

Breastfeeding: The Basics and Beyond

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Objectives

- Discuss regulation of milk production and storage capacity.
- Review the basics of breastfeeding including positioning and attachment at the breast.
- Examine alternative feeding methods for the breastfeeding infant.
- Discuss clinical challenges of breastfeeding and potential solutions.
- Discuss the immunologic benefits of breastfeeding.
- Discuss new areas of research looking at long term benefits of breastfeeding.

Role of Hormones in Breastfeeding

Prolactin

- Released from anterior pituitary gland
- Levels are high in pregnancy
- Helps women respond to stresses of perinatal period
- Direct stimulation of the nipple causes hypothalamus to signal the anterior pituitary to release prolactin

Prolactin, cont'd.

- Binds to receptor sites on the alveoli.
- Stimulates the alveoli (milk-producing cells) to secrete milk.
- Frequent early breast stimulation in the first 2 weeks post partum may increase the sensitivity of receptors to prolactin.
- Surges of prolactin every time baby goes to breast for first ~2 months. After that time, large amounts of milk may be produced with minimal prolactin.

Oxytocin

- Causes uterine contractions and labor
- CRITICAL in breastmilk production
- Released from the posterior pituitary
- Released with nipple stimulation but may also be released by visual, auditory, or psychological stimuli
- Released in surges lasting about 1-2 minutes
- Also causes the cells surrounding alveoli in the breast to contract causing milk “let down” (milk ejection reflex or MER)

Oxytocin and the GI Hormones

- Stimulates the release of GI hormones (insulin, CCK, somatostatin, and gastrin) in both mother and baby.
- GI hormones stimulate intestinal villi, increasing surface area for absorption of nutrients in both mother and baby.
- CCK also helps regulate caloric intake by inducing satiety, post-feeding sedation, and sleep.

Obesity Theory

- Obesity in bottle fed infants historically blamed on overfeeding
- Research suggests there may be other physiologic factors at work

DARLING Study

- Breastmilk only during first yr were lighter than formula fed infants with similar length and OFC
- Energy intake of breastfed infants lower than formula fed infants
 - Even after introduction of solids
- Authors suggest this is a function of self-regulation in breastfed infants

Grummer-Strawn, et al

- Duration of BF (up to 2 years of age) showed a dose-response, protective relationship regarding being overweight at age 4
- Those BF >1 yr had a 51% reduction in risk for overweight than those never BF
- No protection against being overweight among those BF for <3 months
- ? BF infants tend to adapt more readily to new foods such as vegetables which may influence future food choices

Von Kries, et al.

- Exclusive BF for 3-5 months associated with 35% reduction in obesity at age 5-6 yrs
- Not accounted for by other lifestyle factors
- Evidence for a programming effect of BF in preventing obesity later in life

Gilman, et al.

- Infants fed breastmilk more than formula or BF for longer periods
- Lower risk of being overweight during older childhood and adolescence

***Regulation of Milk
Production and Storage
Capacity***

Rate of Milk Synthesis

- Myth: Most milk is made during let down
- Fact: Milk secretion is continuous. Let down releases milk that is already made and stored

Rate of Milk Synthesis

- Rate is related to the degree of breast “emptiness”
- Milk retained in the breast regulates total supply
- Flow adjusts to maintain a ~20% average residual
 - If baby takes more than 80%, supply increases to maintain the 80:20 ratio
 - If baby takes less than 80%, supply decreases to maintain the 80:20 ratio

Feedback Inhibitor of Lactation (FIL)

- Signals the breast to make milk faster or slower
- Ice machine analogy
- If milk is not removed, breasts become engorged, resulting in decreased blood flow, decreased prolactin and oxytocin to the cells, and decreased production
- Rate ranges from 10-60 mL/hour per breast

Breast Storage Capacity

- Varies greatly; ranges from 80-600 mL.
- Women with small storage capacity are capable of secreting as much milk over a 24 hour period as women with large storage capacity. They just need to feed or pump more frequently.
- With a singleton, storage should not be an issue.
- May become an issue with multiples.

