NTR 306: Fundamentals of Nutrition

Life Cycle Nutrition: Part 1

Birth – Adolescence

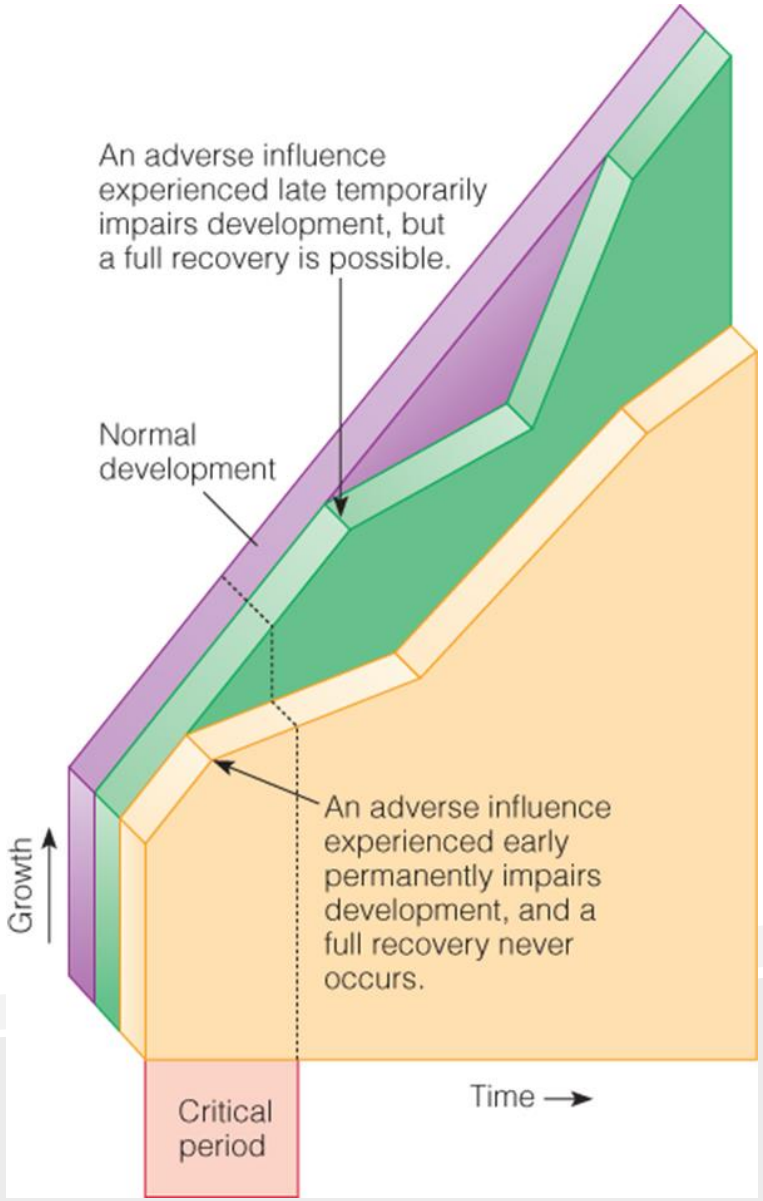
(Chapters 15 & 16)

Fetal Growth & Development

- Zygote
  - Fertilized egg (from ovum & sperm)
  - Rapidly dividing cells
  - Implantation: embeds in uterine wall during first week after conception
- Embryo
  - Early growth: cells double every 24 hours
  - 8 wks: complete nervous, CV (heart), digestive system
- Fetus
  - Fetal stage: 8 wks to 39/40 weeks
  - Organs grow to maturity

