⁴ using multiple criteria, found that nearly 10% of under-fives attending a primary health care center in the United States manifested FTT. About 5% of pediatric admissions in the United Kingdom are for FTT.⁴ The prevalence is even higher in developing countries with wide-spread poverty and high rates of malnutrition and/or HIV infections.^{3,19} Children born to single teenage mothers and working mothers who work for long hours are at increased risk.²² The same is true for children in institutions such as or-

phanage homes and homes for the mentally retarded,^{5,22} with an estimated incidence of 15% as a group.⁵ Under-feeding is the single commonest cause of FTT that results from parental poverty and/or ignorance.^{19,22,24} Ninety-five percent of cases of FTT are due to inadequate food offered or taken.²⁵ The peak incidence of FTT occurs in children between the age of 9–24 months, with no significant gender difference.²² The majority of children who fail to thrive are less than 18 months old.³ The syndrome of FTT is uncommon after the age of 5 years.^{3,22}

CLASSIFICATION OF FTT

Traditionally, causes of FTT have been classified as non-organic and organic. However, some authors have stated that this terminology is misleading.²⁷ They base their opinion on the fact that all cases of FTT are produced by inadequate food or undernutrition and in that context, it is organically determined. In addition, the distinction based on organic and non-organic causes is no longer favoured because many cases of FTT are of mixed etiologies.³

Based on pathophysiology, which is the preferred classification, FTT may be classified into those due to: (i) inadequate caloric intake; (ii) inadequate absorption; (iii) increased caloric requirement, and; (iv) defective utilization of calories. This classification leads to a logical organization of the many conditions that cause or contribute to FTT.¹⁰

1. NON-ORGANIC (PSYCHOSOCIAL) FAILURE TO THRIVE

In non-organic failure to thrive (NFTT), there is no known medical condition causing the poor growth. It is due to poverty, psychosocial problems in the family, maternal deprivation, lack of knowledge and skill in infant nutrition among the caregivers.^{5,11} Other risk factors include substance abuse by parents, single parenthood, general immaturity of one or both parents, economic stress and strain, temporary stresses such as family tragedies (accidents, illnesses, deaths) and marital disharmony.^{6,8,22} Weston et al,²⁸ reported that 66% of mothers whose infants failed to thrive has a positive history of having been abused as children themselves, compared to 26% of controls from similar socioeconomic background. NFTT accounts for over 70% of cases of FTT.⁶ Of this number, approximately one-third is due to care-giver's ignorance, such as incorrect feeding technique, improper preparation of formula or misconception of the infant's nutritional needs,²⁹ all of which are easily corrected. A closer look at these risk factors for NFTT suggests that infants with growth failure may represent a flag for serious social and psychological problems in the family. For example, a depressed mother may not feed her infant adequately. The infant may, in turn, become withdrawn in response to mother's depression and feeds less well.¹⁰ Extreme parental attention, either neglect or hypervigilance, can lead to FTT.¹⁰

2. ORGANIC FAILURE TO THRIVE

It occurs when there is a known underlying medical cause. Organic disorders causing FTT are most commonly infectious (e.g., HIV infection, tuberculosis, intestinal parasitosis), gastrointestinal (e.g., chronic diarrhea, gastroesophageal reflux, pyloric stenosis) or neurologic (e.g., cerebral palsy, mental retardation) disorders.^{6,19,22} Others include genitourinary disorders (e.g., posterior urethral valve, renal tubular acidosis, chronic renal failure, urinary tract infection -UTI), congenital heart disease, and chromosomal anomalies.^{6,7} Urinary tract infection is a major preventable and treatable cause of FTT and all patients presenting with FTT should be evaluated in that regard. Combined neurologic and gastrointestinal disorders account for 60–80% of all organic causes of under nutrition in developed countries.³⁰ An important medical risk factor for under nutrition in childhood is premature birth.¹ Among preterm infants, those who are small for gestational age are particularly vulnerable since prenatal factors have already exerted a deleterious effect on somatic growth.¹ In societies where lead poisoning is common, it is a recognized risk factor for poor growth.^{5,31} Organic FTT virtually never presents with isolated growth failure; other signs and symptoms are generally evident with a detailed history and physical examination.³² Organic disorders account for less than 20% of cases of FTT.⁶

3. MIXED FAILURE TO THRIVE

In mixed FTT, organic and non organic causes coexist. Those with organic disorders may also suffer from environmental deprivation. Likewise, those with severe undernutrition from non-organic FTT can develop organic medical problems.

4. FTT WITH NO SPECIFIC ETIOLOGY

Review of the literature on FTT indicates that in 12–32% of cases of children who have failed to thrive, no specific etiology could be established.^{23,33,34}

CAUSES OF FAILURE TO THRIVE

A. PRENATAL CAUSES:

(i) Prematurity with its complications; (ii) exposure in utero to toxic agents, such as alcohol, tobacco smoke, medications; (iii) infections (e.g., rubella, cytomegalovirus-CMV, HIV); (iv) intrauterine growth restriction from any cause; (v) chromosomal abnormalities (e.g., Down syndrome, Turner syndrome); and (vi) dysmorphic syndromes.

B. POSTNATAL CAUSES BASED ON PATHOPHYSIOLOGY

1. *Inadequate caloric intake which may result from*

- i. Under feeding.
- ii. Incorrect preparation of formula (e.g., too dilute, too concentrated).

