Infant and Pediatric Nutrition-Formulas

Overview

- Infant and toddler growth
- Breast milk
- Infant formulas and indications
- Pediatric formulas and indications

Growth-

- Sensitive indicator of nutrition adequacy
- Term infants triple their birth weight and increase in length by 50% in the first 12 months of life
- Rate of weight gain is most rapid in the first 3 months and progressively decreases
- Change in body fat composition

Assessment of Growth

- American Academy of Pediatrics recommends individual evaluation of each child to assess overall weight gain and growth.
- Intervention may be indicated when-
  - Weight is >10% below birth weight
  - Failure to regain birth weight by 2 weeks of age
  - Weight-for-age or weight-for-length <2 SD below the mean
  - Weight-for-age crosses more than 2 percentile channels downward

Changes in Body Fat Composition

9-15% for boys, 14-21% for girls at school age
22-25% at 12-36 months
14-15% at birth
25-26% at 6 months

Nutrition Facts

Serving Size: 7/8 oz (3.3g)
Servings Per Container About 1

Amount Per Serving %
Total Baby Fat 35%
Diaper Filler 2%
Total Fatness 55%
Rock 'n' Roll Attitude 0%
*Percent Daily Values (PV) are based on a 2,000 calorie diet.

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Energy Demands of Growth Compared to Daily Requirements

- 1 month
- 3 months
- 6 months
- 12 months
- 2 years

Protein Demands of Growth Compared to Daily Requirements

- 1 month
- 3 months
- 6 months
- 12 months
- 2 years

How do infants meet these nutritional needs?

**Human milk**

- Provides superior nutrition for growth
  - 20-22 kcal/oz average caloric density
  - ~42% calories Carbohydrate (lactose and oligosaccharides)
  - ~6% calories Protein (60% aqueous whey, 40% casein)
  - ~52% of calories Fat (includes essential fatty acids, DHA, & ARA)

- Provides adequate hydration
  - 90% water

- Protects against infection

**Potential Protective Effects of Human Milk**

- Chronic disorders
  - Type 1 Diabetes
  - Celiac disease
  - Crohn's disease
  - Childhood cancer (lymphoma, leukemia)
  - Allergies

- Acute disorders
  - Diarrhea
  - Otitis media, recurrent otitis media
  - Urinary tract infections
  - Necrotizing enterocolitis
  - Septicemia
  - Infant botulism

- Hospitalizations

- Infant mortality

- Obesity and overweight
Breastfeeding benefits mom and family too!

• Protects mother’s health
  – helps reduces risk of uterine bleeding and helps the uterus to return to its previous size
  – reduces risk of breast and ovarian cancer
• Helps delay a new pregnancy
• Economic benefits
  – breastfeeding costs less than formula
  – breastfeeding may result in lower medical care costs

Vitamin & Mineral Supplementation for Breastfed Infants

• Vitamin D: add within the first 2 months
  – recommended intake 400 IU/day
  – breast milk content is low (12-60 IU/L)
  – supplement if taking < 500 mls formula/day
• Iron: add at 4-6 months
  – First foods should be high in iron, iron-fortified cereals and pureed meats
• Fluoride: add at 6 months

Contraindications to Breastfeeding

• Galactosemia
• Certain Inborn errors of metabolism
• Mothers infected with HIV or human T-cell lymphotropic virus
• Mothers with active herpetic lesions on the breast
• Mothers with active tuberculosis
• Mothers using illicit drugs
• Mothers taking anitmetabolite chemotherapy

Indications for Infant Formula

• Mother chooses not to breastfeed
• Breastfeeding is contraindicated
• Supplement breastfeeding for infants not taking adequate breast milk to support growth
• Fortify express breast milk for infants requiring more calories, protein, vitamins, and minerals

Infant Formula Composition

• Provides 20 kcal/oz caloric density, generally
  – 41-47% calories Carbohydrate
    • Sources may include lactose, corn syrup solids, maltodextrin, sucrose
  – 8-12% calories Protein
    • Sources may include casein, whey, soy protein isolate, L-methionine, casein hydrolysate, L-amino acids
  – 45-50% of calories Fat
    • Sources may include palm olein, soy oil, coconut oil, high-oleic sunflower and/or safflower oil, may include DHA & ARA