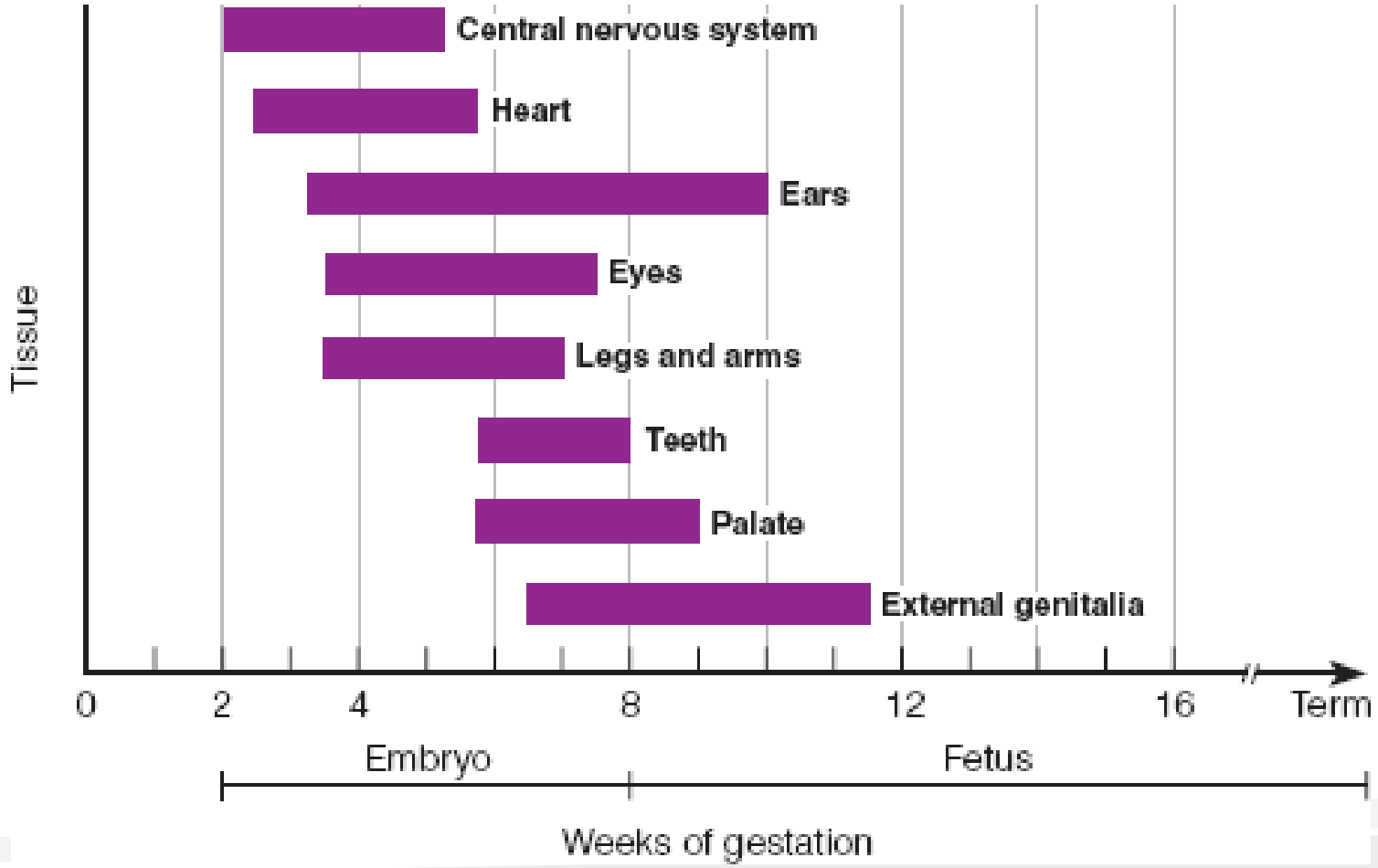
Critical Periods in Utero

- Intense development
- Each organ/tissue has unique critical period
- Damage during these periods = permanent consequences for life and health of fetus
- Example: neural tube development
  - Will become brain and spinal cord
  - Critical period: 17-30 days of gestation
  - Most vulnerable to nutrient deficiencies, excesses, and toxins = central nervous system damage
    - ✓ Anencephaly, spina bifida



Whitney & Rolfes, Understanding Nutrition (15th ed.)

Critical Periods in Utero



Whitney & Rolfes, Understanding Nutrition (16th ed.)

Developmental Origins of Disease

- Fetal programming
  - Mother's nutrition influences gene expression in fetus
  - Influences diseases of adulthood
  - May impact succeeding generations
- Mom's nutritional status (before and during pregnancy)
  - Undernutrition
    - ✓ (increases baby's future risk of) CVD & T2D later in life
  - Overnutrition
    - ✓ (increases baby's future risk of) obesity, CVD, T2D, and asthma later in life

InstaPoll

- How many calories should a healthy person consume when they are pregnant?
  - ✓ Eat for 2 (i.e., double the amount)
  - ✓ Eat about 25% more (+500 kcals)
  - ✓ Eat the same amount as pre-pregnancy
  - ✓ Varies depending on the trimester
  - ✓ Calories don't matter, only the micronutrients do

Mother's Needs During Pregnancy

- Mother's nutrient needs are higher than any other life phase
  - Mother's needs:
    - ✓ Red blood cell mass expands
    - ✓ Placenta growth and development for baby's needs
  - Baby's needs:
    - ✓ Fetal growth and development (bones, muscles)
    - ✓ Fuel for fetal brain
    - ✓ Brain development
    - ✓ Synthesis of fetal DNA and new cells

Baby bump!

Maternal Weight & Infant Health

- Mother's weight gain during pregnancy predicts infant birthweight
  - **Most reliable** indicator of infant health and development
- Weight of mother prior to conception influences fetal growth
  - Mother Underweight:
    - ✓ Preterm birth, low-birthweight infant, infant death
  - Mother Overweight or Obese (~50% of US pregnancies)
    - ✓ Gestational hypertension, gestational diabetes
    - ✓ Infants large for gestational age (LGA)
    - ✓ Rapid weight gain in early life
    - ✓ Increased risk of obesity in later life
    - ✓ Macrosomia: Increased risk of C-section/delivery complications
    - ✓ Neural tube defects, cerebral palsy, heart defects

Dietary/Behaviors Incompatible with Pregnancy

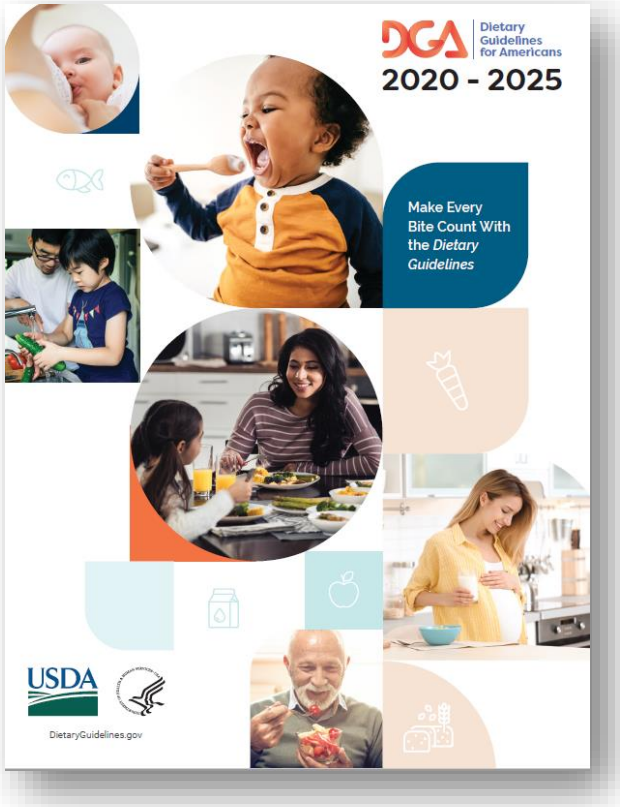
- Alcohol consumption
  - Irreversible mental and physical impairment as alcohol deprives fetus of nutrients & oxygen
  - Fetal Alcohol Syndrome (FAS) and Sudden Infant Death Syndrome (SIDS)
- Smoking, chewing tobacco
  - Restricts blood supply to fetus (low birthweight, organ defects, SIDS)
  - Harmful effects magnified during pregnancy
- Herbal Supplements – consult physician/dietitian
- Illicit drugs (yes, this includes marijuana!)
  - Perinatal death (28 weeks – 1 month after birth)