- iii. Behavior problems affecting eating (e.g., child's temperament).
- iv. Unsuitable feeding habits (e.g., uncooperative child).
- v. Poverty leading to food shortages.
- vi. Child abuse and neglect.
- vii. Mechanical feeding difficulties e.g., congenital anomalies (cleft lip/palate), oromotor dysfunction.
- viii. Prolonged dyspnea of any cause

2. Inadequate absorption which may be associated with

- i. Malabsorption syndromes e.g. celiac disease, cystic fibrosis, cow's milk protein allergy, giardiasis, food sensitivity/intolerance.
- ii. Vitamins and mineral deficiencies e.g., zinc, vitamin A and C deficiency.
- iii. Hepatobiliary diseases, e.g., biliary atresia.
- iv. Necrotizing enterocolitis.
- v. Short gut syndrome.

3. Increased caloric requirement due to

- i. Hyperthyroidism.

- ii. Chronic/recurrent infections e.g., UTI, respiratory tract infection, tuberculosis, HIV infection.
- iii. Chronic anemias.

4. Defective utilization of calories

- i. Inborn errors of metabolism e.g., galactosemia, aminoacidopathies, organic acidurias, storage diseases.
- ii. Diabetes insipidus/mellitus.
- iii. Renal tubular acidosis.
- iv. Chronic hypoxemia.

Risk factors for the development of FTT are summarized in **Table 1**.

**CLINICAL MANIFESTATIONS
OF FAILURE TO THRIVE^{3,22}**

Commonly the parents/care-givers may complain that the child is "not growing well" or "losing weight" or "not feeding well" or "not doing well" or "not like his other siblings/age mates". Usually FTT is discovered and diagnosed by the infant's physician using the birthweight and the anthropometric

TABLE 1. Summary of risk factors for the development of failure to thrive

Infant characteristics
<ul style="list-style-type: none"> • Any chronic medical condition resulting in: <ul style="list-style-type: none"> - Inadequate intake (e.g., swallowing dysfunction, central nervous system damage, anorexia) - Increased metabolic rate (e.g., bronchopulmonary dysplasia, congenital heart disease, fever) - Maldigestion or malabsorption (e.g. AIDS, cystic fibrosis, short gut, inflammatory bowel disease, celiac disease). - Infections (e.g., HIV, TB, giardiasis) • Premature birth (especially with intrauterine growth restriction) • Developmental delay • Congenital anomalies • Intrauterine exposure to toxic agents (e.g., alcohol, tobacco smoke) • Plumbism, anemia • Inborn errors of metabolism (e.g. B₁₂-dependent methylmalonic aciduria, biotinidase deficiency, etc)
Family characteristics
<ul style="list-style-type: none"> • Poverty • Unusual health and nutrition beliefs • Social isolation • Faulty feeding techniques • Substance abuse or other psychopathology (including Munchausen syndrome by proxy) • Violence or abuse

AIDS = acquired immunodeficiency syndrome; HIV = human immunodeficiency virus; TB = tuberculosis
Adapted from Kleinman RE.¹

records of the child.

The infant looks small for age. The child may exhibit loss of subcutaneous fat, reduced muscle mass, thin extremities, narrow face, prominent ribs, and wasted buttocks. Evidence of neglected hygiene, such as diaper rash, unwashed skin, overgrown and dirty fingernails or dirty clothing. Other findings may include avoidance of eye contact, lack of facial expression, absence of cuddling response, hypotonia and assumption of infantile posture with clenched fists. There may be marked preoccupation with thumb sucking.

EVALUATION

A. INITIAL EVALUATION

It has been proposed that only three initial investigations are required to develop an economical, treatment-centered approach to the child that presents with FTT; these include:³⁵ (a) a thorough history, including an itemized psychosocial review; (b) careful physical examination, including determination of the auxological parameters; and (c) direct observation of the child's behavior and of parent-child interaction.

a. History (Table 2)

1. Nutritional history. Nutritional history should include:

- i. Details of breast feeding including the number of feedings, the time interval between feedings, whether both breasts are given or only one breast, whether feeding is continued at night or not, and what the child's behavior is before, after and between feedings. This information should give an idea of the adequacy or inadequacy of mother's milk. If the infant is on formula, it should be clarified whether the formula is prepared correctly. Overdiluted milk will provide a poor caloric intake. Too concentrated milk may be unpalatable leading to refusal to drink. It is also essential to know the total quantity of the formula consumed. Is it given by bottle or cup and spoon? Also, the feeling of the mother should be assessed, e.g., ask "how do you feel when the baby does not feed well?" Time of introduction of complementary feedings and any difficulty should be noted.
- ii. Vitamin and mineral supplements; when started, type, amount, duration.
- iii. Solid food; when started, types, how taken.
- iv. Appetite; whether the appetite is temporarily or persistently impaired (if necessary calculate the caloric intake).
- v. For older children enquire about food likes and dislikes, allergies or idiosyncracies. Is the child fed forcibly? It is desirable to know the feeding routine from the time the child wakes up in the morning until the night. This gives an approximation of the total caloric

TABLE 2. Summary of history taking in infants and children with growth failure

Prenatal
General obstetrical history
Recurrent miscarriages
Was the pregnancy planned?
Use of medications, drugs, or cigarettes
Labour, delivery, and neonatal events
Neonatal asphyxia/Apgar scores
Prematurity
Small for gestational age
Birth weight and length
Congenital malformations or infections
Maternal bonding at birth
Length of hospitalization
Breastfeeding support
Feeding difficulties during neonatal period
Medical history of child
Regular physician
Immunizations
Development
Medical or surgical illnesses
Frequent infections
Growth history
Plot previous measurements
Nutrition history
Feeding behavior and environment
Perceived sensitivities or food allergies
Quantitative assessment of intake (3-day diet record, 24-hour food recall)
Social history
Age and occupation of parents
Who feeds the child?
Life stressors (loss of job, divorce, death in family)
Availability of social and economic support
Perception of growth failure as a problem
History of violence or abuse of care-giver
Review of systems/clues to organic disease
Anorexia
Change in mental status
Dysphagia
Stooling pattern and consistency
Vomiting or gastroesophageal reflux
Recurrent fever
Dysuria, urinary frequency
Activity level, ability to keep up with peers

Source: Duggan C.⁴⁶

intake and the calories supplied from protein, fat and carbohydrate as well as the adequacy of vitamins and minerals intake.

