Failure to Thrive or Growth Faltering: Medical, Developmental/Behavioral, Nutritional, and Social Dimensions

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PRACTICE GAP

Beyond recognizing the medical and nonmedical dimensions that often interact to cause childhood growth faltering and malnutrition, it is important to understand the role of pediatric feeding disorders, to screen for and address social determinants of health, and to understand the multidisciplinary model of treatment.

OBJECTIVES *After completing this article, readers should be able to:*

1. Diagnose growth faltering and childhood malnutrition.
2. Understand the pathogenesis and differential diagnosis of growth faltering.
3. Take a complete relevant history starting with the prenatal period that includes parental heights (if appropriate), nutritional and feeding details, developmental progress, and social determinants of health.
4. Understand the role of diagnostic testing, including first-line laboratory examinations such as complete blood cell count with differential count, iron studies, lead, chemistry panel, and celiac evaluation with immunoglobulin A and tissue transglutaminase antibodies.
5. Evaluate growth faltering in special populations of children with a history of prematurity, intrauterine growth retardation, small for gestational age, autism, and prenatal substance exposures.
6. Understand the role of social determinants in child undernutrition and the screening and resources to address conditions of poverty and inequality, including but not limited to food insecurity.
7. Demonstrate cultural competence when counseling families regarding growth, nutrition, and feeding.
8. Understand multidisciplinary treatment, including medical, nutritional, and often behavioral/feeding therapy, and developmental and psychosocial support, with close follow-up, use of pharmacotherapy when needed, and collaboration among providers and programs.

AUTHOR DISCLOSURE Dr Roger's current affiliation is Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA. Drs Tang, Adolphe, Rogers, and Frank have disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

ABBREVIATIONS

AAP	American Academy of Pediatrics
ASD	autism spectrum disorder
ASPEN	American Society for Parenteral and Enteral Nutrition
CDC	Centers for Disease Control and Prevention
FASD	fetal alcohol spectrum disorder
GI	gastrointestinalHIV human immunodeficiency virus
IgA	immunoglobulinA
SGA	small for gestational age
SNAP	Supplemental Nutrition Assistance Program
WHO	World Health Organization
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

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INTRODUCTION

Failure to thrive is an archaic term—now often replaced with *growth faltering, weight faltering,* or *poor weight gain*—to describe a symptom of many forms of primary and secondary undernutrition, usually in young children. (1)(2) We use the term *growth faltering* herein. Worldwide, childhood malnutrition is still a major cause of morbidity and mortality, with 45% of mortality in children younger than 5 years linked to undernutrition. (3) In the United States, the epidemiology of growth faltering is difficult to measure due to lack of uniformity in the populations studied and the definitions used. (4)(5) Estimates of prevalence have ranged from less than 2% to greater than 10%, with higher rates in populations of children in low-income households, children with special health-care needs, refugee children, and children born at lower birthweight. (6)(7)(8) The traditional organic/nonorganic dichotomy formerly used to classify etiologies is obsolete because childhood growth faltering often derives from the interplay of medical, developmental/behavioral, nutritional, and psychosocial factors resulting in nutritional deficiency.

Growth faltering increases risk in the short term for medical complications of acute infections and chronic conditions, and in the long term for persistent short stature, developmental and psychosocial deficits, and adult conditions such as cardiovascular disease and metabolic syndrome. (9)(10)(11)(12) Successful treatment often requires assessment and intervention in multifaceted domains. This review aims to help clinicians navigate multidisciplinary assessment and treatment of the overlapping medical, developmental/behavioral, nutritional, and psychosocial components of growth faltering and undernutrition in children.

DEFINITIONS

Growth faltering is a descriptive term used to diagnose children whose attained weight for length or BMI is below expected on age- and sex-specific growth charts, or whose weight on these charts has crossed downward more than 2 major percentile lines after having previously achieved a stable growth pattern. (5)(13) We have replaced the term *failure to thrive* with *growth faltering* because the latter is more descriptive, less pejorative, and has begun to replace the former term in many US and worldwide publications. (1)(2)(14)(15)(16)(17)

Growth faltering results from malnutrition. The definition of malnutrition by the World Health Organization (WHO) holistically refers to "deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization." (18) To facilitate the understanding of pediatric nutrition, the American Society for Parenteral and Enteral Nutrition (ASPEN) defines malnutrition as "imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes." To expand this definition, ASPEN suggests a process-focused scheme that includes "chronicity, etiology, and pathogenesis of malnutrition; its relationship with inflammation; and its impact on functional outcomes." (11)

To classify malnutrition, the Centers for Disease Control and Prevention (CDC) recommends using the WHO standards from birth to age 2 years and the CDC reference charts from ages 2 to 20 years. (19) Indicators are summarized in Table 1. Wasting refers to BMI or weight-for-length z scores (standard deviation units) less than –2 and is a measure of acute malnutrition. Stunting is defined by length or height z score less than –2 and is the result of chronic malnutrition, in which case weight may be proportional to height. Low length/height needs to be taken into clinical context because short stature could also be due to familial, genetic, or endocrinologic causes. Using single data points, moderate malnutrition or wasting is defined by attained weight-for-height, BMI, or mid-upper arm circumference z scores between –2 and –3 for moderate malnutrition and less than –3 for severe malnutrition. When at least 2 data points are available, nutritional status may be assessed in dynamic terms by percentage of age-expected weight gain velocity of less than 50% for moderate and less than 25% for severe malnutrition compared with WHO standards, or in children older than 2 years percentage weight loss of 7.5% of previous body weight for moderate and 10% for severe, or deceleration in weight-for-length/height z score of 2 z scores for moderate and 3 z scores for severe. (7) For children with atypical anatomy or for whom height cannot be measured, additional assessment of nutritional status can be performed with measurement of mid-upper arm circumference, arm span, and/or triceps skinfold values (the latter if the provider has the training and the proper equipment).