Dietary/Behavioral Incompatible with Pregnancy

- Vitamin-mineral megadoses
  - Excessive vitamin A = fetal malformations
- Caffeine
  - High intake: may cause miscarriage and low birthweight
- Restrictive dieting
  - Low carbohydrate diets = risk of impaired fetal brain development (glucose is necessary)

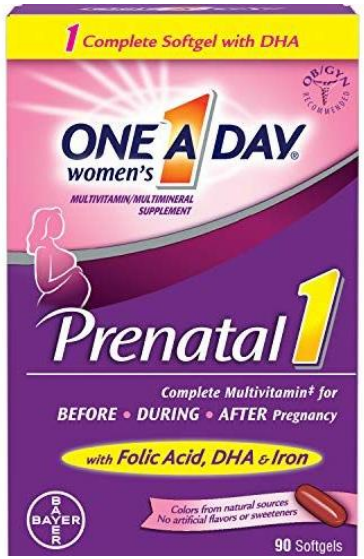
DGA Recommendations: Pregnancy

- 2020-2025: First time pregnancy recommendations included
- Strategies to follow (before, during, and after pregnancy):
  - Follow healthy dietary patterns
  - Establish a "healthy weight"
  - Follow weight gain recommendations
  - Eliminate ALL alcohol, tobacco, illicit drugs
  - Limit caffeine (to ≤ 300 mg/day; 2-3 cups coffee)
  - Limit foods prone to bacterial contamination:
    - ✓ *Smoked foods, processed meats, unpasteurized foods, raw sprouts*
  - Follow food safety guidelines



DGA Recommendations: Pregnancy

- 3 DGA Food Patterns (Healthy American, Vegetarian, Mediterranean)
  - Expected to meet all nutrient needs with some possible exceptions:
    - ✓ Iron, Folate, Choline, Iodine (vegan diets)



- <u>Folate Supplementation</u>
  - Prevention of neural tube defects (brain, spine, spinal cord)
    - ✓ *Critical at least 1 month prior to conception and during 1st trimester*
  - All women of childbearing age (even if not pregnant)
  - 400-800 micrograms of folate daily
    - ✓ *Multivitamins (400 µg) or prenatal vitamins (800 µg)*
    - ✓ *Fortified grains provide additional folate*

DGA Recommendations: Pregnancy

- Energy Needs

Stage of Pregnancy	Estimated Changes in Daily Energy Needs (from Pre-pregnancy) *for 'healthy weight'
1st trimester	+ 0 kcals/day
2nd trimester	+ 340 kcals/day
3rd trimester	+450 kcals/day

DGA Recommendations: Pregnancy

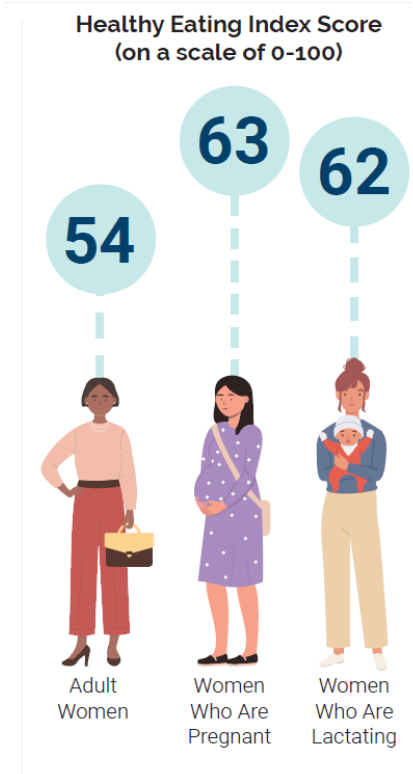
- Weight Gain

Pre-pregnancy Category *(based on BMI)*	Total Weight Gain *(lbs)*	Rates of Weight Gain (2^{nd}-3^{rd} trimesters) *(lbs/wk)*
Underweight	28-40	1
Healthy Weight	25-35	1
Overweight	15-25	½
Obese	11-20	½

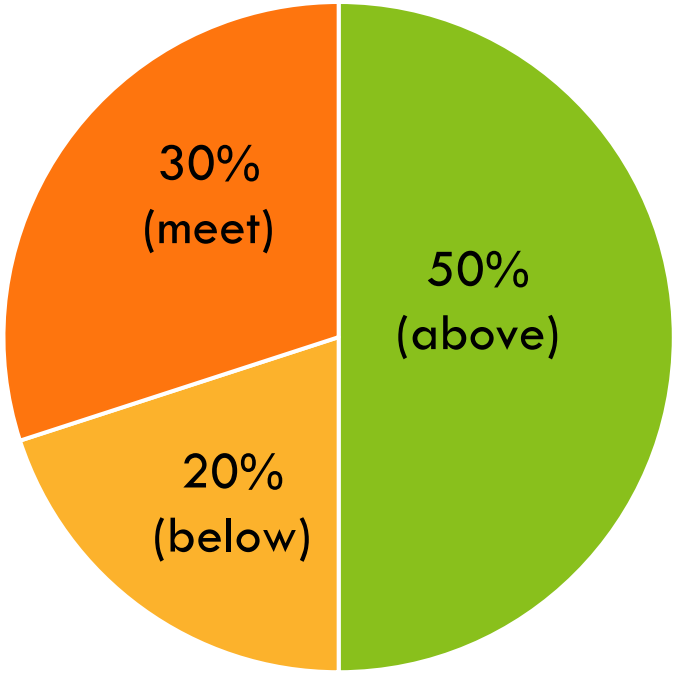
- Depends on pre-pregnancy weight
- 1^{st} trimester: 1-4 lbs (**total**)
- When and how fast weight is gained impacts health of mom and baby
- (Twins: weight gain is ~50% more)

How are we doing?