2. **Past and current medical history.** The history should include information of prenatal care, maternal illnesses during pregnancy, identified fetal growth problems, prematurity and birth weight. Indicators of medical diseases such as vomiting, diarrhea, fever, respiratory symptoms and fatigue should be noted. Past hospitalizations, injuries and accidents that are useful for the evaluation of child abuse or neglect should be recorded. Information about stool pattern, frequency, consistency, or presence of blood or mucus is needed to evaluate the possibility of malabsorption syndromes, infection or allergy.
3. **Family and social history.** Family and social history should include number, age and sex of siblings. Ascertain age of parents (Down syndrome and Klinefelter syndrome in children of elderly mothers) and the child's place in the family (pyloric stenosis). Family history should include growth parameters of siblings. Are there other siblings with FTT (e.g., genetic causes of FTT), or family members with short stature (e.g., familial short stature)? The social history should determine occupation of the parents and family income, and identify those caring for the child. Also child factors (e.g., temperament, development), parental factors (e.g., depression, domestic violence, social isolation, mental retardation, substance abuse), and environmental and societal factors (e.g., poverty, unemployment, illiteracy) should be evaluated, all of which may contribute to growth failure.⁵
4. **Psychosocial review.** The psychosocial history should be as thorough and systematic as a classic physical examination. Goldbloom³⁵ suggested that the interviewer should ask himself three questions about every family: (i) how do they look; (ii) what do they say; and (iii) what do they do? Aspects of history needed for the evaluation of the child with FTT are summarized in Table 2.

b. Physical examination (Table 3)

The four main goals of physical examination include (i) identification of dysmorphic features suggestive of a genetic disorder that affects growth; (ii) detection of an underlying disease that may impair growth; (iii) assessment for signs of possible child abuse; and (iv) assessment of the severity and possible effects of malnutrition.^{36,37} Detection of organomegaly (hepatomegaly and/or splenomegaly) will turn suspicion to metabolic disorders such as lysosomal storage disorders, galactosemia, glycogen storage disorders, etc. Neurologic dysfunction may indicate mitochondrial, storage, amino acid or organic acid disorders, or urea cycle defects. Certain dysmorphic features will point to peroxisomal disorders, mucopolysaccharidosis, glutaric aciduria type II, etc. Hair and skin abnormalities such as kinky hair, alopecia, or seborrheic

dermatitis may constitute features of Menkes disease or biotinidase deficiency. In general, the detection of multiple organ system involvement in a child with FTT should raise suspicion of some underlying inborn error of metabolism.

The basic growth parameters, such as weight, height/length, head circumference and mid-upper-arm circumference must be measured carefully. Recumbent length is measured in children below 2 years of age because standing measurements can be as much as 2 cm shorter.^{36,37} Other anthropometric data such as upper-segment to lower-segment ratio, sitting height and arm span should also be recorded. The anthropometric index used for FTT should be weight-for-length or height. Mid-parental height (MPH) should be determined by using the formula: $MPH = [FH + (MH - 13)] / 2$ or $MPH = [(FH - 13) + MH] / 2$ for boys and girls respectively,⁴⁰ where FH is the father's height and MH is the mother's height in cm. The target range is calculated as the $MPH \pm 8.5$ cm, representing the two standard deviations (2SD) confidence limits.¹⁴

1. Assessment of degree of FTT. The degree of FTT is usually measured by calculating each growth parameter (weight, height and weight/height ratio) as a percentage of the median value for age based on appropriate growth charts³ (Table 4).

It should be noted that appropriate growth charts are often not available for children with specific medical problems and, therefore, serial measurements are especially important for these children.³ For premature infants, correction must be made for the extent of prematurity. Corrected age, rather than chronologic age, should be used in calculations of their growth percentiles until 1-2 years of corrected age.³ Growth charts should be used for evaluating the pattern of FTT. If weight, height and head circumference are all less than what is expected for age, this may suggest an insult during intrauterine life or genetic/chromosomal factors.² If weight and height are delayed with a normal head circumference, endocrinopathies or constitutional growth retardation should be suspected.² When only weight gain is delayed, this usually reflects recent energy (caloric) deprivation.²

Physical examination in infants and children with FTT is summarized in Table 2.

2. Failure to thrive due to environmental deprivation. Children with environmental deprivation primarily demonstrate signs of failure to gain weight: loss of fat, prominence of ribs and muscle wasting, especially in large muscle groups, such as the gluteals.⁶

3. Developmental assessment. It is important to determine the child's developmental status at the time of diagnosis because children with FTT have a higher incidence of developmental delays than the general population.³⁶ In environmental deprivation, all milestones are usually delayed once the infant reaches 4 months of age.⁴² Areas dependent on environmental interactions, such as language develop-

FAILURE TO THRIVE

TABLE 3. Physical examination of infants and children with growth failure.