PATHOGENESIS

Mechanisms of growth faltering can be understood in terms of inadequate energy (caloric) intake, inadequate absorption, excessive energy expenditure due to

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Table 1. Indicators of Malnutrition Using Single and Multiple Data Points

ANTHROPOMETRIC MEASUREMENT	MILD MALNUTRITION	MODERATE MALNUTRITION	SEVERE MALNUTRITION
Single data point			
Weight-for-height/BMI *z* score	−1 to −1.9	−2 to −2.9	≤ −3
Length/height *z* score	No data	No data	≤ −3
Mid-upper arm circumference *z* score	−1 to −1.9	2 to −2.9	≤ −3
Multiple data points			
Weight gain velocity (age <2 y)	<75% of the norm[a] for expected weight gain[b]	<50% of the norm[a] for expected weight gain[b]	<25% of the norm[a] for expected weight gain[b]
Weight loss (age 2–20 y)	5% usual body weight	7.5% usual body weight	10% usual body weight
Deceleration of weight-for-length/height *z* score	Decline of 1 *z* score	Decline of 2 *z* scores	Decline of 3 *z* scores

[a]Guo S, Roche AF, Fomon SJ, et al. Reference data on gains in weight and length during the first two years of life. *J Pediatr.* 1991;119(3):355–362.
[b]World Health Organization data for patients younger than 2 years are available at https://www.who.int/tools/child-growth-standards/standards.
Adapted with permission from Becker P, Carney LN, Corkins MR, et al. Consensus statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: indicators recommended for the identification and documentation of pediatric malnutrition (undernutrition). *Nutr Clin Pract.* 2015;30(1):147–161.

underlying health conditions, or defective utilization of energy (occurring in some genetic and metabolic conditions). (5)

The most common cause of growth faltering, inadequate intake, can be due to insufficient supply or consumption of food. Inadequate intake in the neonatal period sometimes reflects improper mixing of formula or difficulties with breastfeeding. At all ages, inadequate food supplies in the household precipitate inadequate intake (see the extended discussion of food insecurity later herein). Inadequate consumption may occur even when food supplies are sufficient, often secondary to feeding difficulties.

Pediatric feeding disorders have been defined by Goday et al (20) as "impaired oral intake that is not age-appropriate, and is associated with medical, nutritional, feeding skill, and/or psychosocial dysfunction." It is important to recognize that this definition overlaps significantly with the more behaviorally focused diagnosis of avoidant/restrictive food intake disorder, especially when working together with psychologists and psychiatrists. This disorder is defined in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition,* as an eating or feeding disturbance manifested by persistent failure to meet appropriate nutritional and/or energy needs associated with undernutrition and/or interference with psychosocial functioning. (21) Medical, developmental/behavioral, and psychosocial factors often overlap in these cases. (22)

Medical evaluation for feeding difficulties and poor intake as causes of growth faltering includes assessment of aerodigestive causes (such as aspiration), gastrointestinal (GI) anatomical or mucosal abnormalities, developmental problems, and excess consumption of unbalanced sources of nutrition (especially milk or juice). Red flags for aspiration include overt coughing or choking with feeding, congestion with feeding, symptoms consistent with reflux, or more subtle signs of stress in infants, such as blinking, red/watery eyes, feeding aversion, or chronic or recurrent respiratory symptoms or infections. However, Duncan et al (23) showed that clinical evaluation has lower sensitivity for detecting aspiration than does modified barium swallow (videofluoroscopic swallow study) and concluded that this study should be performed for persistent symptoms. Evaluation for feeding difficulties should consider GI causes such as eosinophilic esophagitis, reflux, and rare anatomical problems such as esophageal web or stricture. (24) Underlying developmental problems may contribute to feeding difficulty and consequent malnutrition, which, in turn, may compound the developmental and medical conditions. (25) Excess cow milk consumption has been associated with lower intake of food, although not poor weight gain, and with iron deficiency anemia that can be severe. (26)(27) Iron and micronutrient deficiencies often (although not always) accompany poor growth and feeding disorders, and iron and zinc deficiencies suppress appetite. (8)(11)(27)(28)(29) (30)

Malabsorption may be secondary to GI pathology, such as celiac disease, inflammatory bowel disease, pancreatic insufficiency, or cholestasis. Enteric pathogens such as *Giardia lamblia* can present with depressed appetite and malabsorption and should be considered among children who may have had environmental exposures. (31)

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Table 2 . Nutritional and Feeding-Specific History

Feeding history adjusted for age
Breast or formula
Age solids introduced
Age switched to whole milk
Food allergy or intolerance
Vitamin or mineral supplements
Symptoms of dysphagia, aspiration, or fatiguing with feeds
Current feeding behaviors and interactions
Dietary recall
Frequency of feeding
Duration of feeding episodes
Who feeds and how
Force feeding
Where fed (alone or held, with or separate from family, lap or high chair, watching screens)
Selectivity, food neophobias, texture preferences, and food jags
Perceived appetite
Amount and timing of juice, other sugar-sweetened beverages, and milk
Caretaker's nutrition knowledge and beliefs
Culturally based dietary and feeding practices
Access to nutrition knowledge, including language barriers
Adequacy of developmentally appropriate nutrition information
Unusual dietary beliefs
Adequacy of financial resources for food purchase
Adequacy of earned income
Program participation: Transitional Aid to Needy Families (TANF), Supplemental Social Security Income (SSI) Unemployment Insurance Supplemental Nutrition Assistance Program (SNAP): how much/month for how many people
Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
Child care or school feeding
Use of philanthropic food resources
Recent change in food budget (cuts or increases in benefits, new mouths to feed, job gain or loss)
Family's knowledge of how to budget food purchasing
Material resources for food preparation and storage
Refrigeration
Cooking facilities
Running water