Poor Diet Quality

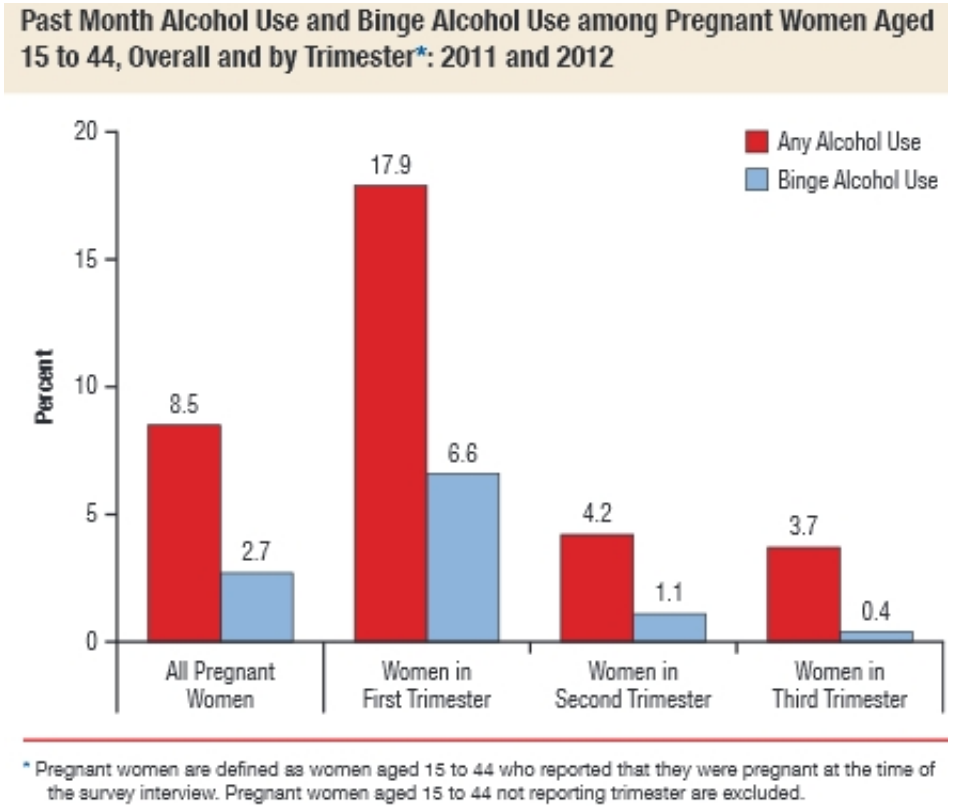


Excessive Weight Gain



% meeting recommendations

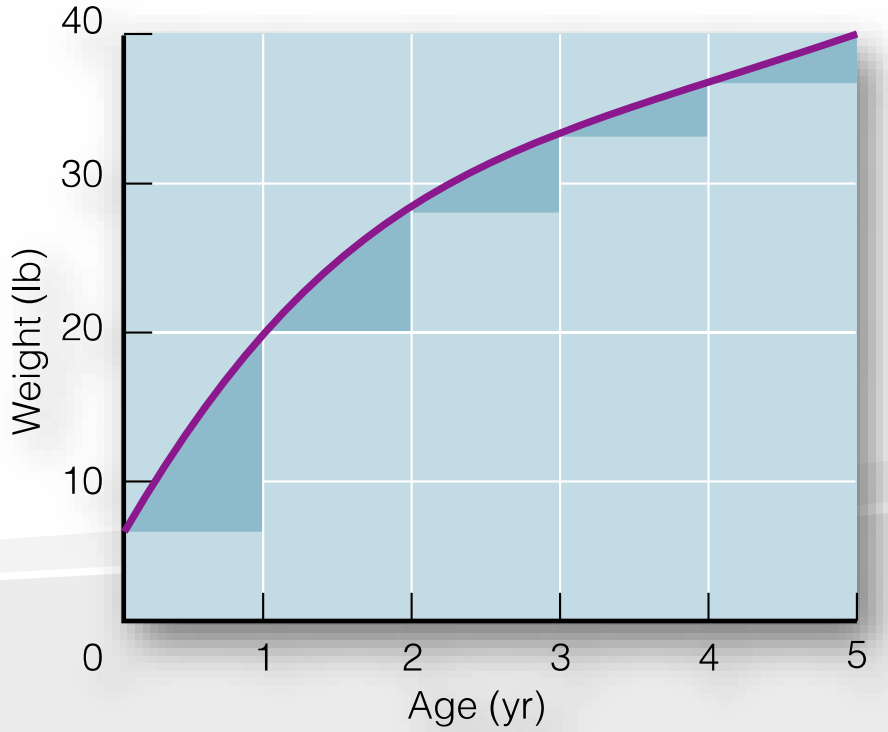
Over-consumption of Alcohol



Infants Needs for Growth & Development

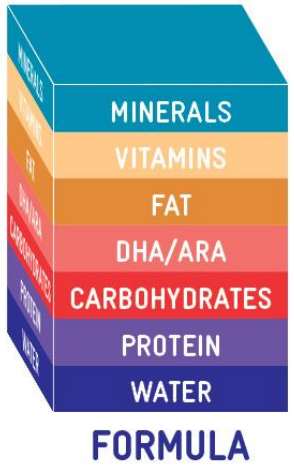
- Brain: 12% of infant's body weight (adult = 2%)
  - Glucose: brain's energy supply
    - ✓ Need ~ 60% intake from CHOs
  - Fatty acids: brain development
- Body:
  - Protein for growth and development
    - ✓ Failure to thrive: protein deficiency (Disrupted digestion, immunity, brain function)