Organ/function	Abnormality	Diagnostic Consideration
Vital signs	Hypotension Hypertension Tachypnea/Tachycardia	Adrenal or thyroid insufficiency Renal diseases Increased metabolic demand
Skin	Pallor Poor hygiene Ecchymoses Candidiasis Eczema Erythema nodosum	Anemia Neglect Abuse Immunodeficiency, HIV infection Allergic disease Ulcerative colitis, vasculitis
HEENT	Hair loss Chronic otitis media Cataracts Aphthous stomatitis Thyroid enlargement	Stress Immunodeficiency, structural oro-facial defect Congenital rubella syndrome, galactosemia Crohn's disease Hypothyroidism
Chest	Wheezes	Cystic fibrosis, asthma
Cardiovascular	Murmur	Congenital heart disease(CHD)
Abdomen	Distension, hyperactive bowel sound, hepatosplenomegaly	Malabsorption, liver disease, glycogen storage disease
Genitourinary	Diaper rashes	Diarrhea, neglect
Rectum	Empty ampulla	Hirschsprung's disease
Extremities	Edema Loss of muscle mass Clubbing	Hypoalbuminemia Chronic malnutrition Chronic lung disease, cyanotic CHD
Nervous system	Abnormal deep tendon reflexes Developmental delay Dysphagia	Cerebral palsy Altered caloric intake or requirements Cranial nerve palsy
Behavior & temperament	Uncooperative	Difficult to feed.

CHD = congenital heart disease; HEENT = head, ears, eyes, neck & throat (examination)

Adapted from Collins et al ⁴¹

TABLE 4. Assessment of degree of failure to thrive

Growth parameter	Degree of Failure to Thrive		
	Mild	Moderate	Severe
Weight	75-90%	60 -74%	<60%
Height	90 -95%	85 – 89%	<85%
Weight/height ratio	81-90%	70 -80%	<70%

Adapted from Baucher H.³

ment and social adaptation are often disproportionately delayed. Specific behavioral evaluations (e.g., recording

responses to approach and withdrawal) have been developed to help differentiate environmental deprivation from underlying organic disease.⁴³ The infant's developmental status should be assessed with a full Denver Developmental Standardized test.⁴⁴

c. Parent-child interaction

Evaluate interaction between the parents and the child during the examination. In environmental deprivation, the parent often readily walks away from the examination table and easily abandons the child to the nurse or physician. There is little eye contact between child and parent and the infant is kept distantly, with little moulding to the parent's body. Often the

infant will not reach out for the parent and little affectionate touching is noted. There is little parental display of pleasure towards the infant.⁶

Observation of feeding is an integral part of the examination, but it is ideally done when the parents are not aware that they are being observed. Breast-fed infants should be weighed before and after several feedings over a 24-hour period since the volume of milk consumed may vary with each meal. In environmental deprivation, the parents often miss the infant's cues and they may distract the infant during feeding; the infant may also turn away from food and appear distressed.⁶ Also, unnecessary force may be used during feeding. Developing a portrait of the child-parent relationship is key to guiding intervention.¹¹

B. LABORATORY EVALUATION

The role of laboratory studies in the evaluation of FTT is to investigate for the presence of possible organic disorders suggested by the history and physical examination.^{33,34} If an organic etiology is suggested, appropriate studies should be undertaken. If history and physical examination do not suggest an organic etiology, an extensive laboratory investigation is not indicated.⁶ However, on admission complete blood count, erythrocyte sedimentation rate, urinalysis, urine culture, urea and electrolyte (including calcium and phosphorus) levels should be carried out. Screening for infections, such as HIV infection, tuberculosis and intestinal parasitosis should be performed. Skeletal survey is indicated if physical abuse is strongly suspected. In addition to being unproductive, blind laboratory fishing expeditions should be avoided for the following reason:^{5,6} (i) they are expensive; (ii) they impair the child's ability to gain weight in a new environment both by frightening the child with venipunctures, barium studies and other stressful procedures and the restriction of feedings associated with some investigations prevent the child from getting enough calories; (iii) they can be misleading since a number of laboratory abnormalities are associated with psychosocial deprivation (e.g., increased serum transaminases, transient abnormalities of glucose tolerance, decreased growth hormone and iron deficiency);²¹ and (iv) they divert attention and resources from the more productive search for evidence of psychosocial deprivation. In one study, a total of 2,607 laboratory studies were performed, with an average of 14 tests per patient. With all tests considered, only 10 (0.4%) served to establish a diagnosis and an additional 1% were able to support a diagnosis.³⁴

Finally, routine laboratory tests may provide clues for an inborn error of metabolism, such as hypoglycemia (disorders of carbohydrate metabolism), abnormal liver function tests (e.g. galactosemia, mitochondrial disease, etc.), decreased bicarbonate (HCO_3) levels (hyperchloremic metabolic acidosis), metabolic acidosis particularly with high anion gap (a feature of organic acidemias), urine positive for reducing substance

(e.g. galactosemia), and ketonuria (glycogen storage disease). In these cases the patient should be referred to a metabolic specialist for further and more specific metabolic testing.