Types of Infant Formulas

• Routine
  – Cow’s Milk Protein
    • Standard
    • Lactose reduced
    • Thickened
    • Partially Hydrolyzed
  – Soy Protein
• Hydrolyzed Protein
• Free Amino Acid (elemental)
• Special Diagnosis
  – Preterm Infants
  – Low mineral
  – Low fat
Routine Formulas - Cow’s Milk Protein

- Protein source is casein and whey
- Indications
  - Supplement breast feeding
  - Calorie and nutrient enhancer to breast milk
  - Sole source of nutrition
- Contraindications
  - Milk protein allergy
  - Galactosemia

Routine Formulas - Cow’s Milk Protein

- Standard
  - Enfamil Premium Lipil (Mead Johnson)
  - Similac Advance (Abbott)
  - Store Brand
  - Organic...

Routine Formulas - Cow’s Milk Protein

- Lactose-reduced
  - Enfamil Gentlease (Mead Johnson)
    - 20% less lactose
  - Similac Sensitive (Abbott)
    - trace lactose
  - May help relieve gassiness, fussiness, and constipation

Routine Formulas - Cow’s Milk Protein

- Thickened
  - Similac Sensitive RS (Abbott)
  - Enfamil AR Lipil (Mead Johnson)
  - Enfamil RestFull (Mead Johnson)
    - Enfamil AR marketed as a sleep aid
  - Added rice starch, wait 2-5 minutes after mixing before feeding to allow to thicken
  - Maintains nutrient composition as opposed to adding cereal to bottles
  - May help infants with GERD, less effective when used with a PPI
  - Contraindicated in premature infants until >38 weeks gestation age

Routine Formulas - Cow’s Milk Protein

- Partially Hydrolyzed
  - Good Start Gentle Plus (Gerber)
    - all whey protein
  - Good Start Protect Plus (Gerber)
    - all whey protein, contains probiotic BIFIDUS BL
  - Enfamil Gentlease Lipil (Mead Johnson)
    - whey > casein, low lactose
  - Protein is partially broken down into small peptides
  - May help relieve gassiness, fussiness, and constipation

Routine Formulas - Soy Protein

- Protein source is soy isolates
- Indications
  - IgE-mediated allergy to cow milk protein?
    - Probably not as 10-14% have soy protein allergy too
  - Galactosemia
  - Vegan diet preference
- Contraindications
  - Cow milk protein enterocolitis/enteropathy
  - Premature infants born <1800 grams
Routine Formulas - Soy Protein

- **Standard**
  - Enfamil ProSobee Lipil (Mead Johnson)
  - Similac Isomil Soy (Abbott)
  - Store Brand
- **Partially hydrolyzed**
  - Good Start Soy Plus (Gerber)
    - Protein is partially broken down into small peptides

- **Diarrhea management**
  - Isomil DF (Abbott)
    - Added soy fiber, 6 gm/liter
    - For infants over 6 months old
    - Only made ready-to-feed liquid
    - Marketed specifically to help manage loose, watery stools. May be effective in antibiotic-induced diarrhea.

Hydrolyzed Protein Formulas

- **Hypoallergenic**
  - Protein is broken down into small peptides and supplemented with added amino acids
- **Indications (general)**
  - cow milk protein allergy
  - soy protein allergy
  - Galactosemia (lactose free)
  - Colic?
- **Contraindications**
  - Expense
  - Taste

- **Nutramigen Lipil (Mead Johnson)**
  - Powder form now contains the probiotic LGG (Enflora LGG)
  - Ready-to-feed and liquid concentrate forms do not have the probiotic added
  - Mixing calls for PACKED scoops
  - Indications
    - Cow milk or soy protein allergy
    - Lactose, galactose, and sucrose free
    - Colic
    - Diarrhea

