The etiology of infantile failure to thrive in the US is extremely diverse. Causes range from naive or malevolent parents; cost of formula for low-income families; mothers inexperienced with breast-feeding; and a range of organic causes.

Many experts categorize failure-to-thrive (FTT) as either organic or non-organic. Recognizing the initial stages of FTT is challenging, but becomes readily apparent over weeks of infant office visits by observing basic vital signs and growth curves.

However, many insurance companies and Medicaid EPSDT only allow these in the first week of life and then again at 2 months of age. I am afraid this means we are going to miss some serious cases of FTT (and newborn jaundice). We should probably ensure the healthy newborn who is breast- or bottle-fed is gaining weight steadily by incorporating a second office visit or a nurse visit at 10 to 14 days of life — regardless of insurance coverage or how payments are capped.

**CASE 1**

The 2-month-old, healthy female had a birth weight of 6 lb, 10 oz as a twin gestation. Her antenatal course, labor and delivery, and newborn hospital course were uncomplicated. She had been feeding 2 to 3 oz of standard milk-based formula every 2 to 3 hours with a weight gain of 16 oz over the previous 21 days. At this visit, her physical examination was entirely normal.

At 3 months old, the patient presented with a chief complaint of constipation noted by small, hard round stools. The mother reported the child was bottle feeding about 4 oz every 3 hours, plus the mother reported adding some rice cereal to most of her bottles. But the child had gained only 8 oz in 1 month. The patient’s head circumference and length were on the appropriate growth curves, and her vital signs and overall examination were normal except for her mild malnourished appearance and loss of subcutaneous body fat. The infant also was very cranky, even while feeding.

I decided to evaluate her apparent FTT more thoroughly. The initial laboratory evaluation revealed that her CBC was normal except for her leukocyte count, which was elevated at 17,500 cells/mm³. This prompted me to perform even more tests to exclude a possible infectious source of her FTT. She had a normal urinalysis with a specific gravity (SG) of 1.010 and no ketones. Her urine culture by catheterization was negative. Her chest radiograph was negative. Her

**Figure 1. Crying 6-week-old infant with FTT; note his very thin extremities. Note the absence of subcutaneous fat and overlapping skin in his thighs and knees (arrows).**

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serum chemistries, ESR, pulse oximeter were normal. A sweat chloride performed a few days later was also normal. My office had arranged a home health nursing agency visit for the family to provide any feeding suggestions or report any unknown hazardous family issues.

During the office visit, I observed the baby feeding and noticed it took her nearly 10 minutes to ingest 1 oz of formula. In my experience, the average newborn at this age will scarf down about 6 oz in 10 minutes. What was going on here? The child was not lethargic, sweaty, tachycardic, or tachypneic.

CASE 2

During his first visit at 13 days old, a healthy male’s birth weight was 8 lb, 7 oz, with a normal antenatal course, and labor and delivery by cesarean section. Without any problems noted on history or physical examination, the patient was feeding 3 oz of formula every 2 to 3 hours. His mother was college-educated and had already raised two healthy children.

By 21 days old, the child had developed nightly, 4-hour long colic spells, and wanted to be held constantly. He had gained 6 oz in 8 days, yet he had not been spitting up his standard milk-based formula. The child was diagnosed with silent gastroesophageal reflux syndrome. Lansoprazole (15 mg twice daily) was started and he was switched to a protein hydrolysate formula.

When he returned for his 6-week check-up, the mother reported that the child had been sleeping all the time, was constantly fussy when awake, and was even sleeping through many feedings. She also observed many choking and gagging spells along with loose stools, although he never seemed to spit up. Further history revealed that he was feeding every 2 hours, but the feedings lasted from 20 to 60 minutes, and he ate only 2 to 4 oz at most.

On physical examination, the child was quite fussy; his anterior fontanelle was normal and not sunken. His vital signs were normal, except that he had only gained 5 oz in 24 days and his length was unchanged from 3 weeks prior. The patient looked malnourished, with loss of most subcutaneous body fat (see Figure 1, page 182). His physical examination was normal otherwise, except that I noted a new 2/6 systolic ejection murmur over the upper left sternal border that radiated throughout his entire precordium and into his upper back. The patient’s dorsalis pedis pulses were quite brisk as well.

I decided to initiate at least a minimal evaluation for his new onset FTT and new heart murmur, having learned from my previous patient a few months earlier. His urinalysis was negative with an SG 1.005 and no ketones. His chest radiograph was normal. I referred him for an echocardiogram in the next few days as well.

What additional simple test did I perform here to clinch the diagnosis? Read on to find out.

DISCUSSION: MATERNAL “NIPPLE CONFUSION”

Case 1

The 3-and-a-half-month-old infant returned 4 days later for follow-up with a weight gain of 11 oz. She looked more content and smiling, seemed to have more subcutaneous fat, and looked much more aware of her mother and surroundings. Her repeat leukocyte count was normal at this visit.

