INFANT NUTRITION: CONDITIONS AND INTERVENTIONS
CHAPTER 9
NUTD238

FALL 2017-2018

Children with Special Health Care Needs- Category of services for infants, children, and adolescents with or at risk for physical or developmental disability, or with a chronic medical condition caused by or associated with genetic/metabolic disorders, birth defects, prematurity, trauma, infection, or perinatal exposure to drugs

Infants at risk

- LBW <2.5kg at birth
- Very LBW <1.5kg at birth
- Extremely LBW <1kg at birth

- The outcomes of infants who survive preterm birth include:
  - 31% rate of disability for those with very LBW
  - 60% rate of disability for those with extremely LBW

- Infants with genetic disorders, malformations, or birth complications are much more likely to have chronic conditions, with increased need for medical, nutritional, &educational services later

Energy and nutrient needs

- Energy needs are same as requirement for healthy infants
  - *Specific nutrients* may be adjusted based on condition

- Nutrition needs are not known for every condition- *many recommendations are based on the best judgement under presenting circumstances*

Energy

- Use of DRI not RDA
- Caloric needs may be the **same, less, or more** than the DRI for infants (570kcal/day)
  - *Most commonly- needs are higher*
- Estimated E needs can change with medications, health conditions, and growth

Extra calories are needed in circumstance including

- Infection
- Fever
- Difficulty breathing
- Temperature regulation
- Recovery from surgery and complications

- **Preterm infants <34wks: have higher E needs-AAP: 120kcal/kg**
  - **The amount of calories needed to gain 15g/d is recommended**

- VLBW, ELBW: **needs are high** but might be hard to meet- they are weak
  - Recovering infant: may **increase** intake up to 180kcal/kg/d

- Down Syndrome: **lower E needs,** *lower muscle tone and lower activity level->* higher food intake would mean more wt and less ability to move and crawl

Protein requirements

- May be **equal to, less than, or higher than** needs of other infants
- DRI: 1.5g/kg if condition present does not affect growth or digestion

- *Protein recommendation is sufficient if total caloric intake is high enough to meet E needs*
  - ***Protein sparing?***

- Slow head growth (indicator of brain growth) is a sign of inadequate protein intake in preterm infants

- *Conditions that would slow growth may require higher protein levels than the DRI*
  - Recovery from surgery or LBW: 3.0-3.5g/kg
  - ELBW: 4g/kg- safe with adequate fluid intake and no kidney problems

- *Lower protein recommendation are unusual in infancy*
  - Infants with lower muscle activity due to smaller muscle size need lower protein- e.g., Down Syndrome

Form of protein

- Many conditions associated with preterm birth and illness stress the liver and reduce its ability to function (produce enzymes)- *cause changes in protein and fat digestion*

- Single aa or hydrolyzed proteins (short chain) may be required
  - E.g., PKU

Fats

- Recommendation: up to 55% of calories from fat
- Fat is more difficult to absorb for infants with VLBW, ELBW- need for pancreatic and liver enzymes

- MCT: do not require bile for absorption- MCT oil could be provided for adequate fat intake
- LA, ALA- provided in BM, human- milk fortifier, or special formulas
- *Study findings: improved cognitive development for LBW infants provided DHA and ALA in human milk, was found when the infants were tested at 6 months of age*

Vitamins and minerals

- Requirement is affected by health conditions esp those involving digestion
  - Medications may increase turnover of certain vitamins
- Supplements are usually prescribed for sick or recovering infants
- Hypocalcemia may occur with many conditions-Ca supplements are required

- Human milk fortifiers- *boost calorie, vitamin, and mineral intake: added to BM*- given in certain conditions esp if volume of feeding is low
  - Vit A, D, C, Ca, P, Na, Cl

- Some formulas are concentrated to meet needs of premature infant
  - Supplemented with extra Zn, Ca, P, Cu

Growth

- **First goal of nutritional care:** maintain growth for age and gender

- **Steady** increase in wt and ht-> adequate growth even if gains are not at the typical rate

- Sufficient calories and nutrients usually lead to good growth but not always
  - → Slow growth may be a symptom of an underlying condition rather than a sign of inadequate nutrition *e.g., infants with genetic forms of kidney disease may be short even if adequate intake is consumed*

Adjustments in the usual methods and interpretation of growth are needed in conditions known to influence growth and development which include:

- Using growth charts for specific diagnoses rather than standard growth charts e.g., Down syndrome charts
- Noting indicators of body composition e.g., taking body-fat measurement- *can be used to signify that caloric intake is not limiting growth because fat stores are adequate*
- Considering medications that change weight gain, appetite, or body composition- side effects of medications can explain rapid changes in weight

Growth in preterm infants

- CDC growth charts can be used to assess growth of preterm infants with BW>2.5kg
- Body composition differences in preterm and term infants?
- VLBW and ELBW are not represented by standard growth charts- specific growth charts
- All preterm growth charts show that **HC is a main indicator of growth** approaching that in term infants- both wt and length lag at discharge even when 40wk gestational age is reached

Correction for gestational age

- **Gestation-adjusted age:** 40- gestational age at birth
- Divide resulting # of wks by 4
- Result in months is subtracted from the infant's current age
  - If an infant was born at 30wks gestation, she is 10 weeks early→equals 2.5 months preterm
  - When she is 3 months old-> her adjusted age is 2 wks or 0.5 mos- *this age should be used in plotting her growth on the GC to assess her development*

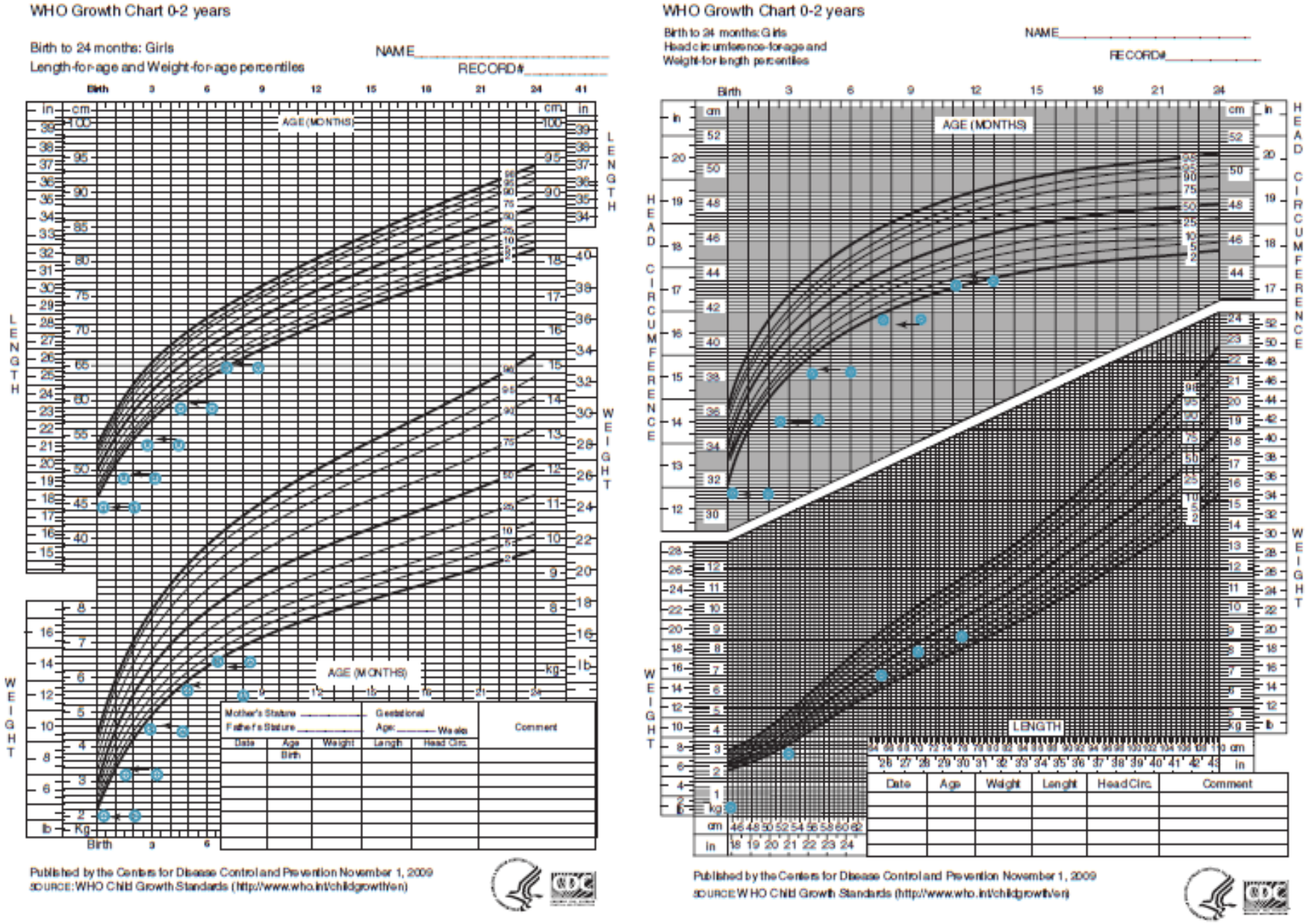


ILLUSTRATION 9.2 ▸ WHO growth charts showing chronological and corrected age measurements of a girl born at 32 week gestation.

This girl may be smaller than her peers at two years of age, but is currently achieving appropriate growth at a corrected age of 7 months.

Does intrauterine (IU) growth predict growth outside?

- Possible

- Many factors during and after pregnancy are known to affect growth rate which include:
  - IU environment- adequacy of the placenta in delivering nutrients; the presence of toxins such as viruses, alcohol, or maternal medications; or the depletion of a needed substance, such as folic acid
  - Fetal-origin errors in cell migration or formation of organs, whether or not a cause is known
  - Unknown factors that cause preterm birth, such as environmental toxins/air pollution

- If the IU insult was early in gestation (e.g, exposure to alcohol or drugs)→Birth wt, length, and head size are affected- the abnormal fetal growth pattern may persist despite adequate medical and nutrition support after birth

- Later exposure in the 2nd or early part of the 3rd trimester may result in preservation of head size and body length, but low BW

- IU growth may not predict growth for some infants whose **birth (delivery)** removes them from adverse exposure within the IU environment e.g., maternal uncontrolled diabetes, smoking, or PKU

- ***The earlier the exposure to the toxin, the worse the effects on later growth***