C. FURTHER EVALUATION

1. Hospitalization: Although some authors state that most children with failure to thrive can be treated as outpatients,^{4,5,11,45} I think it is better to hospitalize the infant with FTT for 10 – 14 days. Hospitalization has both diagnostic and therapeutic benefits. The diagnostic benefits of admission include observation of feeding, parental-child interaction, and consultation of sub-specialists. The therapeutic benefits include administration of intravenous fluids for dehydration, systemic antibiotic treatment for infection, blood transfusion for severe life-threatening anemia and possibly parenteral nutrition, all of which are often in-hospital procedures. In addition, if an organic etiology is discovered for the FTT, specific therapy can be initiated during hospitalization. In psychosocial FTT, hospitalization provides the opportunity to educate parents about appropriate foods and feeding styles for infants. Hospitalization is necessary when the safety of the child is a concern. In most situations in our set up, there is no viable alternative to hospitalization.

2. Quantitative assessment of intake: A prospective 3-day diet record should be a standard part of the evaluation. This is useful in assessing undernutrition even when organic disease is present. A 24-hour food recall is also desirable. Having parents write down the types of food and amounts a child eats over a three-day period is one way of quantifying caloric intake. In some instances, it can make parents aware of how much the child is or is not eating.¹¹

DIFFERENTIAL DIAGNOSIS OF FAILURE TO THRIVE

1. FAMILIAL SHORT STATURE

Although children with familial short stature often are close to the third percentile on the growth chart, they have normal weight-to-height ratio and growth velocity, their bone age is equal to their chronological age, and they look happy and healthy.⁴⁷ Their growth curve runs parallel to and just below the normal curves.⁴⁸

2. CONSTITUTIONAL GROWTH DELAY

In constitutional growth delay, weight and height start to decrease near the end of infancy, parallel the normal growth curves through middle childhood, and accelerate toward the end of adolescence.⁴⁸ Growth velocity during childhood is normal, bone age is delayed, puberty is delayed, health is otherwise normal, and usually they have a family history of delayed growth and puberty.⁴⁷

3. EARLY ONSET GROWTH DELAY

About 25% of normal infants will shift to lower growth percentile in the first two years of life and then follow that percentile.^{11,49} This should not be diagnosed as failure to thrive. Smith et al¹³ reported that 30% of healthy, full-term, white infants cross one percentile line and 23% cross two percentile lines as they proceed from birth to the age of 2 years. In both history and physical examination, there are no remarkable findings except that similar features may be found in other siblings in the family.²³ Although in some children puberty may be delayed, a normal pubertal growth spurt occurs later in adolescence.²³ The bone age corresponds to the height age.²³

4. SPECIFIC INFANT POPULATIONS

Preterm infants and those who suffered intrauterine growth restriction may demonstrate growth failure in the immediate postnatal period^{50,51} but a catch-up growth has been reported to occur during the first 2 to 3 years of life.^{52,53} As long as the child's growth follows a curve with a normal interval growth rate, FTT should not be diagnosed.⁵⁴ Over diagnosis of growth failure can be avoided by using modified growth charts developed for specific populations, such as preterm infants,^{55,56} exclusively breast fed infants,^{57,58} specific ethnicities (e.g., Asians)^{59,60} and infants with genetic syndromes such as Down⁶¹ and Turner^{62,63} syndromes. Use of these charts can help to reassure the physician that these children are growing appropriately.

In preterm infants, their chronological age should be corrected by gestational age until the age of 24 months for weight measurements, 40 months for length, and 18 months for head circumference.¹ This is a crude method because it does not capture the variability in growth velocity that very low birthweight infants demonstrate.⁴⁸ Exclusively breast-fed infants tend to plot higher for weight in the first 6 months of life but relatively lower in the second half of the first year.⁴⁸

5. DIENCEPHALIC SYNDROME

This syndrome must be differentiated from psychosocial FTT. The diencephalic syndrome normally presents in the first year of life with failure to thrive, emaciation, increased appetite, euphoric affect and nystagmoid eye movements.^{64,65} Clinically they differ from FTT because in contrast to their poor physical condition they are alert, happy, active, relate easily and are not depressed.⁶⁵ The diencephalic syndrome results from neoplasms in the area of the hypothalamus and the third ventricle.⁶⁴

6. PSYCHOSOCIAL SHORT STATURE (PSYCHOSOCIAL DWARFISM)

Psychosocial dwarfism is a syndrome of deceleration of linear growth combined with characteristic behaviour disturbances (sleep disorder and bizarre eating habits), both of which are reversible by a change in the psychosocial environ-

ment.⁶⁶ Usually the age at onset is between 18 and 24 months.⁶⁶ Affected children are often shy, passive, typically depressed and socially withdrawn.⁵ The short stature may or may not be associated with concomitant FTT.⁵

MANAGEMENT OF THE CHILD WITH FAILURE TO THRIVE

Treatment of FTT is both immediate and long-term and should be directed at both the infant and the mother/family.

A good treatment plan must address the following:

1. The child's diet and eating pattern.
2. The child's developmental stimulation.
3. Improvement in care-giver skills.
4. Nursing considerations in the treatment of FTT.
5. Presence of any underlying disease.
6. Regular and effective follow up.
7. Consultation and referral to specialists.

1. THE CHILD'S DIET AND EATING PATTERN

The mainstay of management of failure to thrive, regardless of etiology, is nutritional intervention and feeding behaviour modifications. For breast-fed infants, the feeding interval should not be greater than four hours and the maximum time allowed for suckling should be 20 minutes. Beyond this time the infant becomes tired. The behavioural modification should center on improving feeding techniques, avoiding large amount of juices and eliminating distractive events, such as watching television during meals. Excessive fruit juice intake is an important contributor to poor growth because it provides a low carbohydrate intake and diminishes the appetite for nutritious meals.⁶⁷ Successful management of FTT is followed by a catch-up growth.¹⁹ Catch-up growth refers to gaining weight at a rate greater than the 50th percentile for age (Fig. 1).⁶⁸ For obtaining a catch-up growth, children with FTT require 1.5 to 2 times the expected calorie intake for their age.²⁵ Details are shown in Table 5.

