

# Failure to Thrive: A Practical Guide

GRETCHEN J. HOMAN, MD, *University of Kansas School of Medicine, Wichita, Kansas*

Children with very low weight for age or height and those who do not maintain an appropriate growth pattern may have failure to thrive (FTT), also known as weight faltering. If confirmed by repeated valid measurements, FTT should prompt a search for causes of undernutrition, including neglect, family food insecurity, and underlying medical conditions. Inadequate caloric intake is the most common cause of FTT, but inadequate nutrient absorption or increased metabolism is also possible. Difficulty attaining or maintaining appropriate weight is the first indication of FTT, and sustained undernutrition can impede appropriate height, head circumference, and the development of cognitive skills or immune function in extreme cases. Early identification and management of the issues causing undernutrition are critical. In most cases, an appropriate growth velocity can be established with outpatient management based on proper nutrition and family support. Primary care physicians can effectively treat most children with FTT, and subspecialist consultation or hospitalization is rarely indicated. (*Am Fam Physician*. 2016;94(4):295-299. Copyright © 2016 American Academy of Family Physicians.)



More online  
at <http://www.aafp.org/afp>.

**CME** This clinical content conforms to AAFP criteria for continuing medical education (CME). See CME Quiz Questions on page 270.

Author disclosure: No relevant financial affiliations.

► **Patient information:** A handout on this topic, written by the author of this article, is available at <http://www.aafp.org/afp/2016/0815/p295-s1.html>.

**F**ailure to thrive (FTT) is an abnormal pattern of weight gain defined by the lack of sufficient usable nutrition and documented by inadequate weight gain over time. The decrease in the velocity of weight gain results in the child steadily falling off the expected weight curve on growth charts.<sup>1-3</sup> The term weight faltering has been proposed to more appropriately emphasize that problems with appropriate weight gain are the initial and most reliable clinical finding of undernutrition. The term weight faltering is also perceived to be less negative or alarming, and less potentially critical of parents or caretakers.<sup>2,4,5</sup>

Although problems achieving or sustaining appropriate weight are the predominant manifestations of FTT, ongoing severe malnutrition impairs overall growth, impacting weight first, then length and head circumference. In extreme cases, the development of cognitive skills and appropriate immune function can be impaired, resulting in failure to achieve developmental milestones and normal health.<sup>2,5,6</sup>

## Diagnosis

The term FTT should be used as a clinical finding and not as a diagnosis.<sup>4,7</sup> Recognition depends on reliable and valid measurements over time; therefore, serial measurements of weight and height must be accurately obtained and charted on an appropriate reference scale (growth chart).<sup>4-6,8,9</sup> The

World Health Organization (WHO) growth charts are recommended for patients up to two years of age (<http://www.who.int/childgrowth>).<sup>10-13</sup> The Centers for Disease Control and Prevention (CDC) growth charts are recommended for patients two to 20 years of age (<http://www.cdc.gov/growthcharts>).<sup>11,12</sup> Specialized growth charts can be used in addition to these standard charts for supplemental data collection in children born prematurely or with specific diagnoses, such as Turner syndrome or trisomy 21.<sup>13,14</sup>

Although there is no consensus on the definition of childhood FTT, the term is often used for infants and children with weight below the 5th percentile for sex and corrected age.<sup>15</sup> Supporting definitions include weight for length below the 5th percentile; body mass index for age below the 5th percentile<sup>3</sup>; or a sustained decrease in growth velocity, in which weight for age or weight for length/height falls by two major percentiles (percentile markers 95, 90, 75, 50, 25, 10, and 5) over time.<sup>15</sup>

The prevalence of FTT depends on the population studied and recognition criteria used. In the United States, FTT may occur in up to 10% of children in primary care and in approximately 5% of children who are hospitalized.<sup>4,15</sup> The rate of detection depends on the vigilance of individual physicians.<sup>16</sup>