Lactogenesis

- Lactogenesis Stage I
 - Occurs by mid-pregnancy
 - High levels of progesterone and estrogen hold secretion of milk in check
- Lactogenesis Stage II
 - Decrease in progesterone and delivering the placenta are the triggers for copious milk secretion to begin
 - Estrogen drops
 - Oxytocin and prolactin receptors sensitized
 - Secretion begins in earnest about 36 hours after birth
 - 30-50 mL on day 1; 500 mL by day 3-5
- Lactogenesis Stage III
 - Ongoing milk production

Delay of Lactogenesis Stage II

- Maternal pain meds, C-section
- Primiparity
- Prolonged second stage of labor (>1 h)
- Delivery of infant >8 pounds
- Obesity; diabetes



Initiating Breastfeeding to Promote Success

Role of Early Feedings in Success

Hours to successful breastfeeding	Baby put to breast within 1 h of delivery	Baby put to breast after 1 h from delivery
Mother given no analgesia or given < 1 h before birth (less uptake by infant)	6.4 hours	49.7 hours
Analgesia given >1 h before birth	50.3 hours	62.5 hours

Re-evaluating Hospital Routines

- Make breastfeeding part of the birth experience
- Most healthy, term babies nurse within 1-1.5 hours
- Sucking reflex peaks within first few hours of life; reflex appears to be less acute if this time is missed
- Baby placed skin to skin will crawl to breast and often self latch

Feeding Patterns—First 24 Hours

- Born with extra fluid and fat stores (don't need as much to eat).
- Encourage feedings every few hours
- Supplement in first 24 hours only for medical indication such as hypoglycemia, preterm birth, or mother separated due to maternal illness
- Normal intake of $\frac{1}{2}$ tsp colostrum per feeding
- Normal output of 1 wet diaper and 1 mec stool

Feeding Patterns 24-72 Hours

- By 24 hours of age, expect baby to wake on own and look for the breast
- Encourage 8 feedings per day until weight gain established
- On day 2, normal intake is 1 tsp colostrum/feeding
- On day 2, normal output is 2 wet diapers and 2+ mec stools

Positioning and Attachment at the Breast

Common Features in All Positions

- Baby's chest, abdomen, and both knees are facing and touching mother's body.
- Baby is tucked in close
- Head is facing forward, slightly extended (not arched or turned)
- Baby's ear, shoulder, and hips are in a straight line
- Cup breast with thumb parallel to baby's upper lip and fingers parallel to lower lip.
 - "Sandwich analogy."

Cradle Hold

- Position of Mother
 - Mother's same-side forearm as the breast supports the baby's back with hand cupping baby's bottom (in the crook of her elbow)
 - Pillow under elbow
- Position for Baby
 - Lying on side facing mother (tummy to tummy)
 - Body at breast level
 - Head in crook of mother's arm at elbow
 - Nose opposite nipple prior to attachment

Cross-Cradle Hold

- Position of Mother
 - Same as cradle hold except her opposite-side arm as the breast encircles the baby
 - Arm goes through legs, up, back, and hold's baby's head
- Position of Baby
 - Baby's head held snugly in mother's hand with base of head grasped by mother's thumb and forefinger
 - Mother's palm supporting baby's upper back
 - Pillows underneath baby to bring baby up to breast level

Football Hold or Clutch Hold

- Position of Mother
 - Same side arm encircles baby
- Position of Baby
 - Body under mother's arm with legs flexed at hips
 - Head held snugly in mother's hand with base of head grasped by mother's thumb and forefinger
 - Mother's palm supporting baby's upper back
 - Avoid flexing baby's head as this can interfere with feeding and breathing

Getting the Baby Latched

- Touch baby's lip gently with the tip of nipple
- Back baby off with his nose opposite nipple so that jaw is lower than nipple (allows mouth to take in bigger portion of breast rather than just the nipple)
- Wait until baby's mouth opens very wide like a yawn
- Quickly pull baby in close with the arm holding him
- Lips are flanged and centered over areola
- Nose is close and chin touches breast (lead to the breast with the chin)