Formula for calculation of catch-up growth requirement³⁰

$$\frac{\text{Kcal or protein(g) for weight age x ideal body weight}}{\text{Actual weight}}$$

Some children with FTT are anorexic and picky eaters. They may, therefore, not be able to obtain the required amount of calories and, therefore, they need calorie-dense feeds. Toddlers can receive more calories by adding taste-pleasing fats such as cheese or butter, and where not feasible palm oil, to common toddler foods. In addition, vitamin and mineral supplementation is required. Although some practitioners add zinc to reduce the energy cost of weight gain during catch-up growth, the data about its benefit are controversial.^{69,70} Meals

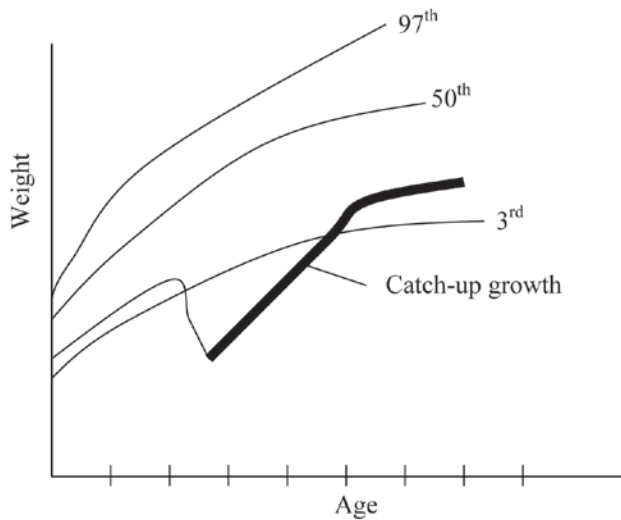


FIGURE 1. Failure to thrive and catch-up growth related to weight centile.
Source (with permission): Poskitt EME.¹⁹

TABLE 5. Average amount of carbohydrate and protein required for catch-up growth.

Age	Kcal/kg	Protein(g)/kg
0 – 6 months	115	2.2
6 – 12 months	105	2.0
1 – 3 years	100	1.8
4 – 6 years	85	1.5

Source: Vinton NE et al³⁰

should be pleasant, regularly scheduled, and the child should not be fed too rapidly or too slowly. Starting with small amount of food and gradually offering more is preferable to beginning with large quantities. Snacks need to be timed between meals so that the child’s appetite will not be affected. The type of caloric supplementation must be based on the severity of FTT and the underlying medical condition. For instance, the amount of protein in the diet must be carefully monitored in children with renal failure.³ Children with severe malnutrition must be re-fed carefully to prevent re-feeding syndrome.^{3,67} For older infants and young children with psychosocial FTT, meals should last for about 30 minutes, solid foods should be offered before liquids, environmental distraction should be minimized and children should eat with other people and not be force-fed.⁷¹ The primary physician may consider consulting a pediatric dietician to help provide a calorie-dense diet.

Monitoring nutritional therapy

The first priority is to achieve an ideal weight-for-age. The second goal is to attain a catch-up in length that is close to that expected for the child’s age. Steps in the treatment are directed towards both immediate and long-term normal growth of the child.⁷²

Effectiveness of therapy is monitored by gain in weight. Weight gain in response to adequate caloric intake usually establishes the diagnosis of psychosocial FTT.^{3,23} If FTT continues during hospitalization despite adequate dietary input, the presence of an occult organic disease is most likely and requires further investigation.²³ Adequacy of weight gain varies with age (Table 6).

Calculation of daily or monthly growth, such as weight gain in grams per day (Table 6), allows for more precise comparison of growth rate to the normal.⁴⁸ Although length growth is harder to assess, it should be 0.2 to 0.4 mm per day in most children.⁷³

2. THE CHILD’S DEVELOPMENTAL STIMULATION

An organized program of intensive environmental stimulation and affection during waking hours that utilizes parents, volunteers and child-life (social) workers is necessary.³³ Temporary or permanent foster home may be required to eliminate an adverse psychosocial environment. Studies have shown that appropriate psychosocial stimulation is important for cognitive development, both early and later in the child’s life.^{74,75}

3. IMPROVEMENT IN CARE-GIVER SKILL

Parents should be counselled about family interactions that are damaging to the child. Pay attention to the care-giver ability to recognize the child’s cues, responsiveness, and parental warmth and appropriate behaviour towards the child. Ensuring that food is appropriately prepared and presented, and making allowances for any difficulties that the child has in chewing and swallowing may all lead to improvement.³ Introduction of solids in small frequent feedings is useful. Infants should be fed in semi-upright position.⁷⁶ All staff members must work constructively with the parents, increasingly passing responsi-

TABLE 6. Acceptable weight gain per day according to age.

Age (months)	Weight gain (g/day)
Birth to <3	20 – 30
3 to <6	15 – 22
6 to <9	15 – 20
9 to <12	6 – 11
12 to <18	5 – 8
18 to 24	3 – 7

Source: Brayden et al²

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bility back to them. They should avoid judgmental utterances. Engaging the parents as co-investigator is essential. It helps foster their self-esteem and avoids blaming those who may already feel frustrated and guilty because of perceived inability to nurture their child.