## Etiology

The most common cause of FTT is inadequate caloric intake. Other causes are

**Table 1. Potential Causes of Failure to Thrive**

Inadequate caloric intake	Inadequate nutrient absorption	Increased metabolism
Gastroesophageal reflux	Anemia, iron deficiency	Chronic infection (e.g., human immunodeficiency virus infection, AIDS, tuberculosis)
Inadequate breast milk supply or ineffective latching	Biliary atresia	Chronic lung disease of prematurity
Incorrect formula preparation	Celiac disease	Congenital heart disease
Mechanical feeding difficulties (e.g., cleft lip or palate)	Chronic gastrointestinal conditions (e.g., irritable bowel syndrome), infections	Hyperthyroidism
Neglect or abuse	Cystic fibrosis	Inflammatory conditions (e.g., asthma, inflammatory bowel disease)
Poor feeding habits	Inborn errors of metabolism	Malignancy
Poor oral neuromotor coordination	Milk protein allergy	Renal failure
Toxin-induced gastrointestinal upset (e.g., elevated lead levels leading to anorexia, constipation, or abdominal pain)	Pancreatic cholestatic conditions	

inadequate nutrient absorption, increased energy requirements (metabolic demands), or a combination of mechanisms. Specific causes of FTT are listed in *Table 1*. Risk factors for FTT are traditionally classified as psychosocial or medical (*Table 2*<sup>5</sup>), although FTT is commonly caused by multiple complex factors resulting in inadequate caloric intake. The prevalence of various causes of FTT may differ based on the patient's age and the underlying cause.

### Diagnostic Evaluation

FTT can be confirmed based on a detailed history, physical examination, and growth parameters documented over time. Targeted laboratory and other diagnostic testing should be performed when there is reasonable suspicion of a specific underlying condition.

### HISTORY

The key elements of the history include a nutritional evaluation and medical, family, and social histories (*Table 3*). The nutritional evaluation requires obtaining information about caloric intake and overall nutritional quality from the caregivers who feed the patient. Food diaries can help quantify intake and identify dysfunctional mealtimes, grazing habits, lack of a routine or schedule, distractions during feeding, and inappropriate caretaker responses to the child's feeding behaviors.<sup>13,17,18</sup> A common problem in toddlers is excessive intake of nutrition-poor liquids, such as "fruit" juice that is predominantly flavored sugar water, that produce satiety before nutritious foods can be consumed.<sup>19</sup>

A brief developmental evaluation using any standard validated questionnaire helps to identify patients with potential developmental abnormalities contributing to FTT. Abnormal development may be an early indicator of an underlying medical condition, such as a neuromuscular disorder or a psychosocial problem, such as neglect, that can contribute to or exacerbate FTT. Also, children with FTT have a higher incidence of developmental delay.<sup>20</sup> The assessment provides a baseline for ongoing

monitoring of development that may be impacted by severe nutritional compromise. One example of a free tool for monitoring development is the Rourke Baby Record from Canada (available at <http://www.rourkebabyrecord.ca>).<sup>21</sup>

### PHYSICAL EXAMINATION

The goals of the physical examination are identification of any chronic or acute illness, recognition of dysmorphism suggesting a genetic condition, assessment for normal development, and quantification of the degree of undernutrition. *Table 4* includes key physical

**Table 2. Risk Factors for Failure to Thrive**

#### Medical conditions

Congenital anomalies (e.g., cerebral palsy, autism, trisomy 21)  
 Developmental delay  
 Gastroesophageal reflux  
 Low birth weight (< 2,500 g [5 lb, 8 oz])\*  
 Poor oral health, dental caries  
 Prematurity (< 37 weeks' gestation)  
 Tongue-tie (controversial)

#### Psychosocial (family) issues

Disordered feeding techniques  
 Family stressors  
 Parental or family history of intimate partner abuse or violence (perpetrator or victim)  
 Poor parenting skills  
 Postpartum depression  
 Poverty†  
 Social isolation of a caretaker  
 Substance abuse  
 Unusual health and nutritional beliefs (e.g., restricted diets)

\*—Low birth weight is a major predictor of need for future referral for failure to thrive.<sup>5</sup>

†—Poverty is the most significant psychosocial risk factor.<sup>5</sup>

Information from reference 5.