- *Evidence: what happens in early life during critical periods can have lifetime consequences "fetal programming" hypothesis*

CATCH UP TIME NEEDED

- The amount of time needed for catch-up growth for premature infants differs based on gestational age at birth and subsequent complications

- Clinical conventions are to provide **1 yr for catch-up growth for infants born 32 weeks or later, and 3 years for catch-up growth for VLBW or ELBW infants**

- Catch-up growth after LBW is usually encouraged, but rapid growth in infancy may be raising risks for later chronic conditions, such as CVD and diabetes if the rate of weight gain is excessive

Interpretation of growth

- Discharge after preterm birth- based on a pattern of weight gain, such as 20–30g/day

- Growth is monitored as a sign of improving health in small and sick infants- however, complications make this difficult to achieve

Nutrition for infants with special health care needs

Table 9.1 Nutrition concerns in infants with special health care needs

Growth	Slow rate of weight gain Fast rate of weight gain Slow rate of gain in length Disproportionate rate of weight to height gain Unusual growth pattern with plateau in weight or length gain Altered body composition that decreases or increases muscle size or activity Altered brain size that decreases or increases muscle size or activity Altered size of organs or skeleton, such as an enlarged liver or shortened leg length
Nutritional Adequacy	Calorie needs are higher or lower Nutrient requirements higher or lower overall Specific nutrients, such as protein or sodium, are required in higher or lower amounts Vitamins, minerals, or cofactors (such as carnitine) are required in higher or lower amounts
Feeding	Disruption of the delivery of nutrients as a result of: • Structure or functioning of the mouth or oral cavity • Structure or functioning of the gastrointestinal tract, including diarrhea, vomiting, and constipation • Appetite suppression by constipation or medications • Disrupted interaction of the infant with the parent, such as infant cues being so subtle that parent responses are delayed • Posture or position that promotes or interferes during meal times • Timing of nursing, meals, and snacks throughout the day • Inappropriate food choices or methods of preparation • Interruptions in adequate shelter for feeding and sleeping • Instructions unclear or too complicated for the parent to follow

Nutrition risks to development

- Infants who are small or sick near birth may have major growing and feeding problems

- Many health conditions can change the rate of infant development- **developmental delays- *can include fine motor, cognitive, communication, social or emotional development***