Assessment of Latch

- Look
- Listen
- Feel

Assessment of Latch

- Look:
 - Nipple completely disappears into mouth
 - Areola (if visible) is centered
 - Nose touching breast
 - Lips flanged ($\sim 120^\circ$)
 - No cheek dimpling
 - Suck becomes rhythmic
 - Chin close
 - Cheeks full and rounded (not sucked in or collapsed)

Assessment of Latch

- Listen
 - Quiet drawing sound
 - Swallowing
 - No clicking (indicates poor suction which could be due to cleft palate, notch in palate, or high arch)
 - Breaths occurring regularly (usually after every swallow or at least every 3rd suck)

Assessment of Latch

- Feel
 - Ask mother what it feels like
 - Should be a deep, firm pull without pain
 - If she is not sure, try gently letting baby's head come away from the breast. Nipple will NOT slip out of mouth if baby is well-attached

***Alternative Feeding
Methods for Breastfeeding
Infants***

Nipple Shields

- Medela makes 3 sizes (16, 20, 24 mm diameter)
- Uses:
 - In cases of latch difficulties where methods to latch have not worked (inverted or short nipples, engorged breasts, baby with a disorganized suck)
 - To protect very damaged nipples during breastfeeding.
 - When a baby is refusing breast due to previous bottle use
 - Preterm infants

Tube & Syringe Feeding at Breast

- Using a syringe and tubing, drip milk into baby's mouth while he is at the breast
- Could be used for a baby who is not feeding well
- Could also be used to provide additional kcal if a baby is latching well but needs more kcal
- Supplemental Nursing Systems (SNS)

Finger Feeding

- Use largest finger to encourage baby to open mouth wide
- Mechanics of feeding are more similar to breastfeeding than bottle feeding
- Use syringe and tubing to provide breastmilk or formula while baby sucks on finger

Cup Feeding

- Infant “laps” breastmilk from a small medicine cup
- Pros: Eliminates nipple confusion
- Cons: Mechanics are not like breastfeeding

Clinical Breastfeeding Challenges

Hyperbilirubinemia in the Term Infant

- Bilirubin results from breakdown of unneeded RBCs.
- The extra Hgb combines with biliverdin in the reticuloendothelial system to produce bilirubin.
- Indirect or unconjugated bili (fat soluble) is transported to liver where it is converted to direct or conjugated bili (water soluble) with glucuronyl transferase.
- D. bili is excreted via bile into the intestines and is passed out through the stool or reabsorbed into the system and recycled.

Physiologic Jaundice in the Newborn

- Reabsorption into circulation can be substantial in the newborn.
 - Gut initially sterile
 - B-glucuronidase activity is high which unconjugates the bilirubin
- High levels of indirect (unconjugated) bilirubin are toxic to tissue, particularly the brain.
- Direct (conjugated) bilirubin does NOT cross the blood brain barrier.

Characteristics & Management

- Affects up to 50% of term newborns.
- Starts on Day 2, peaks days 3-5, then drops.
- Do NOT interrupt breastfeeding. Do NOT supplement with formula for this reason only.
- Typical hyperbilirubinemia is not a BF problem, it is due to excessive RBC breakdown.
- Monitor and assess breastfeeding.
- Treatment may include phototherapy.

“Breastfeeding Jaundice” (aka: “Lack of BF Jaundice”)

- Caused by ineffective milk removal, infrequent feeding, and/or insufficient milk supply.
- Poor feeding leads to infrequent stooling leading to recirculation and reabsorption of bilirubin
- 6-25% of breastfed babies have exaggerated jaundice.
- May be difficult to differentiate between physiologic jaundice.
- May be physiologic in origin combined with lack of kcal.
- Early onset (day 2-3); Early peak (day 4-5)

Management

- Prevention (assessment and assistance with BF)
- Do NOT interrupt BF
- Increase feeding frequency
- Supplement with expressed breastmilk or formula if excessive weight loss
- Possible phototherapy
- Consider formula feeding if levels remain elevated
- Tx of jaundice without correcting BF is not enough

“Breastmilk Jaundice”

- Very uncommon (1:200 BF infants); cause unknown.
- Milk or a substance in milk which enhances intestinal reabsorption of indirect (unconjugated) bilirubin.
- Later onset (day 5-10), late peak (Day 10-15).
- Infant may remain jaundiced for many weeks.
- Infant is otherwise healthy and feeding well.
- Conjugate and unconjugate very fast which may be why there isn't a problem with unconjugated bili crossing the BBB leading to brain damage.