Adapted with permission from Frank DA. Failure to thrive. In: Kleinman RE, Greer FR, eds. *Pediatric Nutrition.* 7th ed. Itasca, IL: American Academy of Pediatrics; 2013:663–700.

Increased metabolic demand can be due to a wide range of medical conditions, including heart and lung disease, infection, and malignancy. Obstructive sleep apnea, usually manifested by chronic snoring, can also be associated with growth failure, although the mechanism is not clear. (32) (33)(34)

Defective energy utilization encompasses some genetic (such as trisomies 21 and 18) or metabolic (such as abnormal glucose metabolism in glycogen storage disease) conditions. Genetic or metabolic conditions can also cause growth problems secondary to medical complications, delayed feeding skills, or elevated risk of celiac disease in the case of trisomy 21 or Turner syndrome.

CLINICAL ASPECTS: HISTORY AND PHYSICAL EXAMINATION

In evaluating infants and young children with growth faltering, it is essential to obtain a meticulous history of the pregnancy and the perinatal period, not only by interviewing caregivers but also by reviewing, if available, the child's (and ideally the mother's) perinatal records. The medical and social histories of pregnancy and birth status, as well as mid-parental height if available, inform the interpretation of current anthropometry and risk factors for poor growth. The review of systems should be thorough because growth can falter due to involvement of any of the body systems. It is important to gather detailed feeding and nutritional histories (see Table 2).

Family history should specifically include history of GI disease, atopy, developmental disorders, and nutritional status, along with mental health. Maternal depression may be associated with growth faltering in children; however, evidence in this area is mixed and generally does not support an association between maternal depression and growth faltering in high-resource countries. (35)(36)(37)

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Examination should assess signs of disordered nutritional status and signs of micronutrient deficiency in terms of muscle mass and adiposity, hair, and skin. Patients should also be assessed for tooth decay, tonsillar hypertrophy, skin or neurologic abnormalities, dysmorphisms, cardiac murmur, and organomegaly.

GROWTH MEASUREMENT AND USE/ INTERPRETATION OF GROWTH CHARTS

Given the importance of growth measurements in evaluating children for growth faltering, obtaining accurate anthropometric measurements is critical. Before 2 years of age, children should be weighed naked or in a clean and dry diaper; older than 2 years, clothing should be light and shoes should be off. A length board (rather than paper and pencil) should be used for children younger than 2 years for length, and a calibrated stadiometer should be used for older children. (38)

When using growth curves to assess nutritional status, serial anthropometric measurements should be interpreted in the context of any previously known growth pattern. Evaluation of growth trajectory should consider early on the possibility of "regression to the mean" or "catch-down growth" especially in large-for–gestational age infants, along with expectations for catch-up growth for infants who were premature and/or small for gestational age (SGA) in the context of parental stature if known. (5)(39)(40) Growth curves should also be interpreted longitudinally using both weight and length or height whenever possible to help delineate the processes of wasting and stunting, in which there is usually a decrease in weight trajectory followed by decreased linear growth, from other nonnutritional causes, such as constitutional delay or genetic or familial short stature. (5)(41) Deceleration in head circumference is a late sign of severe malnutrition in children younger than 2 years or is an indication of a possible syndromic condition.

Specific growth charts also exist for some genetic conditions, including trisomy 21, Turner syndrome, or cri-du-chat syndrome; growth should be plotted on these curves for children with these syndromes with the caveat that these growth charts may be based on data that included children who were malnourished secondary to medical complications or suboptimal nutritional management of their syndromes. (42)(43) Other markers of nutritional status should also be used in children with genetic conditions, especially weight for length or BMI, and in the future we may have better data on use of other markers of body composition. (44)

DIAGNOSTIC TESTING

In the outpatient setting, diagnostic evaluations in the absence of findings on history or physical examination have tended to have a low yield; older studies have been corroborated by newer studies, including those from subspecialty clinics to which more severe cases may present. (29)(45) The initial presentation, evaluation, and following growth and clinical trajectory should determine the diagnostic evaluation. If a child presents with minimally poor weight gain and improves after nutritional counseling, detailed laboratory assessment may not be necessary. More severe malnutrition or lack of response to initial counseling merit more evaluation, depending on the history and physical examination findings. Evaluation may include the following: complete blood cell count with differential count for anemia and other rarer abnormalities such as signs of immunodeficiency and malignancy; iron studies because iron deficiency is common in children with poor growth; (46) lead; a chemistry panel to assess for problems such as renal tubular acidosis or to monitor refeeding syndrome if necessary once nutritional rehabilitation has started; celiac disease evaluation, including total immunoglobulinA (IgA) and tissue transglutaminase IgA antibodies in children old enough to have been introduced to grains because celiac disease is increasing in prevalence and can present with growth faltering without other symptoms; (47) urine tests if there is concern for infection, glycosuria, or renal pathology; stool studies for infection or malabsorption depending on symptoms and travel history; human immunodeficiency virus (HIV) testing or other infectious evaluation; and measurement of micronutrients other than iron should be considered only if indicated by the history or physical examination.