- **Similac Alimentum (Abbott)**
  - New name will be Similac Expert Care Alimentum
  - Ready-to-feed form is corn free
  - Fat is 33 % MCT oil
  - Indications
    - Cow milk or soy protein allergy
    - Colic
    - Diarrhea
    - Fat malabsorption (cystic fibrosis, pancreatic insufficiency)

- **Pregestimil Lipil (Mead Johnson)**
  - Fat is 55 % MCT oil
  - Limited retail availability, most stores due not stock on the shelves. Pharmacies can order.
  - Mixing calls for PACKED scoops
  - Indications
    - Cow milk or soy protein allergy
    - Lactose and sucrose free
    - Diarrhea
    - Fat malabsorption (cystic fibrosis, pancreatic insufficiency, short bowel, cholestasis)
### Free Amino Acid Formulas

**Hypoallergenic**  
- Protein is all non-allergic free amino acids

**Indications**  
- Multiple food allergies  
- Severe milk protein allergy  
- Malabsorption

**Contraindications**  
- Expense  
- Not available retail- must special order  
- Taste

### Free Amino Acid Formulas

**Neocate Infant (Nutricia)**  
- Fat now 33 % MCT  
- Non-standard mixing  
  - added powder then water, for 20 calories/oz dilution  
    the ratio is 1 scoop to make 1 oz total

**Additional Indications**  
- Short bowel syndrome  
- Eosinophilic GI disorders  
- GI-tract impairment

### Free Amino Acid Formulas

**EleCare (Abbott)**  
- Fat is 33 % MCT  
- Unflavored cans have 20 calories/oz and 30 calories/oz mixing instructions  
- Vanilla flavored, only approved for >1 year olds, cans only have 30 calories/oz mixing instructions

**Additional Indications**  
- Short bowel syndrome  
- Eosinophilic GI disorders  
- GI-tract impairment

### Free Amino Acid Formulas

**Nutramigen AA Lipil (Mead Johnson)**  
- Does not have MCT  
- Non-standard mixing  
  - For 20 calories/oz the ratio is 1 scoop per 1 oz of water

### Special Diagnosis Formulas - Preterm Infants

**Protein source is casein and whey**

**Indications**  
- For preterm infants weighing <2000 gm at birth that require higher calories, protein, and minerals  
- Supplement breast feeding, fortify breast milk, or sole source of nutrition

**Contraindications**  
- NOT indicated for term infants due to risk for hypervitaminosis and hypercalcemia

### Special Diagnosis Formulas - Preterm Infants

**Types**  
- Premature In-hospital  
  - Generally only used in the hospital/NICU  
  - Not indicated when infants weigh >3600 gm

- Premature Post-Discharge  
  - For preterm infants weighing <2000 gm at birth who are now >2500 gm and/or discharging from the hospital/NICU  
  - Generally used until corrected age of 6-9 months, may be used until 1 year corrected age
Special Diagnosis Formulas: Preterm Infants

- Premature In-hospital
  - Ready-to-feed liquids
    - Enfamil Premature Lipil (Mead Johnson)
      - 20 and 24 calories/oz
    - Similac Special Care (Abbott)
      - 20 and 24 calories/oz, 20 and 24 calories/oz low iron, 24 calories/oz high protein, and 30 calories/oz
    - Good Start Premature (Gerber)
      - 24 calories/oz
      - Protein source is partially hydrolyzed whey

- Premature Post-Discharge
  - Human milk Fortifiers
    - Enfamil Human Milk Fortifier (Mead Johnson)
    - Similac Human Milk Fortifier (Abbott)
  - Fortifiers are added to expressed breast milk to make 22-24 calories/oz, generally

- Premature Post-Discharge
  - Standard dilution is 22 calories/oz

Special Diagnosis Formulas: Low Long-Chain Fat

- Enfaport (Mead Johnson)
  - Fat blend is 84% medium-chain triglycerides
  - Milk protein based, all casein
  - 8 oz liquid, ready-to-use at 30 calories/oz
  - Indications
    - Fatty acid metabolism disorders
    - Severe fat malabsorption
    - Chylothorax
    - Lymphangiectasia
  - Contraindications
    - Not a long-term sole-source of nutrition due to risk for fatty acid, vitamin, and mineral deficiencies