4. NURSING CONSIDERATIONS IN THE MANAGEMENT OF FTT

A nursing-care plan should include careful charting of intake, weight, and observations of the mother's feeding style and interaction with the child. The nursing staff should instruct the mother on how to improve behaviours that may be deprivational, including instructions on how to hold the infant close during feeding.

The mother should be taught how to cook locally available foods. Foods should be thickened to increase caloric density and hence intake. Parents should be educated about the child's nutritional and psychological requirements. The child should be stimulated by maternal care, affection and social interaction with toys and peers. Home visits by a community health nurse to assess family dynamics and economic situation is important. Parental anxiety about the child's FTT can be allayed by reassurance from the nurse.

5. UNDERLYING ORGANIC DISEASE

Treat vigorously any identified underlying organic disease. Often the underlying cause of FTT syndrome remains unclear. In this case an empiric trial of nutritional therapy by a person experienced in feeding infants along with careful observation and support of the family is necessary. Children with FTT due to infection must be evaluated and treated promptly. The synergistic relationship between nutritional status and infection is particularly evident during infancy. Special attention should be paid to uncover possibly treatable inborn errors of metabolism, particularly when FTT persists despite increased caloric intake through diet. Of course, in metabolic disorders rarely is FTT an isolated symptom, and one must evaluate the full spectrum of clinical findings.

6. REGULAR FOLLOW UP

Upon discharge, close follow-up with home visits is essential to ensure maintenance of nutritional status. In this regard, Wright et al⁷⁷ have shown that home nursing visits are associated with better outcomes. Follow-up should ensure that the child is indeed now thriving normally by observing the growth parameters and using the appropriate growth charts. It also ensures that the child continues to receive adequate nutrition at home. Cognitive development should be monitored and, where necessary, additional stimulation should be provided at home or in a preschool facility. The period of convalescence, which should encompass calorie-dense diet, is essential for full recovery of children with FTT. Regular effective follow-up is critical, in that achieving nutritional and growth recovery in

hospital is probably less difficult than maintaining adequate long-term nutritional intake and developmental stimulation at home.³⁷ Children with FTT should be followed up at least every 4 weeks until catch-up is demonstrated and the positive trend maintained.

7. CONSULTATION AND REFERRAL TO SPECIALIST(S)

For children who are not improving because of an undiagnosed medical condition or a particularly challenging social situation, a multidisciplinary approach may be required.^{10,78} Determining whether FTT is an isolated finding is crucial in deciding to proceed with further metabolic tests or with referral to a metabolic specialist. Children with multisystem progressive findings are more likely to be afflicted by an inborn error in metabolism and certainly need further investigation to establish the correct diagnosis. **Figure 2** shows a schema of clinical approach to management of a child presenting with FTT. Although some exceptions to this schema may exist, it is appropriate for most cases.

PREVENTION OF FAILURE TO THRIVE

Promotion of exclusive breast feeding for early infancy, followed by optimum complementary feeding in the presence of good hygienic practices diminishes the risk of infections, promotes infant growth and prevents child undernutrition.⁷⁹

Community effort to educate and encourage people to seek help for their social, emotional, economic and interpersonal problems may help reduce the incidence of psychosocial FTT.

Encouraging parenting education courses in secondary schools as well as educational community programs may help new parents enter parenthood with an increased knowledge of infant's nutritional and other needs.

Early detection of FTT and intervention can reduce the severity of symptoms, enhance the process of normal growth and development, and improve the quality of life experienced by infants and children.

Prevention of low birthweight (a risk factor for FTT) through balanced energy-protein supplementation, micro-nutrient supplementation, treatment of infection/malaria, cessation of smoking and alcohol ingestion in pregnancy are major interventions capable of preventing low birthweight.⁸⁰

Neonatal screening for treatable metabolic disorders (e.g. thyroid function tests, blood testing for phenylketonuria, galactosemia, etc.)