As recommended by the American Academy of Pediatrics (AAP) and the American Academy of Allergy, Asthma & Immunology in their "Choosing Wisely" campaign, we do not routinely send IgE tests for food allergens unless specifically indicated by history and/or physical examination findings. Not only are false-positives common, but negative testing does not rule out food allergy, especially in GI disease, which is less likely to be IgE-mediated. (48) Furthermore, in atopic children, food elimination poses potential increased risk for later systemic response and unnecessarily restricted diets, which can further exacerbate growth faltering. (49)(50)

Further highly targeted diagnostic testing dictated by history and physical examination findings may include a sweat test for cystic fibrosis, modified barium swallow to assess for aspiration, endoscopic evaluation if there is

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suspected GI pathology, thyroid function tests if the child has short stature, and head imaging in the rare case of suspicion for intracranial mass/diencephalic syndrome. (51)

CLINICAL CONSIDERATIONS IN INFANTS WITH A HISTORY OF PREMATURITY, INTRAUTERINE GROWTH RETARDATION, AND SGA

Clinical evaluation should begin by assessing as accurately as possible the child's gestational age at birth and whether intrauterine growth retardation was identified by serial prenatal measurements. Besides intrauterine growth and gestational age, birthweight should be categorized as appropriate for gestational age, SGA (<10th percentile for gestational age), or large for gestational age (>90th percentile for gestational age). Premature infants, commonly also having intrauterine growth retardation, can already face nutritional deficits at the time of NICU discharge, including having slower gain of weight, length, and head circumference than their gestational-age equivalents. After discharge, complications of prematurity, including chronic lung disease, can cause increased metabolic needs, and feeding difficulties secondary to aspiration, reflux, and/or developmental delays can cause feeding difficulties and insufficient intake. (52)

Regardless of gestational age, weight and length at birth reflect both the duration of gestation and the rate of growth during gestation. Infants whose rate of intrauterine growth for gestational age is depressed are at risk for postnatal growth failure, regardless of gestational age. The degree of risk of postnatal growth failure after SGA can vary depending on the cause of the SGA; degree of prematurity; contributing socioenvironmental, teratogenic, and genetic factors; and relative degree of deficit in weight, length, and head circumference at birth. (53) Controversy persists as to the relative importance of the symmetrical/asymmetrical differences in SGA growth expectations. (54) SGA infants whose weight, length, and head circumference are proportionately depressed at birth (ie, "symmetrical") in general carry a relatively poorer prognosis for later growth and development and should be evaluated for genetic diagnoses or exposures to intrauterine infections or teratogens. (53)(55)

In evaluating growth, several transitions will be made among growth curves. The WHO growth standards were constructed from a cohort that omitted preterm infants, but recent researchers have suggested that after 42 to 50 weeks' postmenstrual age, former low birthweight infants should be assessed using these sex-specific WHO standards. Before that age there are several preterm specific growth references, and the Fenton growth chart for preterm infants can facilitate smooth transition to the WHO standards 4 to 10 weeks after term. (56) Plotting of growth on the WHO standards should be corrected for gestational age for preterm infants until age 2 to 3 years. (11)(57)(58)(59) For children referred for growth faltering who were SGA at birth, if substantial catch-up growth has not occurred by 2 years of age in response to optimal nutrition and care, referral for endocrine consultation for potential growth hormone therapy should be considered (not for deficiency). (53)(55)

We lack sufficient evidence for optimal rate of postnatal catch-up growth for infants with low birthweight, whether preterm or SGA, to enhance cognitive outcome while not increasing long-term cardiovascular risk; however, sustained deterioration in growth velocity is always a matter of concern and in the first year after birth has been linked to suboptimal cognitive performance in the short- and long-term. (60) Brief postnatal weight loss because of normal extracellular volume loss should be resolved by 21 days after birth, after which time deceleration in weight velocity z score should be investigated for remediable social, medical, and nutritional stressors described elsewhere in this article.

CLINICAL CONSIDERATIONS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

Children with autism spectrum disorder (ASD) may have behavioral and sensory difficulties, as well as concurrent GI disorders, which can lead to poor growth. Conversely, growth and feeding difficulties can be a red flag for developmental concerns, including ASD. Children with ASD often struggle with rigid obsessional behaviors, sensory sensitivity, and anxiety around food. (61)(62) Depending on which foods are accepted, this selectivity can contribute to aberrant weight gain and growth.

Children with ASD are at risk for both GI symptoms and feeding difficulties, which can result in growth faltering as well as risk for overweight (often still at risk for micronutrient and sometimes macronutrient deficiencies). Children with ASD have approximately 4 times higher odds of GI symptoms than comparison populations, but communication barriers often make clinical diagnosis challenging. (63) Children with both ASD and GI symptoms tend to manifest more severe ASD core symptoms than others. A review by Marshall et al (64) found that common characteristics of feeding difficulties include restricted dietary variety or limited diet based on texture, food neophobia, and food refusal; both dietary quality and

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mealtime behaviors were common problems. Some studies did find children with ASD to be underweight compared with controls, but more studies actually found a higher rate of being overweight. (63) Because these difficulties can start quite early, clinicians should be alert to the possibility of ASD in young children with severe, persistent feeding problems, often associated with growth faltering. (61)(64)

FETAL ALCOHOL SPECTRUM DISORDER AND OTHER RECREATIONAL PSYCHOACTIVE SUBSTANCE EXPOSURES

The approach to the diagnosis and treatment of a child with prenatal exposures to alcohol and/or recreational psychoactive substances whose growth is faltering should be very similar to that used for all children presenting with growth faltering, taking into consideration medical, nutritional, developmental, and social risks. Although many recreational psychoactive substances are associated with reduced infant size at birth, (65) only heavy prenatal alcohol exposure is clearly associated with postnatal growth restriction, and only heavy alcohol use is consistently associated with cardiac and renal malformations that may contribute to growth failure. (66) History of prenatal substance exposure does not obviate the need for appropriate assessment and intervention of growth faltering.