Special Diagnosis Formulas: Low Mineral

- Similac PM 60/40 (Abbott)
  - Milk protein source, 60:40 ratio of whey to casein
  - Indications
    - Renal function impairment
    - Hypercalcemia or hypocalcemia due to hyperphosphatemia
  - Precautions
    - Additional iron may be needed
    - Additional electrolytes may be needed

Formula Selection and Mixing Guide

- Specialized Infant Feeding Guidelines for Healthcare Professionals
- New 2010 version
- Contains mixing instructions for 22, 24, and 27 calories/oz
- Written and Compiled by Oregon Pediatric Nutrition Practice Group
- Order at www.eatrightoregon.org/PNPG/
Infant Formulas: What’s New?

- “Functional” Additives
  - Prebiotics, non-digestible food ingredients that stimulate the growth and/or activity of good bacteria in the digestive system
    - Enfamil Premium’s Triple Health Guard
      - Contains probiotic GOS (galactooligosaccharides) and nucleotides, starting in April 2010 adding another prebiotic - polydextrose
    - Similac Advance’s EarlyShield
      - Contains prebiotic GOS (galactooligosaccharides), nucleotides, and antioxidants (beta-carotene, lycopene, and lutein)
      - Starting the summer of 2010 Abbott will be adding the “EarlyShield” to Similac Sensitive and Similac Isomil (probiotic will be FOS (fructooligosaccharides))

- Other Formulas...
  - Second Stage Formulas
    - Similac Go & Grow, Similac Go & Grow Soy (Abbott)
    - Enfagrow Premium Next Step, Enfagrow Soy Next Step (Mead Johnson)
    - Good Start 2 Gentle Plus, Good Start 2 Protect Plus, Good Start 2 Soy Plus (Gerber)
    - Abbott products
      - For babies 9-24 months old who also eat solid foods.
      - Higher in calcium, phosphorous, iron, and vitamins C & E.
      - Standard dilution is 20 calories/oz
      - Not available through WIC

Indications for Pediatric Formulas

- Complete nutrition source for children ages 1 to 10 (up to 13 years for some formulas)
- High calorie oral supplement
- Tube feeding formula
- Lactose and gluten free