Weight doubles by 5 months
Weight triples by 12 months



DGA Recommendations for Infants

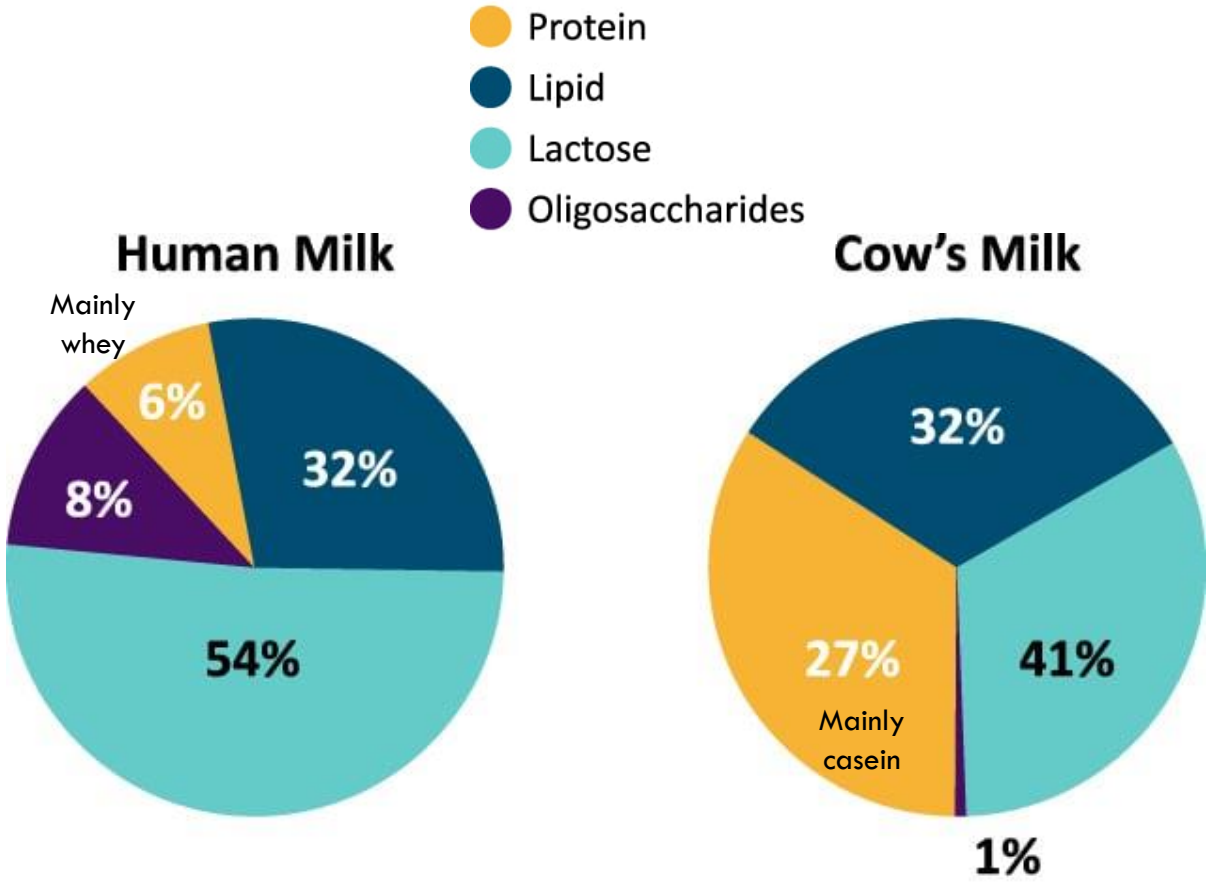
- 1st 6 months: Exclusively human milk + Vitamin D supplementation
  - Or: iron-fortified infant formula
- Human milk unique composition:
  - Highly bioavailable nutrients
    - ✓ CHO content: mainly lactose (enhances calcium absorption)
    - ✓ Protein: efficiently digested and absorbed
    - ✓ Lipid content: PUFAs important for cognitive function
  - Immunological protection
  - Hormones for physiological development
  - Protects against food allergies
  - Supports healthy weight
- Formula only mimics human milk *nutritionally*



What's the Beef with Cow's Milk?

Cow's milk composition:

- More protein, different proteins
- Lacks iron
- Lower in vitamin A
- Much higher minerals (Na, K, Ca, P, Mg)
- Much higher saturated fat content



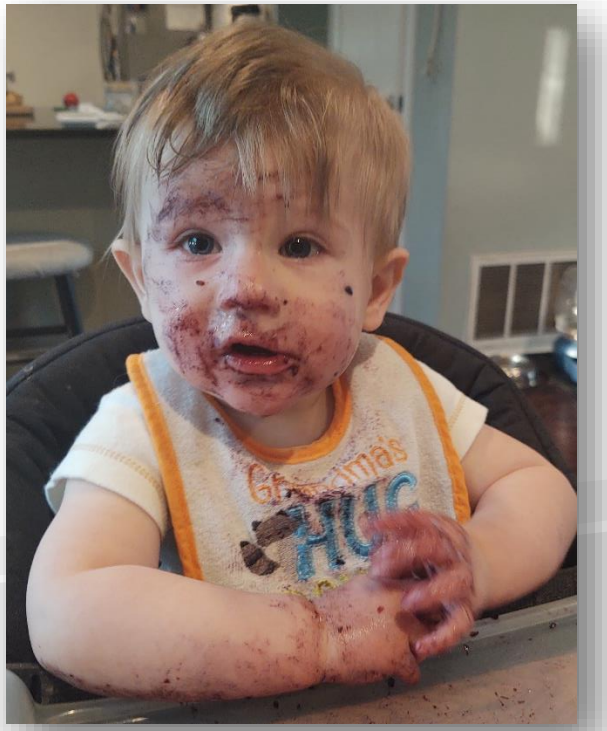
Additional Benefits of Breastfeeding

- Parents benefit from breastfeeding, too!
  - Contracts the uterus
  - May protect against breast and ovarian cancer
  - May reduce the risk of T2D, hypertension, CVD
  - Increases energy expenditure
    - ✓ Helps re-establish healthy body weight postpartum

Stage of Lactation	Estimated Changes in Daily Energy Needs (vs. Pre-pregnancy)
Months 1-6	+ 330 kcals/day
Months 6+	+ 400 kcals/day

Introducing First Foods

- ~6 months: Complementary foods introduced
  - Provide needed nutrients beyond breastmilk/formula: iron and zinc
  - Introduce: fruits, vegetables, nuts, seeds, whole grains, animal-sourced foods
  - Allergies:
    - ✓ Introduce single-ingredient foods, one at a time
    - ✓ Wait 3-5 days before introducing new food
    - ✓ Peanuts: introduce early
  - Avoid: cow's milk, honey, salt, SSBs, sweets, ultra-processed foods
- 1 Year Old: ≥ 2/3 of energy should come from foods



