IDENTIFYING MALNUTRITION IN PEDIATRIC ONCOLOGY PATIENTS THROUGH NUTRITION-FOCUSED PHYSICAL EXAM

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APRIL 4, 2018
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Independent Contractor, Abbott Nutrition Health Institute (ANHI)
LEARNING OBJECTIVES

1. Outline criteria for diagnosing pediatric malnutrition
2. Identify malnutrition risk factors over the course of childhood cancer treatment
3. Describe the components of a head-to-toe physical exam
4. Identify focus areas for NFPE in the pediatric oncology patient population
**PEDIATRIC MALNUTRITION**

- **Imbalance** between *nutrient requirements* and *intake* resulting in *cumulative deficits* in *energy, protein, or micronutrients* that may negatively affect growth, development, and other relevant outcomes

- **5 key domains**
  - Anthropometry, etiology & chronicity (illness-related or nonillness-related, acute or chronic), mechanism, imbalance, outcomes

- **4 mechanisms for illness-related malnutrition**
  - Decreased intake/starvation, increased requirement/hypermetabolism, increased losses, altered utilization of nutrients
Consensus Statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: Indicators Recommended for the Identification and Documentation of Pediatric Malnutrition (Undernutrition)

Patricia J. Becker, MS, RD, CSP, LDN, CNSC; Liesje Nieman Carney, RD, CSP, LDN; Mark Richard Corkins, MD, CNSC, SPR, FAAP; Jessica Monczka, RD, LDN, CNSC; Elizabeth Smith, RD, LDN, CNSC; Susan Elizabeth Smith, RD, CSP, LD; Bonnie A. Spear, PhD, RDN, LD; Jane V. White, PhD, RD, LDN, FADA, FAND
## Consensus Statement Indicators

<table>
<thead>
<tr>
<th>Indicators (&lt;2 years old)</th>
<th>Indicators (&gt;2 years old)</th>
<th># of Data points (value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-for-length</td>
<td>Body Mass Index (BMI)</td>
<td>One (z score)</td>
</tr>
<tr>
<td>Length</td>
<td>Height</td>
<td>One (z score)</td>
</tr>
<tr>
<td>MUAC</td>
<td>MUAC</td>
<td>One (z score)</td>
</tr>
<tr>
<td>Growth velocity</td>
<td>Weight loss</td>
<td>Two (% norm/usual)</td>
</tr>
<tr>
<td>Decline in wt-for-length z score</td>
<td>Decline in BMI-for-age z score</td>
<td>Two (difference)</td>
</tr>
<tr>
<td>Dietary intake</td>
<td>Dietary intake</td>
<td>Two (% estimated)</td>
</tr>
</tbody>
</table>

# PRIMARY INDICATORS

One Data Point

<table>
<thead>
<tr>
<th>Indicator (z score)</th>
<th>Mild Malnutrition</th>
<th>Moderate Malnutrition</th>
<th>Severe Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-for-length (1 mo – 2 yrs)</td>
<td>-1 to -1.9</td>
<td>-2 to -2.9</td>
<td>-3 or below</td>
</tr>
<tr>
<td>BMI-for-age (2 – 18 yrs)</td>
<td>-1 to -1.9</td>
<td>-2 to -2.9</td>
<td>-3 or below</td>
</tr>
<tr>
<td>MUAC (6 mo – 5 yrs)</td>
<td>-1 to -1.9</td>
<td>-2 to -2.9</td>
<td>-3 or below</td>
</tr>
<tr>
<td>Length/height-for-age (1 mo – 18 yrs)</td>
<td>No data</td>
<td>No data</td>
<td>-3 or below</td>
</tr>
</tbody>
</table>

# PRIMARY INDICATORS

## Two Data Points

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mild Malnutrition</th>
<th>Moderate Malnutrition</th>
<th>Severe Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth velocity (&lt;2 yrs of age)</td>
<td>&lt;75% of norm for expected wt gain*</td>
<td>&lt;50% of norm*</td>
<td>&lt;25% of norm*</td>
</tr>
<tr>
<td>Weight loss (2 – 18 yrs of age)</td>
<td>5% usual body weight</td>
<td>7.5% usual body weight</td>
<td>10% usual body weight</td>
</tr>
<tr>
<td>Decline in wt-for-length or BMI-for-age z score</td>
<td>↓ of 1 SD</td>
<td>↓ of 2 SD</td>
<td>↓ of 3 SD</td>
</tr>
<tr>
<td>Inadequate nutrient intake</td>
<td>51 – 75% estimated energy/protein needs</td>
<td>26 – 50% estimated energy/protein needs</td>
<td>≤25% estimated energy/protein needs</td>
</tr>
</tbody>
</table>