COMPLICATIONS

1. Malnutrition-infection cycle: recurrent infection exacerbates malnutrition, which in turn leads to greater suscep-

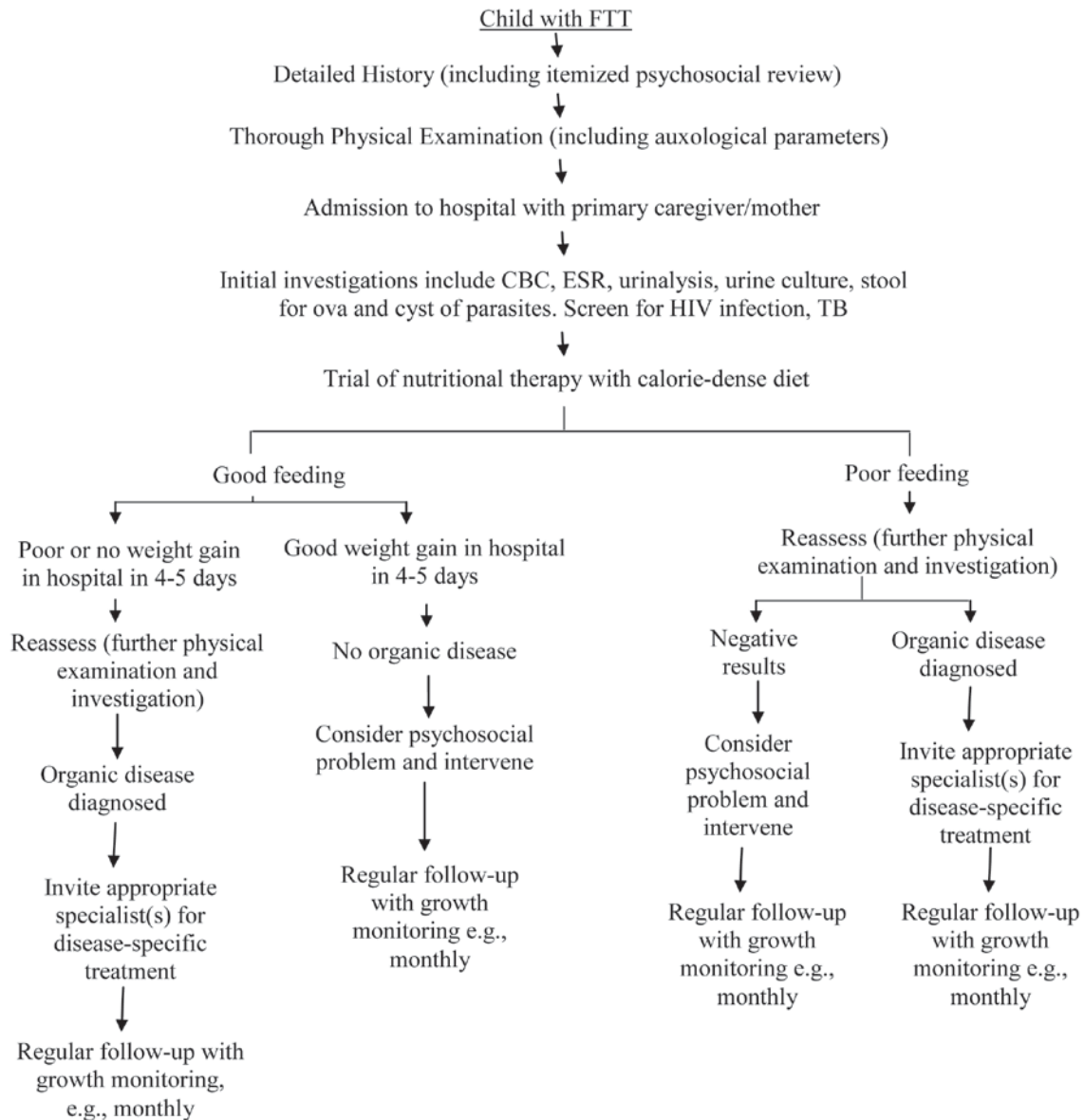


FIGURE 2. Algorithm of management of child with FTT. CBC = complete blood count; ESR = erythrocyte sedimentation rate; FTT = failure to thrive; HIV = human immunodeficiency virus; TB = tuberculosis

tibility to infection. Children with FTT must be evaluated and treated promptly for infection.

2. Re-feeding syndrome: re-feeding syndrome is characterized by fluid retention, hypophosphatemia, hypomagnesemia and hypokalemia.⁶⁸ To avoid the re-feeding syndrome, when nutritional rehabilitation is initiated, calories can safely be started at 20% above the child's recent intake.⁶⁸ If no estimate of caloric intake is available, 50 to 75% of the normal energy requirement is safe.⁶⁸ If tolerated, caloric intake can be increased by 10 to 20% per day, with monitoring for electrolyte imbalances, poor cardiac

function, edema, or feeding intolerance.⁶⁸ If any of these occur, stop further caloric increases until the child's clinical status stabilizes.

3. Chronic, severe undernutrition in infancy may depress head growth, an ominous predictor of later cognitive disability.³

PROGNOSIS

The timing of the insult, the duration and severity of the disease that caused growth failure determine the ultimate

outcome.^{25,30} The extent to which full catch-up growth occurs is often debated. A short period of poor growth is likely to resolve completely if sustained adequate nutrition is supplied for accelerated growth.¹⁹ On the other hand, a prolonged period of poor growth is likely to lead to persistent small size, particularly if it occurs early in infancy when it may be difficult to make up the huge increments in size of the first 6 months of life.¹⁹ When growth faltering occurs during or just prior to puberty, there is only a limited period of time during which catch-up growth can occur, ultimately leading to incomplete catch-up growth.¹⁹ Repeated episodes of growth faltering without catch-up growth will lead to clinical marasmus if death from overwhelming infection does not intervene.¹⁹

There are a limited number of outcome studies on children with FTT, each with different definitions and designs, so it is difficult to comment with certainty on the long-term results of FTT.⁸¹ However, some follow-up studies have separately reported impaired physical growth and cognitive development in children who had FTT.⁸²⁻⁸⁶ Long-term effects on height and weight appear more marked than on intelligence quotient (I.Q.).⁸⁴ Children with a past history of non organic FTT have been found at the age of five years to be shorter and lighter than their matched controls.⁸⁵ Regardless of etiology, FTT in the first year of life is particularly ominous, because maximal postnatal brain growth occurs in the first 6 months of life.³ Approximately a third of children with psychosocial FTT are developmentally delayed and have social and emotional problems.³ A possible explanation is that reaching optimal potential may be difficult given that the socioeconomic and cultural environment in which these children live is not easily changed. The prognosis is more variable in organic FTT depending on the specific diagnosis and severity of FTT.

CONCLUSION

Although definitions of FTT vary, most authorities agree that FTT can only be assessed accurately by comparing height and weight on a growth chart over time. Laboratory evaluation should be guided by history and physical examination findings only. The management of FTT should begin with a careful search for its etiology. Nutritional intervention by using a calorie-dense diet is the cornerstone of treatment of FTT, regardless of etiology. Social issues of the family and associated medical problems must be addressed. A careful and timely search for the underlying cause of FTT and gradual aggressive caloric supplementation are important in obtaining the best possible outcome in children with FTT.

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