**Table 3. Significant History Components in the Assessment of Failure to Thrive**

<i>Component</i>	<i>Examples</i>
<b>Feeding history</b>	
Environment	Regular feeding routine at home and day care
Family eating patterns	Cultural or religious food restrictions; immigrant families may be unfamiliar with the nutritional quality of local foods
Preparation of food	Formula mixing technique, frequency of feedings, use of baby foods and table foods
Resources	Use of Women, Infants, and Children program, social workers, and home health visits; access to food supplies
<b>Personal medical history</b>	
Medical conditions	Atopy,* food allergies,† gastroesophageal reflux, urinary tract infections, renal tubular acidosis
Prematurity	—
Surgeries	—
<b>Family medical history</b>	
Gastrointestinal conditions	Celiac disease, inflammatory bowel disease, cystic fibrosis
Parental childhood nutrition	Parental malnourishment
Parental height, parental age at puberty	Genetic short stature, constitutional growth delay
Psychiatric illness, substance abuse	Affecting caretaker function
<b>Social history</b>	
Living conditions	Safety and comfort, ability of parents to provide appropriate nutrition
Parent-child relationship	Poor parenting skills, lack of attachment
Primary caregivers	Parents, family members, foster family
Stressors	Financial and emotional support for child and family
<b>Review of systems</b>	
Illness (respiratory infections, gastroenteritis, fevers, fussiness or irritability), recurrent illness,‡ travel	Emergency department and office visits, hospitalizations, parasite exposure, exposure to endemic illnesses (e.g., tuberculosis)

\*—Atopic dermatitis in children may be triggered by a food allergy. An undiagnosed allergy with continued allergen exposure may contribute to failure to thrive.

†—Inappropriately restrictive diets for food allergies can contribute to failure to thrive and malnutrition.

‡—Malnourished children are at risk of immune compromise, specifically cell-mediated immunity and impaired complement and secretory immunoglobulin A production.

examination findings in children with FTT. Underlying medical problems need to be appropriately treated. The physical condition of the child and any comorbid conditions determine the subsequent steps in management.

#### DIAGNOSTIC TESTING

No standard set of laboratory tests is recommended for FTT. A thorough history and physical examination may be all that is indicated to initiate treatment.<sup>5,22</sup> If used, reasonable initial laboratory testing includes complete blood count, urinalysis, electrolyte measurement,

thyroid tests, and testing for celiac disease. Specific testing for cystic fibrosis, food allergies, human immunodeficiency virus infection, or tuberculosis may be indicated depending on the presentation. Additional testing should be specific for a suspected diagnosis based on history and physical examination findings.

#### Treatment

The goal of treatment is to establish optimal growth velocity while supporting the family in the plan of care. Prolonged malnutrition can negatively impact growth potential and cognitive development.<sup>1,2</sup> Early intervention that results in corrected growth parameters is believed to lead to positive developmental outcomes, but further studies are needed.<sup>2,16</sup> Primary care physicians can treat most patients with FTT in the outpatient setting. If usual treatment is insufficient, support from additional health care professionals, such as a dietitian, social worker, dentist, or lactation specialist, may be helpful.

Attention to several specific health factors is needed to ensure overall treatment success. Dental caries should be treated. Sleep disorders or problems should be identified and addressed because poor sleep can contribute to poor activity and behavior, and subsequently poor nutrition.<sup>23</sup> Parents of children who are being treated for FTT should be counseled on sick care management and the importance of encouraging a regular balanced diet. Home nursing visits can complement clinic evaluations, especially for families who have difficulty with transportation or getting time off of work. Families with problems obtaining nutritious foods (food insecurity) should be provided

with social work support or other community resources, such as the Women, Infants, and Children program.

Pharmacotherapy, such as cyproheptadine or megestrol (Megace), has been studied and may be helpful for specific populations with significant underlying diseases (e.g., cystic fibrosis, chronic renal disease) or in patients undergoing cancer treatment.<sup>24-26</sup> However, appetite stimulants are not recommended for most patients with FTT.

Catch-up growth will occur when the child gains at two to three times the average rate per age<sup>5</sup> (eTable A). eTable B shows one method for calculating catch-up

## SORT: KEY RECOMMENDATIONS FOR PRACTICE

<i>Clinical recommendation</i>	<i>Evidence rating</i>	<i>References</i>	<i>Comments</i>
Valid weight measurements over time, rather than at a single point, are required for the recognition of failure to thrive.	C	4-6, 8, 9	—
World Health Organization growth charts are recommended for children up to two years of age. Centers for Disease Control and Prevention growth charts are recommended for patients two to 20 years of age.	C	10-12	Specialized growth charts can be used in addition to the standard charts for supplemental data collection in children born prematurely or with specific diagnoses, such as Turner syndrome or trisomy 21.
Routine laboratory testing and hospitalization are rarely indicated in the assessment of failure to thrive.	C	5, 22, 27	Testing should generally be targeted at specific underlying diagnoses that are suspected.