Introducing First Foods

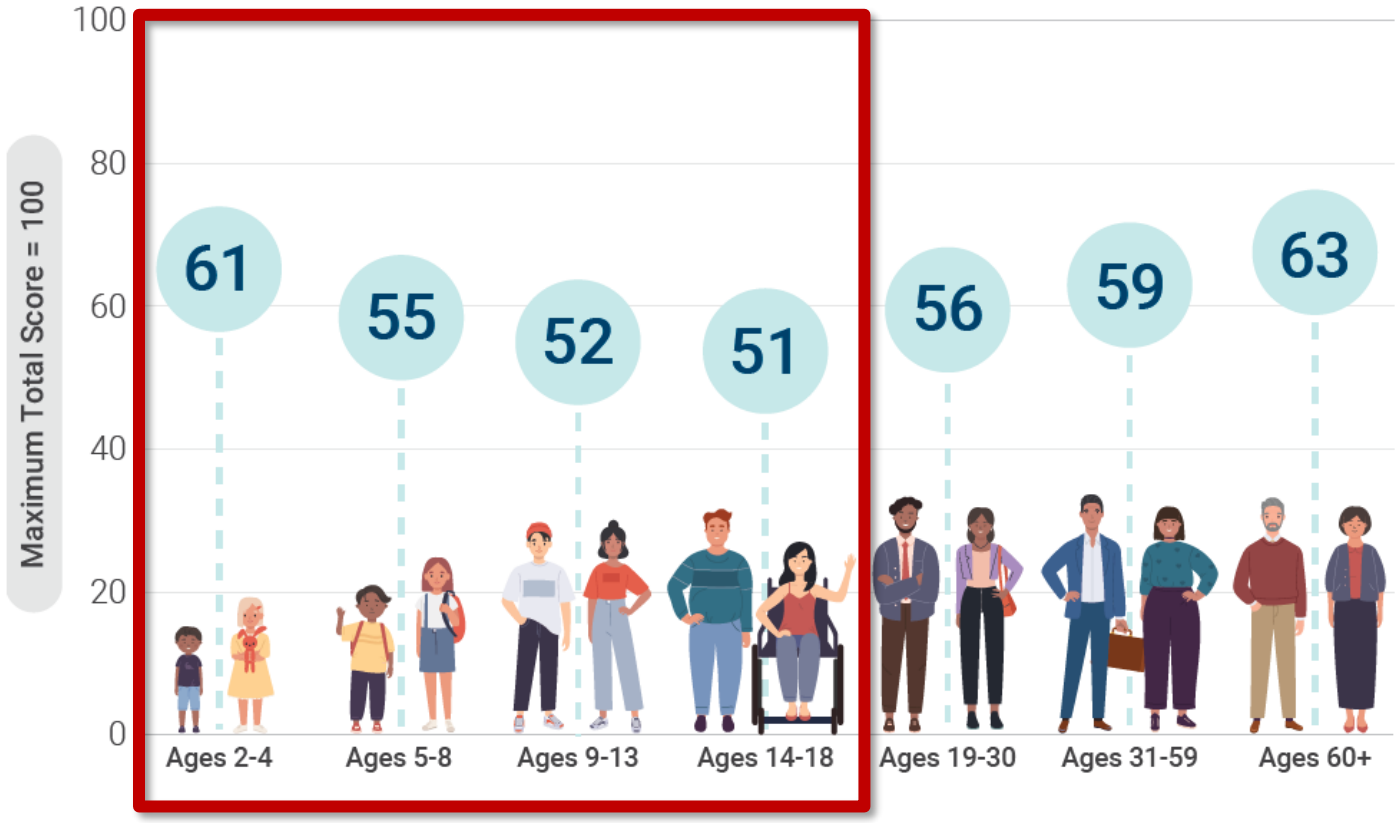
- Taste preferences begin in-utero!
  - Amniotic fluid takes on flavors (based on mother's diet)
    - ✓ Vanilla, carrot, garlic, mint, etc.
  - Mother's preferences will impact infant/toddlers' initial preferences
- Born with innate liking for sweet and salty; dislike for bitter (e.g., broccoli)
- Food liking/acceptance/preferences = modifiable behavior
  - Food exposure – as much as 8-15 tries!
  - Pairing healthy foods with sweet/salty foods

Establishing Health in Childhood (2-18 years old)

1) Growth
   - ✓ Strong muscles and bones
   - ✓ Developmental milestones (physical: crawling, walking)
2) Cognitive Function
   - ✓ Developmental milestones (mental: learn, speak, think)
3) Mental/Emotional strength
4) Social interactions/relationship-building

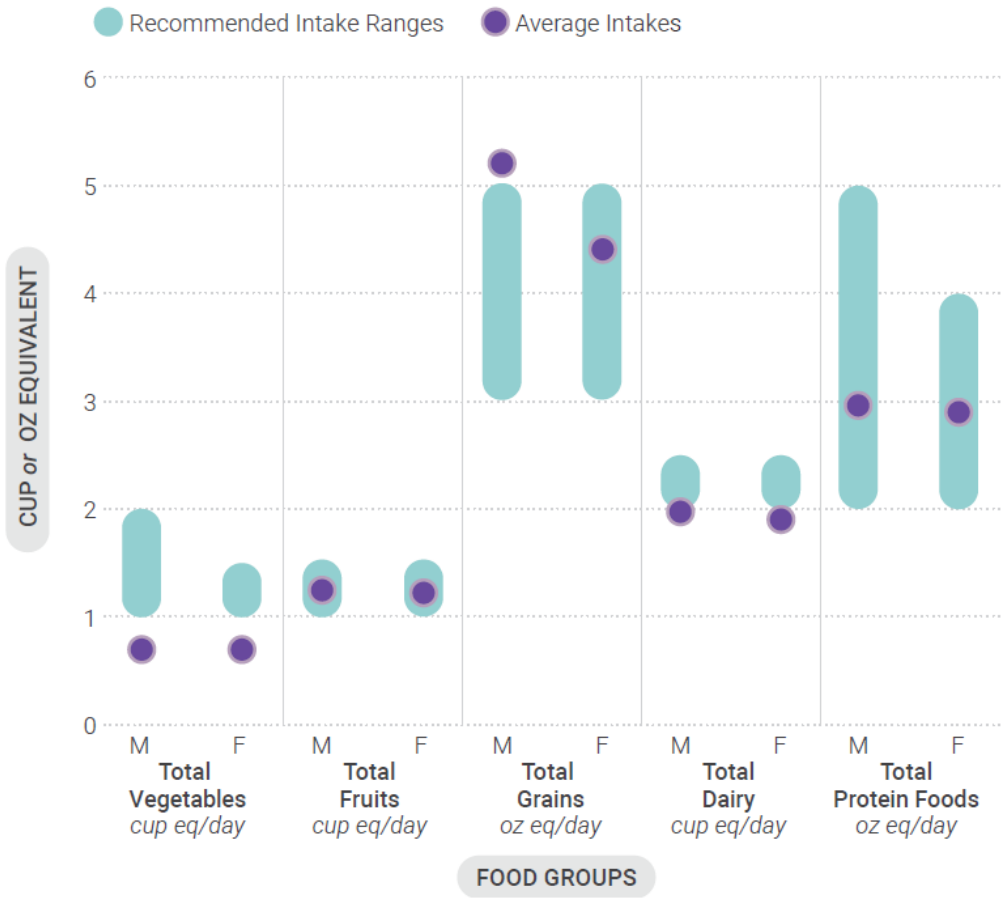
How Healthy is the Young American Diet?

