Nutrition for oral health throughout childhood and adolescence

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Nutrition for oral and systemic health throughout childhood and adolescence

Teresa A. Marshall has no conflicts of interest with any organizations 4/30/21
Presentation organization

→ Identify characteristics of the normal pediatric diet
→ Review associations between diet/nutrition
  • Caries
  • Periodontal disease
  • Oral cancer
  • Dental erosion
→ Describe strategies to screen and assess the pediatric diet for oral health risk
Purpose of childhood….

→ To grow…physically, cognitively, emotionally…
→ To achieve one’s full ‘innate’ potential…
→ To live at full capacity as an adult…
  • Healthy
  • Happy
  • Productive
  • Function physically, cognitively and emotionally

→ Dependent on access to adequate and appropriate ‘nutrition’ throughout childhood and adolescence
Pediatric diet and nutrition

Identify characteristics of the normal pediatric diet
Objectives of the pediatric diet

→ To provide adequate nutrients for growth, maintenance and repair
  • Addresses the physical and cognitive growth

→ To limit substances associated with disease and/or ill health
  • Addresses the healthy condition

→ Within an environment that fosters mental well being
  • Addresses the emotional growth

→ Presentation today – identify the diet that meets these goals
  • With special emphasis on oral health
Diet and nutrition

- Diet – combination of foods consumed
- Foods – compounds that we consume
- Nutrients – substances within foods that support growth, maintenance and repair
Nutrient Requirements

Intakes defined by Dietary Reference Intakes (USA)

- Vitamins & minerals
  - Range of acceptable intake
- Carbohydrate, fat and protein – energy containing
  - Protein – to provide adequate essential amino acids
  - Fat – to provide adequate essential fatty acids
  - Balance – to meet, but not exceed energy requirements
- Water
  - Range of acceptable Intake

Delivered by foods – MyPlate –

- Quantities of foods balanced to provide adequate nutrients
  - Without excessive substances associated with disease
Failure to achieve desired nutrient intakes

→ Malnutrition
  • Deficiency of nutrients/energy
  • Excess of nutrients/energy
  • Imbalance of nutrients
Malnutrition etiology

→ Primary:
  • Inadequate food intake (deficiencies)
  • Excessive food intake (toxicities)
  • Inappropriate food choices (deficiency/toxicity blend)

→ Secondary:
  • Altered physiological process resulting in disconnect between intake and tissue level
Malnutrition etiology beyond diet…. nutritional programming

→ The known
  • Early nutrition ‘programs’ lifelong metabolic responses
    • Obesity
    • Type 2 diabetes
    • Cardiovascular disease
  • Mechanisms
    • Epigenetics
    • Early inflammatory response
    • Adipocyte dysfunction
    • Intestinal microbial composition
    • Taste preferences

• Early sweet exposure increases sweet preference

• First 1000 days…proper nutrition is critical for brain development
Feeding practices

- Early infancy
  - Tongue thrust
  - Sucking reflex
  - Oral motor coordination
- Transition to solid foods
- Transition from bottle to cup
- Acceptance of novel foods
- Independence struggles
  - Toddler
  - Adolescent
Food choices

- Food Groups
- Texture
- Processing
Meal structure

→ Importance
  • Adequate intake of desirable foods
  • Too frequent
  • Too limited – complicates having a healthy relationship with food

→ Rationale
  • Stomach size
  • Growth rate

→ Ideal…balance between adequate intake and maintaining an appetite
  • 3 meals and 1-3 snacks
  • Caloric beverages at meal/snack time
Healthy food environment

- Balance of food groups meeting energy requirements
- Access
  - Food security
- Pleasant surroundings
- Power struggles
  - Ellyn Satter’s book
Summary of normal pediatric nutrition

- Appropriate foods to meet nutrient requirements
- Delivered via structured meal patterns
  - Support growth
  - Limit disease – including caries
- In a healthy environment
Diet, nutrition & oral health

Review relationships between diet, nutrition, and oral health
Caries - Periodontal Disease - Oral Cancer – Dental Erosion
Cariology 101: Classic Keyes model

• Interaction:

  Oral bacteria  Tooth  Carbohydrate
Contemporary carbohydrates

- Microflora
- Improved oral hygiene
- Fluoride therapy
- Both

Carbohydrates
Contemporary cariogenic carbohydrates

→ Modified starches
  - Oxidized, hydrolyzed by acid, gelatinized
  - Chemical structure is changed
  - Effectively reduces the number of steps before the “starch” is cariogenic

→ Oligosaccharides
  - Byproduct of starch breakdown
  - Short chain polysaccharide (3-10 glucose units)
    - Maltodextrin

→ High fructose corn syrup
  - Produced from cornstarch
  - Contains fructose, glucose and oligosaccharides

→ Sugars
  - Sucrose, maltose, lactose and fructose
Dietary Patterns Low-Income African-American Children

ABSTRACT: Objective: To evaluate the relationship of dietary patterns and oral health outcomes in African-American children. We aimed to describe the dietary patterns, nutrient intake, and overall diet quality and correlate them with caries experience.