- *Nutrition- related symptoms that reflect slow development:*
  - Slower growth than is expected for age
  - Having difficulties in feeding- e.g., refusing food from spoon by 8 months

- Concerns regarding growth and feeding are sufficient to request evaluation for eligibility of intervention
  - → Infant fits category of child with health care needs- family can benefit from nutritional, medical and developmental interventions without requiring a specific diagnosis

- Example: Down syndrome nutrition concerns:
  - Feeding difficulties related to weak muscles in face
  - High risk of overweight and constipation
    - They love to suck- easy to overfeed
    - Slower development of movement- lower PA
  - Heart and intestinal conditions more common in this case- nutritional needs may increase if surgery is required

- Developmental delays in infancy do not lead to developmental disabilities in all cases
  - Catch up can occur at a later stage
- After infancy the term developmental delay may be replaced with a more specific type of medical or developmental diagnosis

Severe preterm birth and nutrition

- VLBW: ~1.5kg; gestational age from 28-32wks
  - Requires intensive care
  - High nutritional needs during infancy
- ELBW: <1.5kg; gestational age 23-28wks
  - Delayed development is a common outcome

- **Initial problem after birth-** *newborn cannot nurse like a full term infant*
  - **Main goal:** provide sufficient calories and nutrients to meet needs: nutrition support start with PN then EN
  - Metabolism is high- if sufficient calories are not provided, infants will use fat stores and protein in tissues and muscles to meet glucose needs

- Most require respiratory support to breathe

How sick babies are fed

- VLBW, ELBW
  - Vulnerable to problems related to the GIT- this affects how nutrients are provided and composition of the diet
    - E.g., infection of GIT may lead to increased illness- change method of feeding
    - Blood loss from intestine (necrotizing enterocolitis- inflammation or damage to section of intestine): replace oral feeding with PN

- Conditions such as GER, constipation or vomiting- may interfere with infant feeding however, EN is not stopped→it stimulates intestine

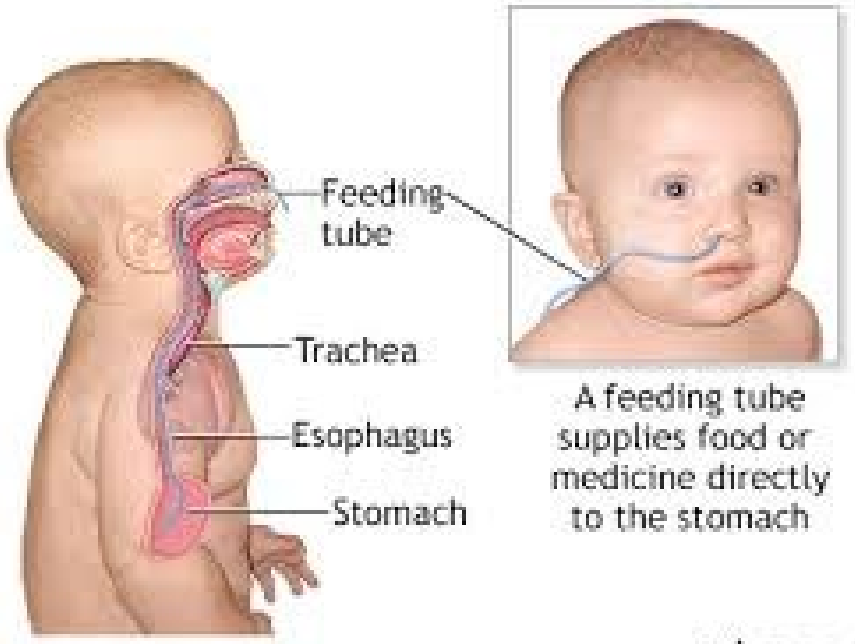
- *Feeding methods are selected based on the length of time before it is expected the baby can nurse or feed without help*