Children with prenatal substance exposure in settings in which perinatal HIV screening is not universal should be screened at presentation for growth faltering because growth failure is a hallmark of HIV infection in untreated children. (67) Other vertically transmitted infections associated with intravenous substance use (eg, syphilis, hepatitis C) should be considered if a mother or child has had inadequate medical care before presentation.

Nutritional and developmental behavioral factors should also be assessed. Iron deficiency anemia has been described in infants exposed prenatally to a mother's binge alcohol use and has been found to be independently associated with reduced postnatal growth particularly among infants with dysmorphic features classic for fetal alcohol spectrum disorder (FASD). (68) Delayed feeding skills and aberrant feeding behaviors have also been noted in children with FASD. (69) As in all cases of growth faltering, assessment should be performed for parental distress, family violence, and inadequacy of basic care provided to the child. These factors are of particular concern in families with untreated alcohol and other substance use disorders. (70)

Although attained growth in children with FASD can be less than the 10th percentile, even with dietary and other interventions, the trajectory of growth should be at least appropriate for age, with weight and length/height proportionate. (71) Elevated BMI may be seen in adolescents with FASD, so nutritional interventions should be carefully titrated. (72)

CHILD PROTECTION CONSIDERATIONS IN GROWTH FALTERING AND INDICATIONS FOR HOSPITALIZATION

Given clinician subjectivity and varying state legal criteria for diagnosing "neglect" above and beyond a family's inability to meet children's needs due to economic deprivation, neglect is not a valid diagnosis of exclusion in cases of growth faltering. It is also important to note that an inability of parents to provide children with adequate nutrition as a result of poverty should not be conflated with child neglect or abuse. (73)

Child abuse, including medical child abuse or food withholding, is a rare proximate cause of growth faltering. (74)(75)(76) Other clinical concerns that may necessitate the involvement of child protective services in the treatment of growth faltering, as in other pediatric diseases, include situations in which caregivers cannot provide or sustain needed outpatient interventions for their children because of profound cognitive disability, untreated severe psychiatric illness, or substance use disorders. (73)(77) Evidence is insufficient regarding whether infant or child exposure to intimate partner violence among caregivers is associated with poor growth. (78)

Although hospitalization is indicated if the severity of medical conditions or malnutrition warrants it, hospitalization for the purposes of comparing pre-admission weight gain with in-hospital weight gain should not be used as a diagnostic method to determine whether growth faltering is of an "organic" or "inorganic" etiology. Although one prospective study of children hospitalized for growth faltering found that most children displayed improved weight gain after receiving behavioral interventions alone, in-hospital weight gain has not been found to be specific for differentiating neglect from other etiologies. (79)(80)

THE ROLE OF SOCIAL DETERMINANTS OF HEALTH IN GROWTH FALTERING

Social determinants of health, defined as the conditions in which people are born, live, grow, and age, are often significant factors in undernutrition and growth faltering. (81)(82)

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Social determinants of health include food insecurity, housing instability, and energy insecurity, all of which can be viewed as downstream effects of poverty, structural racism, and general financial strain. Poverty itself, mediated through these factors and others, including pervasive family stress, may be a risk factor for poor growth in children. Data from the 2009 Pediatric Nutrition Surveillance Study demonstrate that children who qualify for federal nutrition assistance because of low family income are more likely to be of short stature than those who do not qualify. (6)

Food insecurity can be defined as the limited or uncertain ability to obtain nutritionally adequate and safe foods in a socially acceptable manner. (83) In 2018, 11.1% of US households, in which 11.2 million children resided, experienced food insecurity for some part of the year; the rate of food insecurity was higher in households with young children than in those that did not include children, particularly in nonwhite households. (84) Historically, the prevalence of food insecurity increases during times of economic recession.

Other social determinants predisposing to growth faltering include energy insecurity, which can be defined as an inability to afford energy to fulfill basic needs, and housing instability. Parents often decrease food expenditures by the same amount that they have to increase energy expenditures during colder months; for families who already experience food insecurity, further diverting money away from food purchases could potentially lead to undernutrition in children. (85) Housing instability has been associated with lower weight-for-age z scores, and maternal homelessness during pregnancy is a risk factor for low birthweight, which is associated with growth faltering during childhood. (55)(86)(87)(88)(89)(90)(91)

The effective treatment of growth faltering often requires that these underlying social determinants and unmet material needs be uncovered and addressed. Detecting underlying unmet needs may be accomplished using validated screening tools, as recommended by the AAP. (92) These tools can be designed to screen for a wide range of needs at once, as in the WE CARE model, or can be geared toward a specific social need, such as food insecurity, as is the case with the Hunger Vital Sign. (81)(93) The specific method of screening used should be tailored to the demographics and developmental stage of the target population, and screening should ideally begin only once appropriate resources are identified and referral mechanisms are in place. (94) Compiling a list of local resources for families can be accomplished using online directories, such as Aunt Bertha© or One Degree©, or platforms developed specifically for the health-care sector, including Healthify© or NowPow©. (95)(96)