Research Design and Methods: We conducted a cross-sectional study of 7-year-old children from low-income African-American families. Diet was assessed using a validated FFQ, and caries experience was assessed using the DMFS index.

Results: We identified three distinct dietary patterns: A Healthy Eating Pattern, a Sweet and Fatty Pattern, and a Snack Pattern. The Healthy Eating Pattern was associated with lower caries experience compared to the Sweet and Fatty Pattern. The Snack Pattern was associated with higher caries experience.

Conclusion: Dietary patterns, particularly those associated with higher intake of sugars and fats, are associated with higher caries experience in African-American children. These findings highlight the importance of promoting healthier dietary patterns to improve oral health outcomes.
## Caries at 17 years: lifelong impact of beverages – fluoride - toothbrushing

<table>
<thead>
<tr>
<th>Variable of Interest</th>
<th>Estimated multiplicative effect of exposure (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>0.87 (0.69, 1.11)</td>
<td>0.254</td>
</tr>
<tr>
<td>Juice</td>
<td>0.47 (0.27, 0.83)</td>
<td>0.009</td>
</tr>
<tr>
<td>SSB</td>
<td>1.42 (1.05, 1.92)</td>
<td>0.025</td>
</tr>
<tr>
<td>Water/SFB</td>
<td>0.71 (0.54, 0.93)</td>
<td>0.014</td>
</tr>
<tr>
<td>Total fluoride, excluding SSB fluoride</td>
<td>1.10 (1.01, 1.20)</td>
<td>0.029</td>
</tr>
<tr>
<td>Toothbrushing</td>
<td>0.57 (0.38, 0.86)</td>
<td>0.008</td>
</tr>
<tr>
<td>Female Indicator</td>
<td>1.55 (1.11, 2.18)</td>
<td>0.011</td>
</tr>
<tr>
<td>Baseline SES – Low</td>
<td>1 (Ref.)</td>
<td>-</td>
</tr>
<tr>
<td>Baseline SES – Middle</td>
<td>0.82 (0.53, 1.27)</td>
<td>0.366</td>
</tr>
<tr>
<td>Baseline SES - High</td>
<td>1.13 (0.73, 1.76)</td>
<td>0.582</td>
</tr>
</tbody>
</table>
Exposure

- Frequency
  - Number of times consumed per day

- Length of each consumption period

- Total exposure = # exposures $\times$ length of exposure
Frequency and caries experience

<table>
<thead>
<tr>
<th>Year</th>
<th>Meal</th>
<th>Snack</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.13</td>
<td>2.31</td>
<td>2.03</td>
</tr>
<tr>
<td>(N = 616)</td>
<td>(0.49, 2.60)</td>
<td>(1.08, 4.94)</td>
<td>(0.95, 4.31)</td>
</tr>
<tr>
<td>2</td>
<td>0.58</td>
<td>2.58</td>
<td>2.69</td>
</tr>
<tr>
<td>(N = 527)</td>
<td>(0.29, 1.19)</td>
<td>(1.23, 5.42)</td>
<td>(1.30, 5.58)</td>
</tr>
<tr>
<td>3</td>
<td>1.06</td>
<td>2.39</td>
<td>2.61</td>
</tr>
<tr>
<td>(N = 441)</td>
<td>(0.44, 2.56)</td>
<td>(1.13, 5.06)</td>
<td>(1.23, 5.54)</td>
</tr>
<tr>
<td>4</td>
<td>1.38</td>
<td>4.26</td>
<td>4.62</td>
</tr>
<tr>
<td>(N = 411)</td>
<td>(0.55, 3.50)</td>
<td>(1.58, 11.48)</td>
<td>(1.72, 12.39)</td>
</tr>
<tr>
<td>5</td>
<td>0.90</td>
<td>1.78</td>
<td>1.38</td>
</tr>
<tr>
<td>(N = 413)</td>
<td>(0.40, 2.00)</td>
<td>(0.81, 3.91)</td>
<td>(0.66, 2.90)</td>
</tr>
<tr>
<td>1-5</td>
<td>0.97</td>
<td>2.24</td>
<td>2.26</td>
</tr>
<tr>
<td>(N = 398)</td>
<td>(0.51, 1.85)</td>
<td>(1.03, 4.86)</td>
<td>(1.06, 4.82)</td>
</tr>
</tbody>
</table>