*A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <http://www.aafp.org/afpsort>.*

calorie needs. For infants, an evaluation of breastfeeding and lactation or an adjustment in formula concentration is indicated if inadequate caloric intake is responsible for FTT. *eTable C* shows formula recipes for increasing calories. Without performing complicated calculations, most infants will tolerate increasing formula concentration from 19 to 24 kcal per oz. Caregivers of toddlers and older children should be counseled on nutrient-rich, healthy food choices, ideally provided in three meals and three snacks per day.<sup>5</sup>

Follow-up visits ranging from weekly to every few months are used to document weight, and the plan should be adjusted as the child progresses. These frequent visits provide opportunities to ensure that immunizations are up to date to support the child's immune system. Infants need more frequent follow-up than older children. Daily weight checks at home or in the office are discouraged. Weight change is better averaged over intervals of a few days to weeks until normal growth velocity is achieved. When weight checks occur over a short interval (e.g., during a hospital stay) they should occur on the same scale and at the same time of day, before feedings and with consistent dress. When weight is checked in the office, a routinely calibrated scale and consistent technique should be used.

Hospitalization is rarely indicated<sup>5,22,27</sup> but can facilitate subspecialist involvement and provide observed structured feeding evaluations. *Table 5* includes indications for hospitalization. Hospitalization should be considered if the child is at severe health risk. Hospitalization or subspecialist referral should be considered if intensive outpatient treatment is ineffective after three to four months, or sooner for newborns.<sup>3</sup> Children with complex medical, developmental, and social problems may show weight gain in the hospital setting because of the support of the

highly trained multidisciplinary medical staff. Weight gain in the hospital does not necessarily confirm inadequate feeding or care by the family as the cause of FTT. Successful hospitalization requires careful integration of the child's usual caretakers in the patient's care and discharge planning.

Accelerated growth must be maintained for four to nine months to resolve FTT and achieve appropriate weight for height. Weight for height measurements above the 10th percentile with normal weight gain on two evaluations at least one month apart are reassuring for successful treatment.<sup>5</sup> Relapses are possible, and continued observation is needed after successful completion of the frequent visit schedule. The risk of relapse is increased if the underlying etiology is not adequately addressed. Once FTT is resolved, patients require standard well visits with emphasis on monitoring for nutrition and growth.<sup>9,16</sup>

### Prevention

Routine health surveillance visits in early childhood give primary care physicians opportunities to counsel and

**Table 4. Examination Findings in Children with Failure to Thrive**

<i>Finding</i>	<i>Potential underlying causes</i>
Dysmorphic appearance	Genetic abnormality, undiagnosed syndrome
Edema	Renal, liver disease
Hair color/texture change	Zinc deficiency
Heart murmur	Anatomic cardiac defect
Hepatomegaly	Infection, chronic illness, malnutrition
Mental status change	Cerebral palsy, poor social bonding
Poor parent-child interaction	Depression, social stress
Rash, skin changes, bruising	Human immunodeficiency virus infection, cow's milk allergy, abuse
Respiratory compromise	Cystic fibrosis
Wasting	Cerebral palsy, cancer

**Table 5. Indications for Hospitalization in Children with Failure to Thrive**

Extreme parental impairment or anxiety  
 Extremely poor parent-child interaction  
 Need for precise documentation of nutritional intake  
 Outpatient treatment failure  
 Psychosocial factors that put the child's safety at risk  
 Serious underlying illness or medical problem  
 Severe malnutrition or dehydration

educate families on nutrition. Risk factors for FTT can also be identified and addressed. The American Academy of Pediatrics' Bright Futures series has helpful nutrition information for children in different age groups.<sup>28</sup>

**Data Sources:** A PubMed search was completed using the key terms pediatric failure to thrive and pediatric weight faltering. The search included meta analyses, reviews, randomized controlled trials, and clinical trials. Additional searches included UpToDate, Essential Evidence Plus, the Cochrane database, and evidence-based guidelines from the National Guideline Clearinghouse, American Academy of Pediatrics, and Centers for Disease Control and Prevention. Search dates: July and December 2015.

The author thanks Drs. Anne Walling, Brian M. Pate, Kari Harris, and Deborah Kroeker for their review and helpful comments during the preparation of the manuscript.

NOTE: This review updates a previous article on this topic by Cole and Lanham.<sup>3</sup>

## The Author

GRETCHEN J. HOMAN, MD, is a board-certified pediatrician and an assistant professor at the University of Kansas School of Medicine in Wichita.