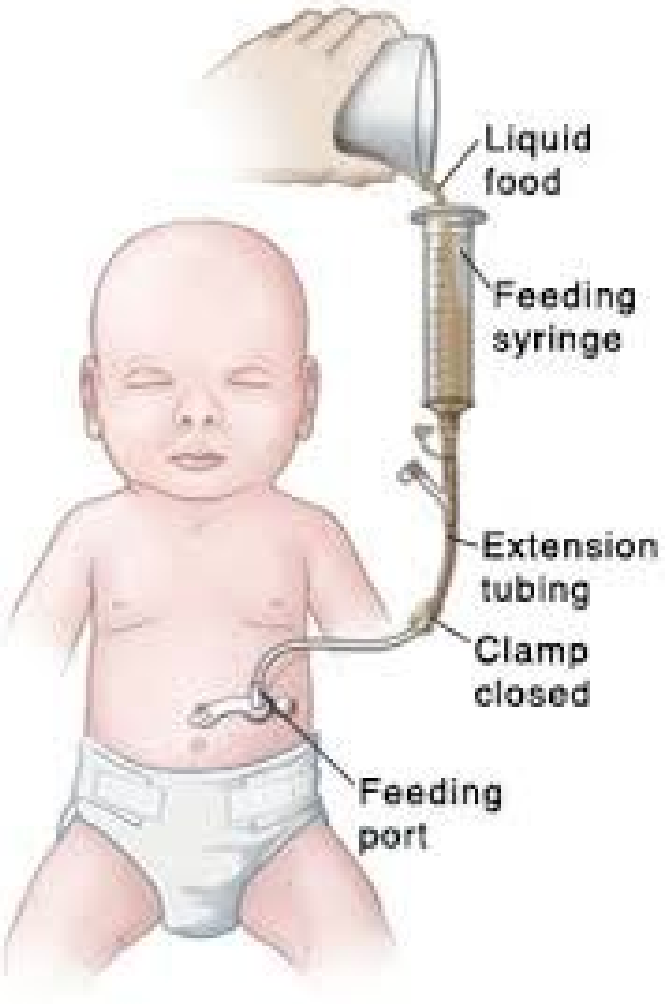
Enteral nutrition support types

- **Gavage feeding**: slow feedings sent from the mouth or nose into the stomach though a tube
  - Oral-gastric (OG): tube placement from mouth to stomach
  - Transpyloric feeding (TP): tube from nose or mouth into upper part of the intestine

- *These two methods are used when nutrition support is expected to be needed for several months:*
  1. **Gastrostomy feeding:** tube placement directly into the stomach, bypassing the mouth through a surgical procedure that creates an opening through the abdominal wall and stomach

  2. **Jejunostomy feeding:** tube placement directly into the upper part of the small intestine


Feeding tube
Trachea
Esophagus
Stomach
A feeding tube supplies food or medicine directly to the stomach
A.D.A.M.


Liquid food
Feeding syringe
Extension tubing
Clamp closed
Feeding port

Food safety

- Preterm infant- immature immunological systems- prone to infection

- **Challenges:**
  - Feeding is slower
  - Formula or BM are at room temp for a longer time
  - Feeding equipment contamination increases with time

→ Hospital policies require change of feeding often- e.g., every 4hrs

What to feed preterm infants

- **BM is the recommended source**
  - Pumped and frozen for use
  - Staff training to encourage BM pumping
  - Infants are generally able to nurse at 37wks- *prior to that they may benefit from being put to the breast to stimulate non-nutritive sucking*

- *BM is contraindicated when it contains:*
  - Harmful medications
  - Street drugs
  - Viruses or other infective agents
  - Or when the infant has a specific type of GIT malformation or inborn errors of metabolism

- BM may be insufficient in nutrients (depending on infant health and weight status)→ unless supplemented by HM fortifier and/or other sources of calories, such as ***MCT oil***

- If not fed modified BM or nursed, the infant's source of nutrition may be cow's milk- or soybean-based formulas
  - Formula for preterm infants is available- higher in calories and nutrients than full-term formula

TABLE 9.2 Selected nutrients in term, premature post-discharge and premature infant formulas per 100 ml

NUTRIENT	TERM 20 CAL/OZ	POST DISCHARGE 22 CAL/OZ	PREMATURE 24 CAL/OZ
Energy, kcal	68	74	80
Protein, g	1.4	2.1	2.7
Vitamin A, IU	203	330	1014
Vitamin D, IU	51	52	122
Vitamin E, IU	1.0	3.0	3.3
Thiamin, mcg	68	148	203
Riboflavin, mcg	101	148	503
Niacin, mcg	710	1480	4058
Vitamin B_6, mcg	41	74	203
Vitamin B_{12}, mcg	0.17	0.22	0.45
Vitamin C, mg	6.1	11.8	30
Folic acid, mcg	10.1	19.2	30
Calcium, mg	53	89	146
Phosphorus, mg	28	49	81
Magnesium, mg	4.1	5.9	9.7
Iron, mg	1.2	1.33	1.46
Zinc, mg	0.5	0.9	1.2