*Adjusted for age at dental exam and total fluoride intake

\* P < 0.05
\*\* P < 0.01
Frequency and early childhood caries

b. Food and beverage frequency

% Children by number of consumption intakes

Food or beverage consumption intakes per day

- Caries-free (n = 38)
- S-ECC (n = 68)
Defined vs. unstructured meal patterns

Contemporary tooth

TOOTH

Carbohydrates

Microflora

Improved oral hygiene
‘Marginal’ tooth

→ Developmental tooth defects
  • Pre/postnatal insults impacting tooth formation
  • Location and severity of defect consistent with timing and nature of insult
  • Defect might increase susceptibility to bacterial colonization and/or acid attack

→ Enamel hypoplasia
  • Type of developmental defect
  • Hypoplastic or hypomineralized enamel
  • Risk factors include malnutrition
    • Vitamin D deficiencies during tooth development
Prenatal vitamin D & ECC

Purpose: to investigate association between maternal vitamin D levels during pregnancy and child caries within one year

Population: Economically disadvantaged pregnant women & offspring
  • Winnipeg, Canada

Results:
  • Mothers with infants having ECC (cavitated) had significantly lower serum 25OHD serum concentrations (p<0.05)
  • Mothers of infants having ECC & white spot lesions tended towards lower serum 25OHD concentrations (p = 0.18)

Conclusion: Low prenatal vitamin D might increase risk of ECC

Prenatal vitamin D & ECC

Schroth et al; Pediatrics. 2014;133; e1277-1284.
Malnutrition & S-ECC

Purpose: to describe nutritional status of children with S-ECC

Population: Children with S-ECC aged 2-6 y in Toronto
  • No control group

Results: Children with severe ECC
  • 17% of children were malnourished
  • 4% low body mass index (BMI)
  • 24% low body fat
  • 16% low serum albumin
  • 80% low serum ferritin, 24% iron depletion, 6% iron deficiency, 11% iron deficiency anemia

Conclusion: Markers of malnutrition present in children with S-ECC

Healthy Eating Index & ECC

→ Purpose: to describe association between diet quality and ECC
→ Population: NHANES 2-5 y children
→ Results:
  • Lower diet quality associated with increased risk of S-ECC (adjusted P = 0.012)
    • Top tertile was 44% less likely to have S-ECC than bottom (P = 0.009)
→ Conclusion: Poor diet quality associated with S-ECC

Life course events and ECC

→ Purpose: Explore ‘life course’ risk factors for ECC
→ Population: Cohort recruited at 8 months and followed till 32 months; China
→ Results:
  • Final model: severity of ECC associated with
    • SES status
    • Hypoplasia
    • Low height (marker for stunting – chronic PEM)
    • Visible plaque
    • S mutans
→ Conclusions: Early life factors, including malnutrition, increase risk of ECC
Periodontal disease - etiology

- Complex chronic inflammatory disease
- Interaction of bacterial infection, the immune system and host’s immune response contribute to the disease process
Periodontitis & nutrition

- Host tissue
- Immune system
- Obesity
Malnutrition: protein energy malnutrition

- Increase risk of bacterial colonization by pathogenic bacteria
- Decreased ability of immune system to fight infection
- Increased susceptibility of unhealthy tissue to insults
- Impaired response of tissue to injury
Individual nutrients

→ Vitamin C
  - Decreased serum vitamin C associated with increased risk of periodontitis in both smokers and nonsmokers

→ Calcium
  - Low dietary intakes (below recommendations) have been associated with increased risk of periodontal disease
Overall diet quality

Purpose: To examine cross-sectional association between diet quality and severe periodontal disease

Population: 13,920 US Hispanic/Latinos
  • Aged 18-74 years

Results: Next slide

Conclusion: Higher diet quality was associated with lower odds of severe periodontal disease
Overall diet quality

Higher AHEI scores = higher diet quality; lowest quartile of scores represents group with lowest diet quality.
Obesity

- Presence of excess body fat
  - >22% in young men, >32% in young women

- BMI (adult; kg/m²)
  - Underweight: < 19
  - Expected: 19-25
  - Overweight: >25-30
  - Obese: >30-40
  - Morbid obesity: >40 (about twice ideal weight)

- Distribution of body fat (android vs. gynoid)
  - Abdominal/visceral fat associated with greater risk of metabolic disease than subcutaneous fat
Dysfunctional adipocytes