Management

- If the bili is not dropping, the AAP recommends taking the baby off breastmilk and use formula for 24 hours.
- The bili tends to rebound a little when breastmilk is resumed but it does not go as high.
- Just the interruption of breastmilk use seems to help.

Sore Nipples

Possible causes

- Incorrect attachment and positioning
- Flat/inverted nipples
- Disorganized or dysfunctional suck
- Ankyloglossia (“tongue tied”)
- Dermatitis in mother
- Infection (S aureus or candida)

Treatment

- Prevention
- Lanolin creams/ointments
- Ultra thin silicone nipple shield
- Water or glycerin based moist wound pads
- Rx antibacterial, antifungal, or steroidal ointments

Engorgement

Possible Causes

- Not emptying the breast (too few feeds, poor latch)
- Previous breast augmentation or reduction
- The pressure causes cytokines in milk to leak into the surrounding tissue and induce inflammation

Treatment

- Prevention
- Hot packs, shower, or “breast bath” before feeds
- Hand expression or breast pump
- Pump after feed (not too long; can increase production)
- Ice packs or heat after feeds
- Tylenol/Ibuprofen prn
- Snug, non-restrictive breast support

Mastitis

- Inflammation of breast (+/- infection)
 - Incidence 2-50% of BF women
 - Most common 2-3 wks PP (75% in first 12 wks)
- Treatment
 - Continue breastfeeding / pumping!!
 - Ensure breast is regularly “emptied”
 - Moist hot packs before feeds
 - Ice packs after feeds
 - Analgesics (Ibuprofen)
 - Abx for infectious type