Healthy Eating Index (HEI)



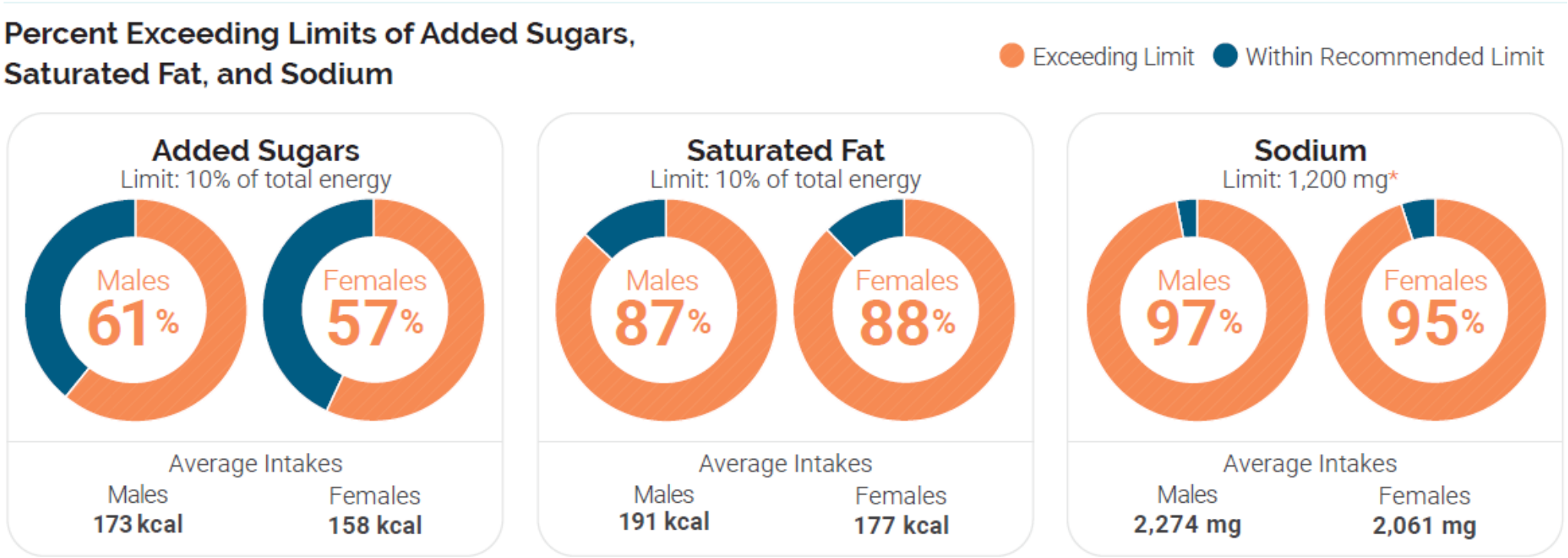
How Healthy is the Young American Diet?