Stenkula and Erlanson-Albertsson, Am J Physiol Regul Integr Comp Physiol; 2018.
Adiposity and periodontal disease

→ Purpose: to investigate cross-sectional associations between obesity and periodontitis
→ Population: nonsmoking 13-21 yo participating in HNANES
→ Independent variables
  • Weight (subcutaneous and visceral adipose tissue)
  • Waist circumference (visceral adipose tissue)
  • Skinfold tissue (subcutaneous adipose tissue)
Adiposity and periodontal disease

Results:

• Weight
  • Individuals with periodontal disease weighted 7kg more than those without
  • Among 17-21 yo
    • 1 kg increase in weight was associated with a 6% increase in periodontal disease

• Waist circumference
  • Individuals with periodontal disease had a waist circumference 8 cm greater than those without
  • Among 17-21 yo
    • 1 cm waist increase associated with 5% increased risk of periodontal disease

• Skinfolds not associated with periodontal disease

Conclusions

• Slight association between adiposity and periodontal disease, particularly central adiposity

Malnutrition: obesity

- Adipocyte size is associated with inflammation
- Weight is associated with periodontal disease
- Waist circumference is associated with periodontal disease

• In adults and adolescents
Oral cancer

- Malnutrition is associated with increased risk of cancer
  - Limited fruit and vegetable intakes associated with oral cancer

- Smokers typically have lower serum vitamin C levels than nonsmokers
  - Antioxidant
  - Need more dietary vitamin C to maintain serum levels
Dental erosion

Dissolution with subsequent removal of minerals from enamel and/or dentin during exposure to acids

• Extrinsic acids
  • Dietary origin
  • Environmental origin (i.e., pool water)
• Intrinsic acids
  • Gastrointestinal acids
Erosion screen

Figure: Dietary screening and counseling for patients with erosion. Sources: Keesing and colleagues,5 Guarda,70 and Kusani and colleagues.71
Dental erosion

Table 2. Eating behaviors influencing erosion potential.*

<table>
<thead>
<tr>
<th>EATING BEHAVIORS PROLONGING EXPOSURE TIME</th>
<th>EATING BEHAVIORS REDUCING EXPOSURE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent intake</td>
<td>Infrequent intake</td>
</tr>
<tr>
<td>Eating and drinking times longer than 30 minutes</td>
<td>Eating and drinking times shorter than 30 minutes</td>
</tr>
<tr>
<td>Holding beverages or foods</td>
<td>Direct chewing and swallowing</td>
</tr>
<tr>
<td>Pocketing foods</td>
<td>No pocketing of foods</td>
</tr>
<tr>
<td>Single erosive foods</td>
<td>Meals of mixed foods</td>
</tr>
<tr>
<td>Swishing beverages</td>
<td>No swishing of beverages</td>
</tr>
</tbody>
</table>

*Sources: Hasselkvist and colleagues,1 Lussi and Jaeggi,4 Reddy and colleagues,19 Johansson and colleagues,20 Waterhouse and colleagues,21 Bartlett and colleagues,22 and Rios and colleagues.23
Eating disorders: caries risk and erosion

→ Increased caries risk
  • Behaviors prolonging exposure
  • Ultra-processed foods
    • Bulimia nervosa
    • Binge-eating disorder
    • Compulsive overeating
    • Night eating syndrome
    • Sleep disorder with eating issues

→ Increased erosion risk
  • Exposure to gastric acid
    • Bulimia nervosa
    • Rumination
    • Purging disorder
Summary of diet, nutrition & oral health

- Caries
- Periodontal disease
- Oral cancer

Increased exposure to fermentable carbohydrates

Increased energy intake (i.e., obesity)

- Caries
- Periodontal disease
- Oral cancer

Inadequate energy intake (i.e., PEM)

Inadequate nutrient intakes

- Oral cancer
- Periodontal disease
- Oral cancer
Oral disease prevention

Carious vs. non-carious diets

Toxic food environment
Caries etiology

→ 3 opportunities for intervention

- Fermentable carbohydrates
- Frequency of exposure
- Nutritional adequacy

Consistent Message
What is a carious diet?

→ Combination of foods that when consumed
  • Provides fermentable carbohydrates
  • At frequent intervals
  • In sufficient quantities
  • To support acid production by oral bacteria

→ *Does not* provide adequate nutrients to support
  • Normal development of tooth structure
  • Production of sufficient, normal saliva and/or
  • Maintenance of normal immune responses
What is a non-cariogenic diet?