While in the office at her visit 4 days earlier, I had examined her bottle carefully. On a hunch, I turned it upside down to evaluate the flow of milk. Wow, was it slow in dripping! I asked the mother about the nipple size of this bottle, and she declared it was still the infant “number 1” nipple. As it had been quite a while since I had a newborn in my household, I inquired whether there were other nipple sizes available. “Of course,” she replied, but added that she had yet to dig them up, since the baby seemed to be feeding fine, albeit very slowly. Subsequent office visits after the nipple size was increased demonstrated that the infant thrived well, growing from her initial <5 percentile to nearly 50th percentile over the next year.
Case 2

For this case of FTT, I was particularly curious after my earlier case. I asked the mother for her son’s bottle and turned it upside down to determine the flow. It was barely dripping. I unscrewed the nipple and noted it was a “number 2” nipple (see Figures 2 and 3, page 183). So I asked her to advance to the “number 3” nipple instead. I would continue the lansoprazole and the protein hydrolysate formula at least for the next week.

When he returned for follow-up in 1 week, he was much happier, more alert, with more noticeable subcutaneous fat, and his diarrhea had subsided. The mother noticed that, with the use of a number 3 nipple, he was now feeding 5 oz in 5 to 10 minutes.

Incidentally, his heart murmurs were diagnosed as mild pulmonary stenosis and small patent ductus arteriosus (which subsequently disappeared as expected by age 4 months). I discontinued his lansoprazole and his protein hydrolysate formula.

When he returned at 10 weeks old, he was feeding 7 to 8 oz in 10 minutes at about 4 hour intervals. His fussiness and colic spells had disappeared. He had gained 24 oz in 21 days. His body fat continued to fill in, he was much more interactive, and his examination was normal except for the systolic murmur localized to his upper left sternal border only. His PDA murmur had resolved.

BOTTLE NIPPLE SIZES

I have learned that most new infant bottles have three different nipple hole sizes ranging from 1 to 3 levels. I subsequently checked the unimpeded flow of milk from each nipple size for one popular brand (Figure 2): size 1 flows at 5 cc per minute (1 oz in 6 minutes); size 2 at 10 cc per minute (2 oz in 6 minutes); and size 3 at 20 cc per minute (4 oz in 6 minutes). For the bottles I checked, no instructions were given as to when to advance the nipple size, or even that there was a reason to advance the nipple size. The nipple size is barely discernable on the rim of the nipples as well. (See Figure 3, page 183.)

Interestingly, neither of these two patients showed any obvious signs of dehydration, such as sunken anterior fontanelle, dry mucus membranes, high urine specific gravity, or ketones in the urine analysis. The only notable physical findings were the significant loss of subcutaneous fat, the irritability, and the lack of interest in surrounding environment. The notable symptoms were the extreme sleepiness, irritability when awake even while feeding, and change in bowel patterns — either constipated or, surprisingly, diarrhea (the colicky symptoms in Case 2 were probably unrelated). These symptoms are often so subtle and gradual that many parents (like ours) may miss them.

Upon inquiry, I have also recently noted that most of the young mothers (including my own daughter with her 2-week-old infant this month) intuitively switch up to larger hole sizes when they notice that their babies are either not satisfied with the current amount being fed, or as the duration of feedings lengthens with minimal increase of volume ingested. But it is hazardous to assume all mothers will have this intuition. Bottle manufacturers should be required to provide more explicit instructions as to when to advance nipple sizes and to provide clearly marked nipple sizes.

FTT ROUTINE EVALUATION

The following cardinal rule regarding infant weight gain is essential for all practitioners to know: most newborns gain an average of an ounce a day from the first week of life until about 4 months of age. Once the clinician observes a distinct pattern of 5% to 10% weight loss without explanation (like gastroenteritis), or a pattern of minimal weight growth over several weeks, the workup for infant FTT should probably proceed.

For a more elaborate discussion of the workup for infant FTT, I will refer the reader to any standard textbook on this topic (eg, Nelson's Textbook of Pediatrics). For the most part, the initial workup of otherwise healthy newborns with FTT is fairly simple. One should inquire about breastfeeding or type of formula, regurgitation, duration and amount and frequency of feedings, diaphoresis or labored breathing while feeding, diarrhea/loose stool frequency, cough, etc. One must also inquire as to medication history and in particular the use of any herbals or “organic” supplements.

On examination of the infant with failure to thrive, first observe the baby’s ease of feeding and the maternal interaction for both breast-fed and bottle-fed infants. A full set of vital signs including length, head circumference, respirations, pulse and temperature are needed. A complete physical examination with particular attention to general neurological status, skin, heart, lungs and abdomen is necessary. For laboratory evaluation, I suggest starting with pulse oximetry; urine analysis with culture; blood work including complete metabolic panel and complete blood count; and often a chest radiograph (for pulmonary findings and cardiac findings).

Before the first FTT visit is concluded however, it may be important to assess the bottle nipple size and its flow, especially if rice cereal is being added for thickened feedings. Advance the infant to the largest nipple size available (usually “number 3”). Extra nipple slits may be needed if rice cereal is being used to treat gastroesophageal reflux disease.