Address correspondence to Gretchen J. Homan, MD, University of Kansas Medical Center, 620 N. Carriage Parkway, Wichita, KS 67208 (e-mail: ghoman@kumc.edu). Reprints are not available from the author.

## REFERENCES

- Mackner LM, Starr RH Jr, Black MM. The cumulative effect of neglect and failure to thrive on cognitive functioning. *Child Abuse Negl.* 1997; 21(7):691-700.
- Emond AM, Blair PS, Emmett PM, Drewett RF. Weight faltering in infancy and IQ levels at 8 years in the Avon Longitudinal Study of Parents and Children. *Pediatrics.* 2007;120(4):e1051-e1058.
- Cole SZ, Lanham JS. Failure to thrive: an update. *Am Fam Physician.* 2011;83(7):829-834.
- Olsen EM. Failure to thrive: still a problem of definition. *Clin Pediatr (Phila).* 2006;45(1):1-6.
- Failure to thrive. In: *Pediatric Nutrition: Policy of the American Academy of Pediatrics.* 7th ed. Elk Grove Village, Ill.: American Academy of Pediatrics; 2014:663-700.
- Raynor P, Rudolf MC. Anthropometric indices of failure to thrive. *Arch Dis Child.* 2000;82(5):364-365.
- Rybak A. Organic and nonorganic feeding disorders. *Ann Nutr Metab.* 2015;66(suppl 5):16-22.
- Olsen EM, Petersen J, Skovgaard AM, Weile B, Jørgensen T, Wright CM. Failure to thrive: the prevalence and concurrence of anthropometric criteria in a general infant population. *Arch Dis Child.* 2007;92(2):109-114.
- Committee on Practice and Ambulatory Medicine, Bright Futures Periodicity Schedule Workgroup. 2016 Recommendations for preventive pediatric health care. *Pediatrics.* 2016;137(1):1-3.
- Wojnarowska B, Palczewska I, Oblacińska A. WHO child growth standards for children 0-5 years. [in Polish]. *Med Wieku Rozwoj.* 2012;16(3): 232-239.
- Meyers A, Joyce K, Coleman SM, et al.; Children's HealthWatch. Health of children classified as underweight by CDC reference but normal by WHO standard. *Pediatrics.* 2013;131(6):e1780-e1787.
- Grummer-Strawn LM, Reinold C, Krebs NF; Centers for Disease Control and Prevention. Use of World Health Organization and CDC growth charts for children aged 0-59 months in the United States [published correction appears in *MMWR Recomm Rep.* 2010;59(36):1184]. *MMWR Recomm Rep.* 2010;59(RR-9):1-15.
- Graber E, Rapaport R. Growth and growth disorders in children and adolescents. *Pediatr Ann.* 2012;41(4):e1-e9.
- Zemel BS, Pipan M, Stallings VA, et al. Growth charts for children with Down syndrome in the United States. *Pediatrics.* 2015;136(5): e1204-e1211.
- Yoo SD, Hwang EH, Lee YJ, Park JH. Clinical characteristics of failure to thrive in infant and toddler: organic vs. nonorganic. *Pediatr Gastroenterol Hepatol Nutr.* 2013;16(4):261-268.
- Black MM, Dubowitz H, Krishnakumar A, Starr RH Jr. Early intervention and recovery among children with failure to thrive: follow-up at age 8. *Pediatrics.* 2007;120(1):59-69.
- Levy Y, Levy A, Zangen T, et al. Diagnostic clues for identification of nonorganic vs organic causes of food refusal and poor feeding. *J Pediatr Gastroenterol Nutr.* 2009;48(3):355-362.
- Kerzner B, Milano K, MacLean WC Jr, Berall G, Stuart S, Chatoor I. A practical approach to classifying and managing feeding difficulties. *Pediatrics.* 2015;135(2):344-353.
- Smith MM, Lifshitz F. Excess fruit juice consumption as a contributing factor in nonorganic failure to thrive. *Pediatrics.* 1994;93(3):438-443.
- Prutsky GJ, Olivera EB, Bittar K. When developmental delay and failure to thrive are not psychosocial. *Hosp Pediatr.* 2016;6(1):47-49.
- Riverin B, Li P, Rourke L, Leduc D, Rourke J. Rourke Baby Record 2014: Evidence-based tool for the health of infants and children from birth to age 5. *Can Fam Physician.* 2015;61(11):949-955.
- Shields B, Wacogne I, Wright CM. Weight faltering and failure to thrive in infancy and early childhood. *BMJ.* 2012;345:e5931.
- Katz ES, Mitchell RB, D'Ambrosio CM. Obstructive sleep apnea in infants. *Am J Respir Crit Care Med.* 2012;185(8):805-816.
- Smith CS, Logomarsino JV. Using megestrol acetate to ameliorate protein-energy wasting in chronic kidney disease. *J Ren Care.* 2016; 42(1):53-59.
- Homnick DN, Marks JH, Hare KL, Bonnema SK. Long-term trial of cyproheptadine as an appetite stimulant in cystic fibrosis. *Pediatr Pulmonol.* 2005;40(3):251-256.
- Couluris M, Mayer JL, Freyer DR, Sandler E, Xu P, Krischer JP. The effect of cyproheptadine hydrochloride (Periactin) and megestrol acetate (Megace) on weight in children with cancer/treatment-related cachexia. *J Pediatr Hematol Oncol.* 2008;30(11):791-797.
- Cincinnati Children's Hospital Medical Center. Best evidence statement. Failure to thrive treatment protocol. June 11, 2009. <http://www.cincinnatichildrens.org/WorkArea/DownloadAsset.aspx?id=88059>. Accessed March 14, 2016.
- American Academy of Pediatrics. Bright futures. <http://www.brightfutures.org>. Accessed July 2015.