Intervention for social determinants of health is associated with improved growth outcomes. State- and national-level nutrition assistance programs for low-income families include the Supplemental Nutrition Assistance Program (SNAP, formerly Food Stamps), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and school meals programs (National School Lunch Program and School Breakfast Program). Participation in SNAP and/or WIC has been found to be associated with lower risk of growth faltering and micronutrient deficiencies. (97) The nutritional benefits of WIC participation can begin as early as the prenatal period with decreased risk of low birthweight and other adverse perinatal outcomes, potentially reducing risk of growth faltering in the future. (98)(99)(100)(101) Participation in SNAP decreases food insecurity and has been positively associated with birthweight and weight status in children. (102)(103)(104)(105)

Fuel assistance and housing subsidies are associated on a population level with improved growth in infants and young children. Participation in the Low Income Home Energy Assistance Program (LIHEAP), a national program that can be used by eligible families to assist with paying for energy bills, has been found to be associated with decreased risk of growth problems in children, likely by reducing overall financial strain in low-income families. (106) Housing subsidies have also been associated with decreased risk of childhood underweight status. (107)

Although policy varies by state, eligibility criteria for programs are sometimes linked. (108) Therefore, any policy changes that restrict access to one program can have a ripple effect that also causes children to lose access to other sources of nutritional assistance. Recently, children in families with immigrant members are in increased jeopardy of nutritional deprivation because perceived threats to parents' immigration status if they participate in public programs have a "chilling effect" on program participation even for children and other family members who may be eligible. (109)

Another "critical and often overlooked social determinant" is climate change, which leads to food, water, and nutrient insecurity. (110)(111) Climate change is associated with increased infectious disease, natural disasters, and migration, all of which affect child growth and access to food. Climate change also influences both the quality and quantity of food being produced. (112)(113)(114) In clinical

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practice, the AAP recommends discussion of climate change during clinical visits, explaining the link between climate change and poor growth is another way that providers can empower parents/families with information to be able to advocate for themselves. Furthermore, pediatricians can help with education on disaster preparedness and can provide referrals as discussed previously herein (and in specific settings for disaster relief) for affected families for whom other social determinants are exacerbated by the effects of climate change. (110)(115)

CULTURAL CONSIDERATIONS IN TREATMENT OF GROWTH FALTERING

In our increasingly diverse societies, cultural food practices should always be considered in constructing effective nutritional evaluation and recommendations for any child with feeding difficulties and growth faltering. This is especially true for recent immigrants who are adapting from one food culture to another, sometimes in the context of constrained financial resources.

Cultural beliefs and practices influence how parents and caregivers perceive their children's weight, and this perception may influence the family's response to dietary recommendations given by health providers who may not share these perceptions. In some cultures a "chubby baby" demonstrates a family's ability to afford sufficient food for their child. (116) Other families who have experienced pervasive deprivation and seen children die of malnutrition in their home country or refugee camp may feel that a child who is able to be physically active is doing well enough overall and that the health professional's concern that the child is underweight is excessive.

Cultural variations in feeding practices influence which foods are offered and when they are introduced in an infant/toddler's diet. Food practices that may have been beneficial in their original environment can now contribute to causing nutritional deficiencies in the Western world. For example, a family coming from a sunny warm climate can be at higher risk for rickets without any diet adjustment for vitamin D in the northern hemisphere. (117)

There is also wide cultural variation in the expected emergence of feeding skills, including weaning from bottle or breast, finger feeding, and self-feeding. Some cultures are reluctant to permit self-feeding until a child can use utensils, which may impair the independent feeding expected of young children in child care and other settings in the United States.

In working with diverse families, cultural dietary practices and beliefs are important to ascertain during an evaluation, especially for groups transitioning to a new culture. In our recommendations to encourage healthy eating and weight, health professionals must be mindful to provide culturally sensitive options to prevent the parent from feeling criticized, which can further exacerbate tension around mealtime and tension between the family and the provider. It is important to acknowledge that most traditional non-Western diets (assuming that a variety of foods is available) promote health better than the typical Western diet, which is high in saturated fat, sugars, and meat and deficient in fruits, vegetables, and whole grains. The goal is not to convert parents from other cultures to a Western diet but to help them adapt their traditional practices and available and preferred foods to meet the child's current nutritional needs. WIC has developed different culturally appropriate food packages and created resources for culturally diverse families to meet children's nutritional needs and can counsel families in their adjustment to this new setting from the perspective of diet and food availability. (118)

TREATMENT AND PROGNOSIS

Globally and in the United States, as emphasized by the AAP Committee on Nutrition, optimizing nutrition and growth from the prenatal period through approximately age 2 years is considered the most critical time not only in minimizing nutrition-related mortality risks but also in optimizing long-term outcomes in stature, cognition, and noncommunicable disease. (9)(119)(120) Nutritional interventions have consequences for health outcomes and socioeconomic implications throughout the life cycle and for the next generation. (121)(122)

From a nutritional perspective, sparse data exist regarding optimal pace of recovery; generally, we aim for sustained expected velocity of weight gain for age without prescribed supplements after a child has attained weight/length or BMI in the −2 to −1 *z* score range. The goal is to help children reach their potential for linear growth, immune function, bone health, and cognitive and academic outcomes. At the same time, the clinician should remain mindful of avoiding excess weight gain while promoting healthful dietary choices to potentially ameliorate the risk of conditions such as cardiovascular disease and diabetes associated with early malnutrition. (10)(13)(123)