Types of Pediatric Formulas

- Cow’s Milk Protein
- Soy Protein
- Blenderized
- Hydrolyzed Protein
- Free Amino Acid (elemental)
- Special Diagnosis
<table>
<thead>
<tr>
<th>Pediatric Formulas- Milk based</th>
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</tr>
</thead>
<tbody>
<tr>
<td>• Standard</td>
<td>• Brands, continued</td>
</tr>
<tr>
<td>• Protein source is casein and whey</td>
<td>• Pediasure and Pediasure with fiber (Abbott)</td>
</tr>
<tr>
<td>• Liquid ready-to-feed bottles, boxes, or cans</td>
<td>• 53 % carbohydrate, 12 % protein, 53 % fat</td>
</tr>
<tr>
<td>• 30 calories/oz (1 calorie/ml)</td>
<td>• Flavors- vanilla, chocolate, strawberry, banana cream, and berry cream</td>
</tr>
<tr>
<td>• Brands</td>
<td>• With fiber is only in vanilla flavor</td>
</tr>
<tr>
<td>• Nutren Junior and Nutren Junior with fiber (Nestle)</td>
<td>• 237 mls per bottle or can</td>
</tr>
<tr>
<td>• 44 % carbohydrate, 12 % protein, 44 % fat</td>
<td>• Available retail</td>
</tr>
<tr>
<td>• Vanilla flavored</td>
<td>• Nutren Junior (Nestle)</td>
</tr>
<tr>
<td>• 250 mls per can</td>
<td>• Formulation for tube feedings, can be taken orally</td>
</tr>
<tr>
<td>• Not available retail and must be ordered</td>
<td>• 237 mls per can</td>
</tr>
<tr>
<td></td>
<td>• Not available retail and must be ordered</td>
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<tr>
<td>• Brands, continued</td>
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<tr>
<td>• Boost Kid Essentials (Nestle)</td>
<td>• Boost Kid Essentials 1.5 and Boost Kid Essentials 1.5 with fiber (Nestle)</td>
</tr>
<tr>
<td>• 54 % carbohydrate, 12 % protein, 34 % fat</td>
<td>• 44 % carbohydrate, 11 % protein, 45 % fat</td>
</tr>
<tr>
<td>• Flavors- vanilla, chocolate, and strawberry</td>
<td>• Flavors- vanilla, soon also in chocolate and strawberry</td>
</tr>
<tr>
<td>• No with fiber version</td>
<td>• With fiber is only in vanilla flavor</td>
</tr>
<tr>
<td>• &quot;Retail&quot; version comes with a straw containing probiotics and is 244 mls/box</td>
<td>• 45 calories/oz (1.5 calories/ml)</td>
</tr>
<tr>
<td>• &quot;Hospital&quot; version does not have probiotics in the straw and is 237 mls/box</td>
<td>• 237 mls per box</td>
</tr>
<tr>
<td></td>
<td>• Not available retail and must be ordered</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pediatric Formulas- Milk based</th>
<th>Pediatric Formulas- Soy based</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Brands, continued</td>
<td>• Bright Beginnings Soy Pediatric Drink (PBM Products)</td>
</tr>
<tr>
<td>• Bright Beginnings Pediatric Drink and Bright Beginnings Pediatric Drink with fiber (PBM Products)</td>
<td>• Protein is soy isolates</td>
</tr>
<tr>
<td>• 43 % carbohydrate, 12 % protein, 45 % fat</td>
<td>• 43 % carbohydrate, 12 % protein, 45 % fat</td>
</tr>
<tr>
<td>• Flavors- vanilla, chocolate, and strawberry</td>
<td>• Liquid ready-to-feed cans</td>
</tr>
<tr>
<td>• With fiber is only in vanilla flavor</td>
<td>• 30 calories/oz (1 calorie/ml)</td>
</tr>
<tr>
<td>• 237 mls per can</td>
<td>• Vanilla flavored</td>
</tr>
<tr>
<td>• Not available retail and must be ordered</td>
<td>• Contians fiber</td>
</tr>
<tr>
<td>• Store brands</td>
<td>• 237 mls per can</td>
</tr>
<tr>
<td></td>
<td>• Not available retail and must be ordered</td>
</tr>
</tbody>
</table>
### Pediatric Formulas- Blenderized

- Compleat Pediatric (Nestle)
  - Protein sources are chicken, milk, and pea
  - Also contains fruits and vegetables
  - 50 % carbohydrate, 15 % protein, 35 % fat
  - Liquid ready-to-feed cans
  - Only for tube feeding
  - 30 calories/oz (1 calorie/ml)
  - Contains fiber
  - 250 mls per can
  - Not available retail and must be ordered

### Pediatric Formulas- Hydrolyzed Protein

- Protein is hydrolyzed into small peptide chains
  - Lactose and gluten free
- Brands
  - Vital Jr (Abbott)
    - Hydrolyzed casein and whey
    - 53 % carbohydrate, 12 % protein, 35 % fat
    - Fat is 50 % MCT
    - Flavors- vanilla and strawberry
    - Contains prebiotic fiber FOS
    - 30 calories/oz (1 calorie/ml)
    - 237 mls per can
    - Not available retail and must be ordered

- Brands continued
  - Peptamen Junior, Peptamen Junior with Prebio, and Peptamen Junior with Fiber (Nestle)
    - Hydrolyzed whey
    - 55 % carbohydrate, 12 % protein, 33 % fat
    - Fat is 60 % MCT
    - Flavors- unflavored, vanilla, chocolate, and strawberry
    - With Prebio is only in vanilla flavor, contains prebiotic fibers FOS and inulin
    - With fiber is only in vanilla flavor, contains prebiotic fibers FOS and inulin as well as insoluble fiber
    - 30 calories/oz (1 calorie/ml)
    - 250 mls per can
    - Not available retail and must be ordered