Preterm infants and feeding

- *Preterm infants may be hard to feed for reasons including:*
  - Fatigue: low levels of arousal of weak infants may lessen feeding duration
  - Low tolerance of volume: abdominal distention due to feeding may result in changes in breathing and HR, so that the infant stops feeding
  - "Disorganized feeding" may result from the infant having experienced unpleasant reactions to feedings

Table 9.3 Preterm and term infant feeding differences

Preterm Infant	Term Infant
Central nervous system does not signal hunger	Signals hunger; has supportive newborn feeding reflexes
Unstable feeding position, such as a forward head position	Stable and facilitating feeding position from newborn reflexes
Oral hypersensitivity	Readily accepts food by mouth

- Most recovering infants improve in their feeding ability with time
- Reflexes that associate feeding with pleasure reemerge
- Interaction of infants and feeder improves

Feeding problems

- Infants who are difficult to feed are at risk for failure to thrive (FTT), child abuse, and neglect
- Preterm infants who were VLBW or ELBW need infant feeding guidelines based on their adjusted gestational age e.g., *recommendation for adding food on a spoon at 6 months would be adjusted to 8 months for an infant who was born at 32 weeks of gestation*
- The emphasis on weight gain and catch-up growth can mistakenly result in overfeeding and signs of GI discomfort, such as spitting up

Table 9.5 Signs of feeding problems in high-risk infants

In Early Infancy (Under 6 Months of Age)

- Baby has a weak suck and cannot make a seal on the nipple; breast milk or formula runs out of the mouth on whatever side is lower, with obvious fatigue after a few minutes of sucking.
- Baby appears to be hungry all the time due to low volume consumed per feeding, and/or time between feedings does not appear to increase from one month to the next.
- Extended feeding times are seen, with the baby napping during the feeding despite efforts to keep the baby interested in the feeding.
- The mother is not sure that the baby is swallowing, although she is appearing to suck.

In Later Infancy (Over 6 Months of Age)

- The baby cannot maintain good head control while being fed from a spoon.
- The baby resists spoon-feeding by not opening her mouth when food is offered.
- The baby drinks from a bottle but does not accept baby foods after repeated attempts.
- The baby resists anything in the mouth except a bottle, breast, nipple, or pacifier.
- The baby does not explore the mouth with fingers or try to mouth toys.
- The baby resists lumpy and textured foods; she may turn her face away or push food away.
- The baby does not give signs to the parents that clearly indicate hunger or fullness.

Nutrition interventions

- Assess growth more frequently or in more depth- e.g., measure body fat stores to identify a change in rate of wt or length gain
- Monitor the infant's intake of all food and liquid by a diet analysis→ document amount of calories and nutrients consumed
- Change the frequency or volume of feedings as needed to meet calorie and nutrient needs
- Change diet composition to improve nutrient density→ to meet energy and nutrient needs

- Assess infant's feeding position and support as needed

- Provide parent education or support services as needed→ for a positive and low stress feeding environment
  - Observe interaction of the infant with the caregiver

Table 9.6 Examples of infant formula for special needs

Condition	Example of Special Infant Formula
Pulmonary problems such as bronchopulmonary dysplasia or cardiac defect	Breast milk or standard infant formula with polycose and MCT oil to provide 28 cal/fl oz (high calories in a low volume)
Phenylketonuria (genetic disorder of protein metabolism)	Mixture of amino acids, carbohydrates, fats, vitamins, and minerals without the amino acid phenylalanine
Maple syrup urine disease (genetic disorder of protein metabolism)	Mixture of amino acids, carbohydrates, fats, vitamins, and minerals without the amino acids leucine, isoleucine, and valine
VLBW infant who required surgery after Necrotizing enterocolitis	Mixture of amino acids, carbohydrates, fats, vitamins, and minerals
Gastroesophageal reflux and swallowing problem	Standard infant formula with baby rice cereal (increased thickness is to lower risk of choking and vomiting)
Chronic renal failure (hereditary kidney disease)	Concentrated natural protein, fats, and carbohydrates providing 40 cal/fl oz