Breast and Oral Thrush

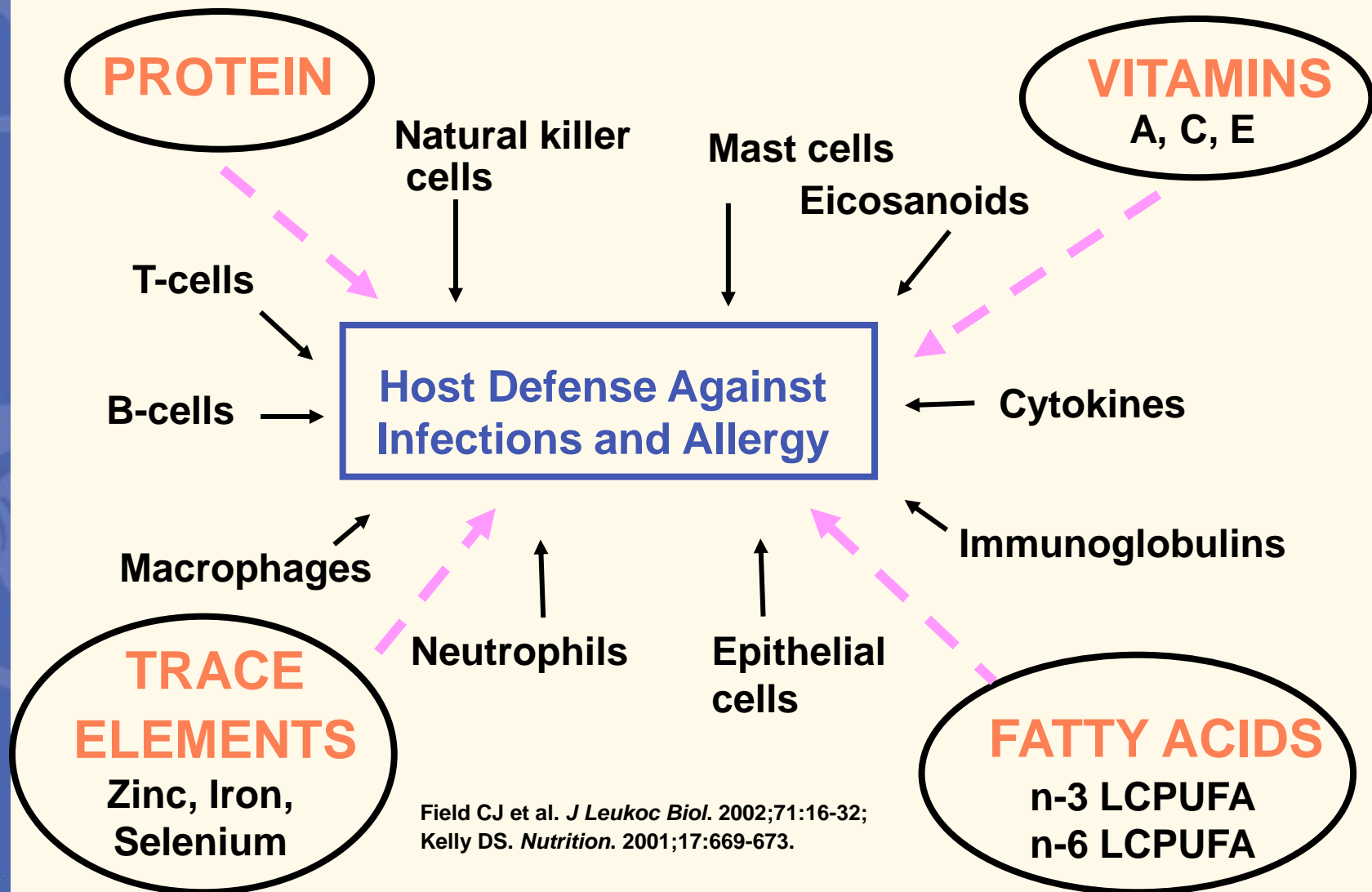
- Candida vs staph infection
- Symptoms
 - Extremely painful nipples with little obvious cause
 - Burning or shooting pains throughout the breast
 - Pain both during and between feeds
 - Rarely see white patches on the breast
 - Infant will usually have yeast diaper rash or oral thrush
- Treatment
 - OTC anti-fungal medications
 - Needs re-eval if no improvement in 5-7 d
 - Swab nipple/areola and baby's mouth with 0.5-1% Gentian Violet qd for 3 days for resistant cases
 - Treat infant regardless of symptoms if mom has yeast.

Plugged Ducts

- Breast inflammation common when mother returns to work or when baby sleeps through the night.
- Symptoms
 - Tenderness w/possible redness & possible defined lump
 - No fever, no extreme illness
 - Possible small white blister on end of nipple
- Treatment
 - Increase feeds and “empty” breasts regularly
 - Heat packs before feeds
 - Firm massage to area before and during feeds
 - No antibiotics

Immunologic Benefits of Breastfeeding

The Role of Nutrients in Supporting the Immune System



Protective Aspects of Breastfeeding

- “Every time a baby breastfeeds, he is immunized.”
- Babies who BF utilize immunizations better than those who are formula fed.
- Most significant against bacterial infections, infections of the gut (NEC), and respiratory infections.
- BF decreases risk of RSV and if they do get RSV there are fewer hospitalizations

Immune Response

The Breastmilk Army

Secretory IgA (Synthesized and stored in the breast)

- Secretory component keeps the baby's gut from digesting the IgA antibody
- Binds to pathogens preventing attachment to infant's cells
- Protects the gut mucosa
- Prepares the gut for future feeds

Leukocytes

- Primarily macrophages and neutrophils
- Phagocytosis of microbial pathogens

Nonspecific factors with antimicrobial effects

- Lysozyme (inhibits bacterial growth by disrupting cell wall)
- Lactoferrin (limits bacterial growth by removing essential Fe)
- Nucleotides (enhance immune function in infants)

“Is this the whole story, or are there effects that reach beyond infancy? Do immunologic factors in breast milk influence the development of the infant’s immune system to the extent that they influence the pathogenesis of chronic disease later in life?”

Jackson KM, et al. *JAOA*. 2006;106(4):203-207.