**eTable A. Normal Median Weight Gain in Children**

Age (months)	Median weight gain (grams per day)
0 to 3	26 to 31
3 to 6	17 to 18
6 to 9	12 to 13
9 to 12	9
12 and older	7 to 9

Information from Malks-Jumba L. Failure to thrive. The University of British Columbia. Learn pediatrics. February 2011. <http://learn.pediatrics.ubc.ca/body-systems/gastrointestinal/failure-to-thrive/>. Accessed April 20, 2016.

**eTable B. Dietary Reference Intake for Young Children**

Age	Kcal per kg per day
0 to 6 months	108
6 to 12 months	98
1 to 3 years	102

NOTE: DRI is a population-based reference but can be used to estimate the RDA for general purposes. Catch-up caloric requirements can be calculated using the DRI from the above chart to estimate the RDA: Kcal per kg per day required for catch-up = DRI for age (kcal per kg per day) × ideal weight for height (ideal weight for height is the median weight [at the 50th percentile] that corresponds to the actual height as read on the growth chart).

Example: A 10-month-old boy with failure to thrive has a weight of 7 kg and height of 72 cm. Looking at a growth chart for boys 0 to 24 months of age, a height of 72 cm corresponds to the 50th percentile for height for a 9-month-old boy. Using this result of 9 months, the target ideal weight can be determined by finding the corresponding weight for a 9-month-old boy at the 50th percentile, which is about 8.8 kg (in other words, 8.8 kg is the 50th percentile for weight for a 9-month-old boy, whose 50th percentile for height happens to be 72 cm). To calculate the catch-up caloric requirements, use the result of 8.8 kg (the target ideal weight) multiplied by the DRI for age (see chart above). In this case: 8.8 kg × 98 kcal per kg per day = 862 kcal per day.

DRI = dietary reference intake; RDA = recommended dietary allowance.

Information from Food and Agriculture Organization of the United Nations. Energy requirements of infants from birth to 12 months. <http://www.fao.org/docrep/007/y5686e/y5686e05.htm>. Accessed April 26, 2016.

**eTable C. Formula Recipes for Increasing Calories in Infants with Failure to Thrive**

Calories (kcal) per oz	Water (oz)	Scoops of formula powder	Final volume (oz)
19 (per standard product instructions)	4	2	4½
20 (per standard product instructions)	4	2	4½
22	3.5	2	4
24	5	3	5.5
26	3	2	3.5
27	7	5	8

NOTE: Standard formula generates 19 or 20 kcal per oz depending on the brand formulation; some companies produce the 19 kcal formula because it is thought to more closely resemble the calorie concentration of breast milk. The recipes in this table use standard formula and yield a higher concentration of calories by mixing relatively more powder with less water. Water should be added to the bottle first, followed by the powdered formula using an unpacked, level scoop. Only the scoop that was included with the formula should be used.

Information from University of Michigan. Formula adjustment (standard formula). <https://www.med.umich.edu/1libr/pa/FormulaAdjustmentstandard.pdf>. Accessed April 26, 2016.