→ Combination of foods that when consumed
  • Provides fermentable carbohydrates
  • At infrequent intervals and in
  • Insufficient quantities
  • To support acid production by oral bacteria

→ Provides adequate protein, energy and nutrients to support normal growth and tissue maintenance
What does a non-cariogenic diet look like?

- MyPlate: [https://www.myplate.gov/](https://www.myplate.gov/)
- Structured meal patterns
  - 3 meals and 2-3 snacks

- Same diet is consistent with periodontal disease prevention, oral cancer disease prevention and systemic health
So why are we where we’re at?

→ We know what a healthy diet is
  • Health promotion
  • Disease prevention

→ Achieving that diet is the problem…at least as we become more ‘westernized’ throughout the world.

→ Why????
“Toxic” food environment

Environment characterized by

- Highly processed foods
  - High energy
  - High fat
  - High sugar
- Readily accessible foods
  - 24/7 availability
  - Fast food establishments
- Heavily marketed foods
  - Shelf location
  - Targeted advertisements
- Limited physical activity
Social determinants of health
Diet counseling

Screening
Assessment
Assessment strategies

→ **Screen** every patient

→ **Assess** those identified at risk for caries or other oral disease
  
  • Obvious disease – target assessment towards current disease
  
  • ‘Healthy’ – target assessment towards prevention

→ **Refer** patients with dietary/systemic health red flags
Goals of screening process

→ Identify patients at risk due to marginal dietary habits
  • Caries risk
  • Periodontal disease risk
  • Oral cancer risk
  • Erosion risk
Screening process

→ Frequency
  • Eats more than 3 meals per day?
  • Eats more than 3 snacks per day?
  • Meals/snacks are not structured (on and off grazing)?
→ Drinks sugared beverages (juice, soft drinks, energy drinks) daily?
  • Drinks more than 8 oz sugared beverages (or juice) daily?
  • Drinks beverages for more than 30 minutes daily?
→ Compliance with MyPlate?
  • All food groups in adequate quantities
  • All food groups consumed daily; inadequate quantities
  • Missing food groups
Goals of assessment process

→ Identify dietary habits that increase disease risk
  • Educate as to rationale for ‘better’ dietary habits
  • Provide guidelines to achieve ‘better’ dietary habits
  • Focus recommendations
    • Patient motivation
    • Reasonable changes

→ Practical perspective
  • Easy for clinician
  • Efficient for practice
  • Patient has to remember conversation when they get home
Chairside diet assessment of caries risk

- Defines key dietary areas for caries risk
- Presents concept of anticipatory guidance
  - Recognize potential obstacles and provide advice before obstacles become a problem
  - No one food is consumed in isolation
    - What are ripple effects of consumption
    - What are ripple effects of lack of consumption
- Examples
## Assessment queries

<table>
<thead>
<tr>
<th>Number</th>
<th>Question</th>
<th>Rationale</th>
<th>Potential Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Are you following a special diet?</td>
<td>Background for diet-related recommendations</td>
<td>Diet-related caries risk recommendations should be consistent with systemic dietary recommendations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify caries risk associated with special diet</td>
<td>Address food choices and eating behaviors associated with caries risk</td>
</tr>
<tr>
<td>2</td>
<td>What changes have you made to your diet during the past 6 months to a year?</td>
<td>Dietary changes might have implications for caries risk</td>
<td>Reinforce dietary changes that decrease caries risk and/or improve overall diet quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Address dietary changes that increase caries risk and/or decrease overall diet quality</td>
</tr>
</tbody>
</table>
Screening & assessment outcome

- Identification of problem
- Etiology of problem
- Counseling within scope of practice
- Referral
  - Appropriate referral
Etiology of problem

→ Knowledge
  • Nutrition basics
  • Meal planning

→ Skillset
  • Food preparation
  • Budgeting – WIC, SNAP $$

→ Resources
  • Transportation to grocery…affordable grocery
  • Adequate housing…fridge and cooking resources
  • $$ to purchase foods

→ Capacity
  • Ability to do more
Diet therapy & disease counseling summary

- Evaluate the situation
- Identify the problem
- Understand rationale for problem
- Provide guidance to address the root of problem
  - Counseling
- Refer if appropriate

Social determinants of health
Toxic food environment
United health care approach
A healthy pediatric diet

- Provide adequate nutrients for growth, maintenance and repair
  - Addresses the physical and cognitive
- Limit substances associated with disease and/or ill health
  - Addresses the healthy condition
- Exist within an environment that fosters mental well being
  - Addresses the emotional growth
Thank you…

Questions