In infants, nutritional management starts with a lactation consult for breastfeeding infants and formula supplementation when indicated with the aim of increasing

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feeding volume if possible and then caloric density of formula or expressed human milk if needed, while keeping in mind free water requirements. In older infants, solids can also be fortified with the addition of powdered formula or oil. For toddlers and children, we focus on increasing calories using calorically dense foods such as oils, avocado, heavy cream, and peanut butter while avoiding foods with low nutritional value such as sweets and fried foods. We often recommend decreasing intake of juice and eliminating other sugar-sweetened beverages, which have minimal nutrient value and may suppress appetite. (124) When needed, supplements, including high-calorie supplemental beverages and multivitamins, can be considered to help children meet micronutrient and macronutrient needs. These supplemental beverages should be prescribed with counseling on ideal use and scheduling so that these beverages are not used in place of food and do not exacerbate feeding difficulties.

From a behavioral perspective, the treatment of feeding disorders in children is focused on parental education around structured mealtimes, which includes setting limits and boundaries, in a consistent and positive environment. This structure includes avoidance of grazing (including liquids other than water), which can suppress appetite at mealtime, and limiting mealtime to usually 20 to 30 minutes to avoid child and family stress. Feeding is more likely to progress in a consistently positive environment without force feeding (including distracting with toys or screens), which can worsen aversion in the long-term, and without caregivers becoming a "short order cook" or rewarding refusal by providing preferred foods after the food served is rejected. Common behavioral tips include letting children get messy with food for the sensory experience, encouraging self-feeding, and providing positive feedback for desired behaviors. Caregiver modeling by eating the desired foods, showing chewing if needed, and generally trying to make meals social and enjoyable is often emphasized.

Ellyn Satter's "division of responsibility" is a common (but not well-studied) approach in which parents are tasked with providing the food (or breast or bottle in the case of infants) and the child is responsible for whether to eat and how much. (125) Marshall et al (126) found that both systematic desensitization (bottom-up, play-based, modeling style) and operant conditioning (top-down, prompt-and-reward style), when combined with parent education, significantly improved dietary variety and quality and in feeding behaviors in children with ASD as well as those without medical complexity.

Without evaluation and treatment of medical factors for undernutrition, nutritional rehabilitation and feeding therapy in isolation are likely to have suboptimal outcomes. A common underlying medical problem especially in infancy is aspiration, which can usually be managed with thickening of milk or adjusting nipple flow rate and positioning. GI pathology causing discomfort, such as eosinophilic esophagitis or celiac disease, must be diagnosed and treated, and constipation management is often an important component of medical treatment. Referral to otolaryngology is appropriate if sleep apnea is a concern or if tonsillar hypertrophy is making swallowing difficult. In children with medical complexity, collaboration with other specialists is key to addressing underlying causes of increased metabolic demand and/or feeding difficulties.

Except for vitamin and mineral supplementation in case of deficits, the role of pharmacologic intervention is limited. There is no evidence for treating growth faltering with acid suppression. Cyproheptadine is relatively safe and effective in the short-term (not studied long-term) even in young children for increasing oral intake, accelerating weight gain, and improving mealtime behavior. (127)(128)(129) Its mechanism is antiserotoninergic and antihistaminergic, with the most common adverse effect of somnolence but less common adverse effects of excitation or other behavioral changes. (130) In clinical practice, we usually start with nonpharmacologic treatment, but depending on a child's progress as well as degree of impairment and family stress, cyproheptadine can be helpful in expediting weight gain as well as feeding improvements. Once improvements are underway, children and their families can more easily undertake the incremental work of continued nutritional and feeding management.

Early referral for multidisciplinary support can help reduce the severity of malnutrition and feeding difficulties and of caregiver stress and long-term developmental and educational impairments. (131)(132) Developmental and psychosocial interventions should be instituted promptly, while medical evaluation and nutritional interventions are being implemented. For severe, complicated, or persistent cases of growth faltering, multidisciplinary care has been shown to decrease caregiver stress, to improve child mealtime behaviors, and to advance caloric intake and weight gain. (133)(134) Depending on the nature of the feeding difficulty, speech and language pathologists are critical to co-manage children who aspirate, and speech and language

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pathologists, occupational therapists, and/or psychologists can be greatly helpful in working around sensory-based and behavioral difficulties and other developmental delays. Collaboration with developmental, communication, and, in children with ASD, applied behavior analysis specialists is often also key. Black et al showed that a home visiting program combined with clinical intervention for early growth faltering resulted in fewer teacher-reported internalizing problems and better work habits at age 8 years compared with children who received only medical/nutritional intervention. (135) Referral to early intervention, Head Start, and specialized services in public schools may be helpful. Social work support is extremely helpful in connecting patients and families to these supports along with addressing family stressors and resource needs.

Successful treatment of growth faltering requires more frequent extended contact than is recommended in the traditional primary care schedule, with degree of malnutrition, disordered feeding, and/or other comorbidities determining the frequency of visits. If multidisciplinary care is geographically accessible and primary care office–based interventions have not improved the child's status over several months, referral might be indicated. In more isolated settings, clinicians may consider mobilizing local early intervention, social service, and nutritional providers into an ad hoc team ideally with frequent telephone coordination. A collaborative and culturally competent approach supports opportunities for children and their families to thrive.