BF & Immune System Development

- Hasselbach, et al
- Confirmed in 2 separate studies
- Infants at 4 months had larger thymus glands than those who were partially BF or formula fed
 - Thymus is central organ in immune system
 - Responsible for proper development of T lymphocytes
 - Clinical significance of size of thymus not known; however, role of thymus in T-cell development suggests potential for direct effect of BF

Allergy, Autoimmunity, & BF

- Meta-analysis of 6 studies showed BF for first 3 months was protective against allergic rhinitis
- Review of 56 published articles suggested BF was protective for atopic allergies
- Research suggests BF may decrease future risk of autoimmune disorders
 - May be due to the fact that BF facilitates increased immunologic tolerance

Autoimmune Disorders

- Crohn's Disease and Ulcerative Colitis
 - Higher risk in formula fed vs. BF infants
- Type I DM (IDDM)
 - Largely a result of genetic factors and dysregulation of the immune system
 - Countries with lowest prevalence of BF at 3 months had highest incidence of IDDM
 - Patients with IDDM were more likely to have been BF < 3 months
 - Formula feeding in place of BF independently associated with IDDM after adjusting for other variables

“Could early consumption of breast milk also provide long-term benefits by protecting individuals from chronic diseases later in life?”

While the evidence is not conclusive, there is enough evidence to suggest that breastfeeding may significantly alter the immune system of the infant.”

Other Potential Benefits of Breastfeeding

BF & Infant Blood Pressure

- Meta-analysis by Martin, et al
 - 15 studies; 17,503 subjects
 - Small reduction in diastolic blood pressure associated with BF
 - Reducing Na intake during infancy
 - Increasing intake of long chain polyunsaturated fatty acids
 - Protecting against hyperinsulinemia in infancy and insulin resistance throughout life
- Could confer important benefits on cardiovascular health at the population level

Risk Factors for Obstructive Sleep Apnea (OSA)

- Large BMI*
- Large neck
- High palate*
- Narrow dental arches*
- Abnormal tongue activity
 - Genetic
 - Result of habits
 - Bottle feeding*
 - Pacifier use*
 - Thumb/finger sucking

Historical Look at Orofacial Structures

- Weston Price, MD—1930s
- Evaluated nonindustrialized islands/cultures
- Evaluated teeth facial contour and mouths of natives and skulls
- Nearly all exhibited:
 - Ideal occlusions
 - Normal palate height
 - Wide dental arches
 - Minimal decay
- Common feature: BF was only method of feeding

BF and Palate Development

- Tongue contributes to shaping of palate
 - At birth, natural position for tongue is pushed forward
 - Protects breast from trauma
 - Helps compress the lactiferous sinuses
 - BF infants have better chance of developing normal palate height & dental arch with rounded U shape
- Bottle/pacifier inserted between tongue & palate
 - Tongue cannot reach palate
 - Physical contact of bottle nipple or pacifier can actually elevate the height of the palate
 - Vacuum created by strong sucking on bottle can also increase height of palate

Bottle Feeding

- Less muscle coordination needed
- Excessive flow may cause tongue to be placed at back of throat to protect airway
- Bottle nipples firmer than breast
 - Tongue gets drawn inside mouth to protect bottom side of tongue from trauma from gum pad
 - Tongue thrust often develops
- “Excessive vacuum that may be needed during bottle-feeding and the development of a tongue-thrust are the main contributing factors to the malocclusions that put an individual at risk for OSA.”

Relationship During Childhood

- Davis and Bell
 - Strong association between exclusive bottle feeding and malocclusion
 - Relationship did NOT diminish with change from primary to permanent teeth
- Labbok and Hendershot
 - Longer duration of BF, lower incidence of malocclusion
 - Bottle feeding leads to habit of tongue-thrusting
 - Significant decrease in tongue-thrusting with increased duration of BF

“What We Eat Can Determine Who We Can Be!”

- RDs are in a prime position to support breastfeeding.
 - Understanding of the mechanics & clinical challenges is imperative.
- Research continues to support that breastmilk is the optimal nutrition for infants and also may confer long term health advantages.
- The best thing healthcare professionals can do is to continue to encourage breastfeeding and support the breastfeeding mother.