Age group with best diet quality (2-4 years old): HEI score = 61

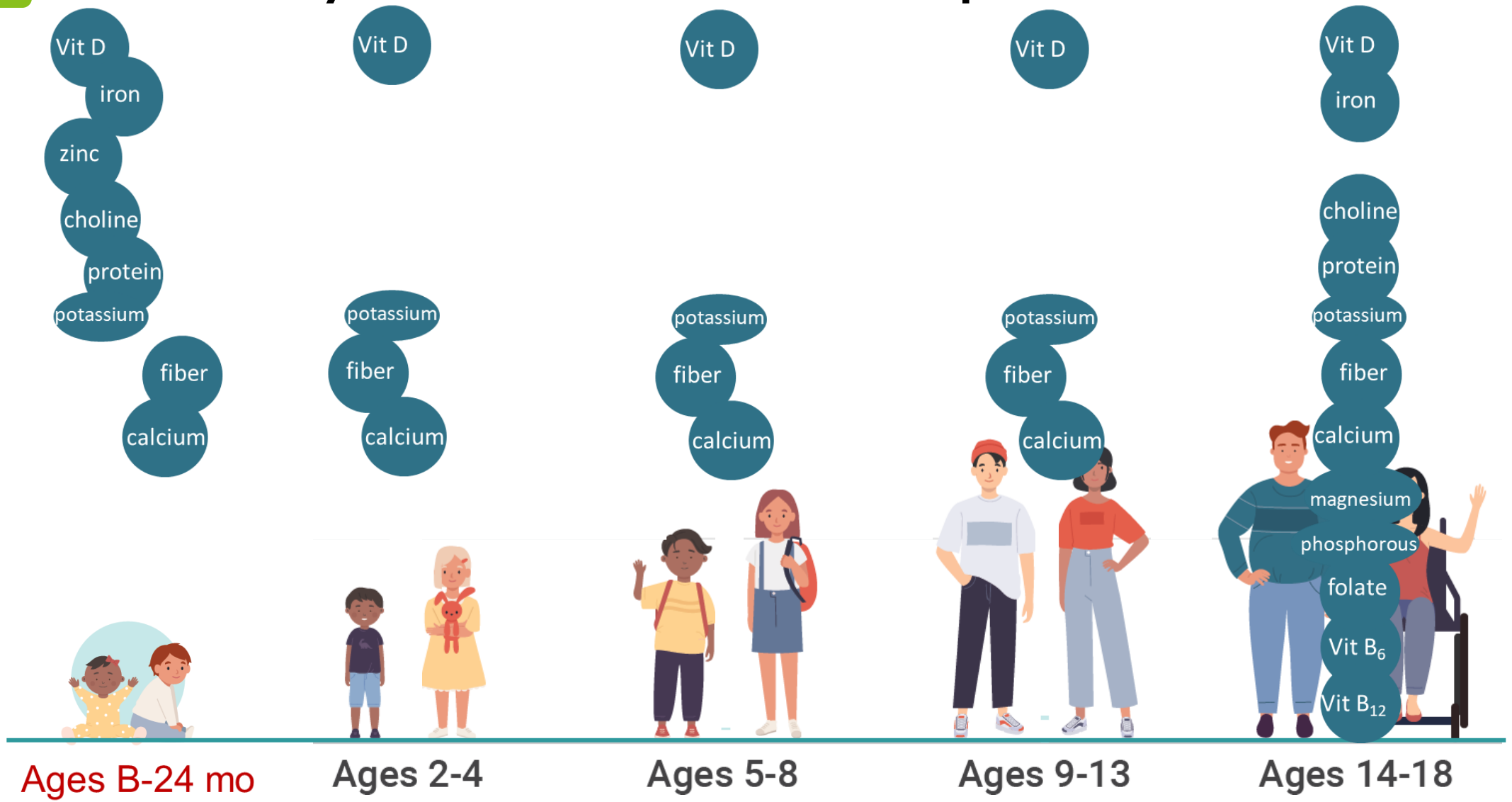


How Healthy is the Young American Diet?

Age group with best diet quality (2-4 years old): HEI score = 61



Summary of Nutrient Inadequacies



Health is Holistic

DGA Recommendations: Childhood (2-18 years)

- Similar energy needs as adults, based on: age, height/weight, sex, activity level
  - Increases with age
    - ✓ 2-8 y: 1,000 – 2,000 kcal/d
    - ✓ 9-13 y: 1,400 – 2,600 kcal/d
    - ✓ 14-18 y: 1,800 – 3,200 kcal/d

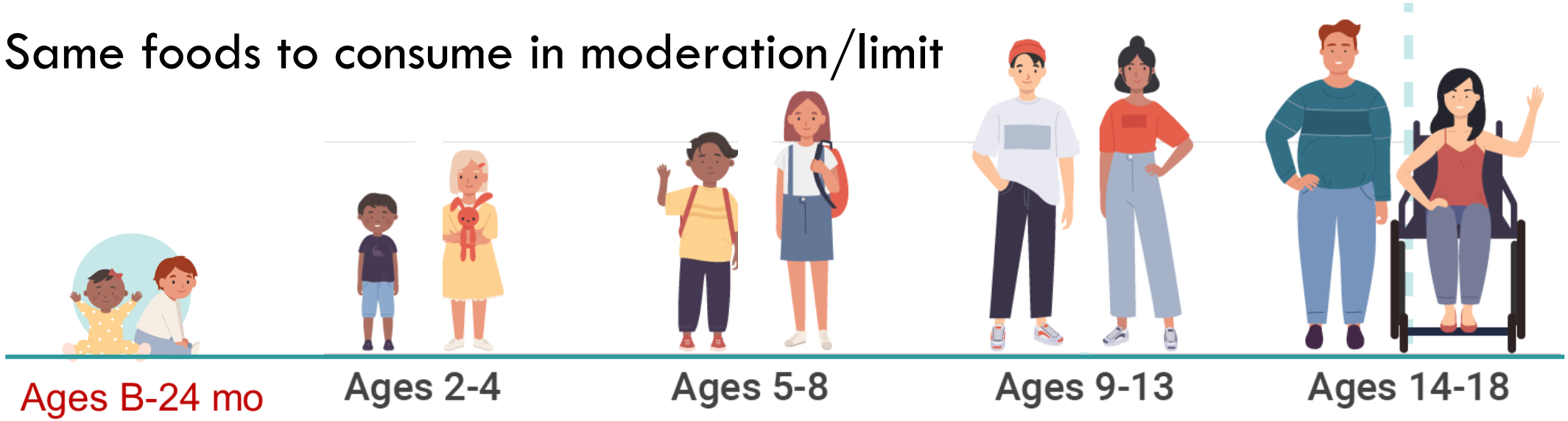
Table 16-16 Iron Recommendations for Adolescents

Males	Females
9–13 yr: 8 mg/day	9–13 yr: 8 mg/day
9–13 yr in growth spurt: 10.9 mg/day	9–13 yr in menarche: 10.5 mg/day
	9–13 yr in menarche and growth spurt: 11.6 mg/day
14–18 yr: 11 mg/day	14–18 yr: 15 mg/day
14–18 yr in growth spurt: 13.9 mg/day	14–18 yr in growth spurt: 16.1 mg/day

- <u>Key Nutrient Differences</u>:
  - Children ages 2-13 y:
    - ✓ Higher protein needs (0.95-1.00 g/kg wt/d)
    - ✓ Higher Vitamin D needs (15 µg/day)
  - Youth ages 14-18 y:
    - ✓ Higher protein needs (0.85 g/kg wt/d)
    - ✓ Higher calcium needs (1300 mg/d)
    - ✓ Higher iron needs
- Supplements NOT recommended

DGA Recommendations: Childhood (2-18 years)

- Formation of dietary patterns
  - Established in this life-stage → continue into adulthood
  - Same 3 dietary patterns recommended: Healthy American, Healthy Vegetarian, Mediterranean
  - Vegan dietary pattern is NOT recommended, especially for younger children
- Same food groups to meet recommendations
- Same foods to consume in moderation/limit



DGA Recommendations: Childhood (2-18 years)

- Family-based meals
  - What does this look like?
  - Why does this matter?
    - ✓ Food introduction/control
    - ✓ Positive social interactions/support
    - ✓ Eating frequencies/patterns
    - ✓ Provides healthier options