Summary

- By consensus, *growth faltering* is a descriptive term for below-expected weight for age, weight for length, or BMI for age or depressed rate of growth for age. (5)(13)
- Malnutrition is defined as per the World Health Organization and the American Society for Parenteral and Enteral Nutrition, with moderate malnutrition defined as a weight-for-length or BMI *z* score less than –2 and severe malnutrition with these parameters as less than –3, or by degree of weight loss or growth deceleration as described previously herein. (11)(18)
- The pathogenesis of growth faltering can be due to inadequate energy intake, inadequate absorption, excessive energy expenditure, or defective utilization of energy. (5)
- Based on expert opinion (evidence quality D), clinical evaluation starts with thorough prenatal and perinatal history and includes complete medical history, family history, nutritional and feeding history, developmental history, and social history.
- Although the optimal rate of growth for children with a history of low birthweight is not known, expert opinion and some research evidence (evidence quality C) is that they should show weight and height within normal limits on growth charts by 2 to 3 years of age without correction for gestational age. (11)
- Based primarily on consensus due to scant data (evidence quality D), targeted laboratory testing to consider depending on clinical history and severity of nutritional status includes complete blood cell count with or without iron studies, chemistry studies, celiac disease serologies, and other tests as indicated based on history and physical examination findings.
- Based on some research evidence and expert opinion (evidence quality D), food insecurity along with energy and housing insecurity, and accompanying stressors, may contribute to poor growth and poor diet. Climate change is another social determinant of which emerging awareness is becoming important. As such, clinicians should screen for underlying social determinants of health using validated tools as per American Academy of Pediatrics guidelines and know resources and programs to which to refer families, along with being informed about advocacy efforts for children. (92)
- Based on expert opinion (evidence quality D), cultural competency is essential in counseling families regarding growth, feeding and nutrition.
- Based primarily on expert opinion (evidence quality D), the goal of treatment is sustained expected velocity of weight gain for age without prescribed supplements after a child has attained weight/length or BMI in the –2 to –1 *z* score range.
- Some research evidence, including the results of a systematic review of randomized trials and retrospective studies (evidence quality B), supports cyproheptadine as a pharmacologic tool for weight gain in children. (127) (128) (129)

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- Some research evidence and expert opinion (evidence quality C) support multidisciplinary support in treatment of growth faltering. These should include 4 dimensions: medical, nutritional, developmental/behavioral, and social. (133)(134)

Acknowledgments

We thank Kerry Pearl for her review of feeding-related portions of the manuscript, Dr Mandy Brown Belfort for her e-mail correspondence regarding nutritional outcomes in preterm infants, and Dr Lucy Marcil for her correspondence regarding child growth and climate change.

References for this article can be found at http://pedsinreview.aappublications.org/content/42/11/590.

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PIR QUIZ

1. A 4-year-old boy is seen for a routine health maintenance visit. He was born large for gestational age at 34 weeks' gestation with no significant health issues as an infant. The parents are concerned because his weight measurements have gradually decreased from the 99th to the 55th percentile. Which of the following represents the best explanation for this decline in weight percentiles in this patient?

   A. Change in the growth curves being used.
   B. No longer correcting for prematurity.
   C. Normal extracellular volume loss.
   D. Regression to the mean.
   E. Social determinants of health.

2. You are seeing a 15-month-old child new to your practice. The family immigrated to the United States in January 2020. The family describes challenges with food and housing since arriving in the United States. The medical student who evaluated the patient noted that the child's head growth has been consistent on the 3rd percentile and wondered if the family qualifies for the Special Supplemental Nutrition Program for Women, Infants, and Children program. You explain to the medical student that the growth effects of malnutrition typically lead to decreased growth parameters in which of the following sequences?

   A. Head circumference, then weight, and then height.
   B. Height, then head circumference, and then weight.
   C. Height, then weight, and then head circumference.
   D. Weight, then head circumference, and then height.
   E. Weight, then height, and then head circumference.

3. You are beginning the evaluation of a 4-year-old child whose weight *z* score is less than –2 on the Centers for Disease Control and Prevention (CDC) reference charts. The third-year medical student in your clinic asks what you would do first to assess this child. Which of the following represents your best next step in the approach to this patient?

   A. Admit the child to the hospital for observation of weight gain.
   B. Contact child protective services for possible neglect.
   C. Obtain a sleep study.
   D. Obtain a video fluoroscopic swallow study.
   E. Provide nutritional counseling and support.

4. A single, working, first-time mother wants to continue breastfeeding her 7-month-old infant. Despite early success and ongoing lactation support, the infant's weight has trended downward across 2 major percentile curves (growth faltering) since the mother returned to work 3 months ago. Collaborating with the mother, you develop a plan to address this problem. This plan would start with which of the following next steps?

   A. Start low-dose acid suppression therapy.
   B. Supplement breastfeeding to increase caloric density of feedings.
   C. Supplement breastfeeding with fatty foods.
   D. Supplement breastfeeding with formula to increase volume of feedings.
   E. Supplement breastfeeding with high-calorie juices.

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5. A 9-year-old child with trisomy 21 and autism has a diet with severely limited food choices. He does not choke, gag, or cough when he eats or drinks things he likes. He has had a normal clinical feeding evaluation. The parents are seeking advice on where to start with changing these behaviors. Which of the following represents your recommended first step in this process?

   A. Allow the child to eat throughout the day between meals.
   B. Begin meal session times of at least 60 minutes.
   C. Have the child eat alone until his variety of food choices improves.
   D. Model preferred eating behaviors as a family group.
   E. Obtain a video fluoroscopic swallow study for possible aspiration.

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Pediatrics in Review 2021;42;590
DOI: 10.1542/pir.2020-001883

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