- Brands continued
  - Peptamen Junior 1.5 (Nestle)
    - Hydrolyzed whey
    - 49 % carbohydrate, 12 % protein, 39 % fat
    - Fat is 60 % MCT
    - Unflavored
    - Has Prebio- contains prebiotic fibers FOS and inulin
    - 45 calories/oz (1.5 calories/ml)
    - 250 mls per can
    - Not available retail and must be ordered

- Brands continued
  - Pepdite Junior (Nutricia)
    - Hydrolyzed pork and soy proteins and amino acids (non-dairy)
    - 42 % carbohydrate, 12 % protein, 46 % fat
    - Fat is 35 % MCT
    - Unflavored and banana flavored
    - Powder, packaged in “single servings”
    - Standard dilution is 30 calories/oz (1 calorie/ml)
      - add one packet to 7 oz (210 mls) of water to make 8 oz (240 mls) total
    - Not available retail and must be ordered

### Pediatric Formulas- Free Amino Acid

- Protein source is free amino acids
  - Hypoallergenic
  - Lactose and gluten free
- Brands
  - EleCare (Abbott)
    - 43 % carbohydrate, 15 % protein, 42 % fat
    - Fat is 33 % MCT
    - Unflavored and vanilla flavor
    - Powder
    - Standard dilution is 30 calories/oz (1 calorie/ml)
      - Unflavored cans have 20 calories/oz and 30 calories/oz mixing instructions
      - Vanilla flavored cans only have 30 calories/oz mixing instructions
    - Not available retail and must be ordered
Pediatric Formulas - Free Amino Acid

• Brands continued
  – Neocate Junior (Nutricia)
    • 42 % carbohydrate, 13 % protein, 45 % fat
    • Fat is 35 % MCT
    • Flavors- unflavored, chocolate, and tropical
    • Powder
    • Standard dilution is 30 calories/oz (1 calorie/ml)
    • Higher vitamin and mineral content than Neocate One+
    • Not available retail and must be ordered

Pediatric Formulas - Free Amino Acid

• Brands continued
  – Vivonex Pediatric (Nestle)
    • 63 % carbohydrate, 12 % protein, 25 % fat
    • Fat is 68 % MCT
    • Unflavored
    • Powder, packaged in “single servings”
    • Standard dilution is 24 calories/oz (0.8 calorie/ml)
      – add one packet to 220 ml of water to make 250 ml total
    • Not available retail and must be ordered

Special Diagnosis Formulas - Low Long-Chain Fat

• Portagen (Mead Johnson)
  – Milk protein, all casein
  – 46 % carbohydrate, 14 % protein, 40 % fat
  – Fat is 87 % MCT
  – Unflavored
  – Powder
  – Standard dilution is 30 calories/oz (1 calorie/ml)
  – Not a long-term sole-source of nutrition due to risk for fatty acid, vitamin, and mineral deficiencies
  – Not available retail and must be ordered

Special Diagnosis Formulas - Low Long-Chain Fat

• Monogen (Nutricia)
  – Milk protein, all whey
  – 64 % carbohydrate, 11 % protein, 25 % fat
  – Fat is 90 % MCT
  – Unflavored
  – Powder
  – Standard dilution is 30 calories/oz (1 calorie/ml), also has mixing instructions for 22 calories/oz
  – Not a long-term sole-source of nutrition due to risk for fatty acid, vitamin, and mineral deficiencies
  – Not available retail and must be ordered
WIC

• Similac Advance, Similac Isomil, and Similac Sensitive are available without medical documentation
• Specialty formulas require medical documentation in Oregon
• A list of Oregon WIC approved formulas are listed on the WIC website at http://www.oregon.gov/DHS/ph/wic/docs/med_doc_WIC_formulary.pdf

References

• World Health Organization. The Benefits of Breastfeeding. April 009. www.who.int/entity/nutrition/publications/infantfeeding/9789241595018_s2_2_slides.ppt –

Thank You!