*using WHO 2006 weight velocity standards  
SD: standard deviation(s)  
EVALUATING THE INDICATORS

• The “Malnutrition Clinical Characteristics Validation and Staffing Study” is underway and has the following specific aims:
  1. Determine the predictive validity of the MCC, or indicators, in relation to patient outcomes
  2. Determine the interrater reliability of the indicators
  3. Quantify the amount of RDN care that is associated with improved inpatient outcomes
• Two-year study timeline with goal of 600 adult and 600 pediatric patients from 60 facilities
• Funded by the Academy Foundation and administered under the leadership of the Academy’s RISA team and Dr. Alison Steiber as principal investigator and co-investigator Dr. Elizabeth Yakes Jimenez, Director of the DPBRN
Malnutrition Risk in the Pediatric Oncology Population: PREVALENCE

- Malnutrition prevalence at diagnosis and during treatment varies based on disease process (Brinksma A et al. *Crit Rev Oncol Hematol*. 2012;83:249-275.)
  - Leukemia: 5–10% at diagnosis, 0–5% during treatment
  - Neuroblastoma: 50% at diagnosis, 20–50% during treatment
  - Solid tumors: estimated 0–30% at diagnosis and during treatment
  - Less is known about patients with brain tumors: one study found 31% of patients with medulloblastoma to be malnourished at diagnosis
- 0–65% prevalence in pediatric cancer patients as defined by BMI, wt loss, MUAC, or TSF based on a review of 46 studies (Iniesta RR et al. *Nutr Rev*. 2015;73:276-295.)
- ~25% of children showed a significant reduction in z scores for wt-for-age, ht-for-age, or wt-for-ht at dx (Brinksma A et al. *Pediatr Blood Cancer*. 2015;62:269-273.)
- A multicenter cohort study assessed prevalence of malnutrition at dx and during therapy at multiple intervals (Zimmermann K et al. *Pediatr Blood Cancer*. 2013;60:642-649.)
  - 5.8% of patients had BMI z scores below -2 at dx
  - During therapy, incidence rose to 22–47% (based on BMI z score under -2 OR wt loss >10% from dx)
  - Age >10 at dx, BMI under -1 at dx, and medulloblastoma were positively associated with a higher proportion of malnutrition time during therapy
- ~33% of children with cancer demonstrated z scores under -2 for wt-for-age, ht-for-age, wt-for-ht, or BMI-for-age (Srivastava R et al. *Indian J Cancer*. 2015;52:199-201.)
  - Malnutrition positively associated with solid tumors and those coming from rural communities
  - Higher prevalence of wasting in ages <5 years
More on Malnutrition Risk in the Pediatric Oncology Population

OUTCOMES

Morbidity and infectious complications, mortality/survival, body composition, quality of life measures

• Malnutrition during initial phase of therapy associated with worse survival, and weight loss of >5% in first 3 months after dx associated with increased presence of febrile neutropenic episodes with bacteremia in 1st year after dx (Loeffen EA et al. Support Care Cancer. 2015;23:143-150.)

• Despite initial wt loss, BMI and fat mass increased during and after treatment—resulting in a 100% increase in # of overnourished pts—but fat-free mass (which was low at dx) remained low (Brinksma et al. Clin Nutr. 2015;34:66-73.)

• Undernutrition and weight loss associated with lower health-related QOL scores, specifically in physical functioning, emotional and social functioning, pain, and nausea (Brinksma A et al. Support Care Cancer. 2015;23:3043-3052.)

NUTRIENTS OF CONCERN

• Based on inadequate intakes, lab values reflective of depletion, or treatment side effects
  – Vitamin D
  – Vitamins A, C, and E
  – Magnesium
  – Selenium
  – Zinc

**Table 4: Pediatric patients risk for malnutrition according to disease, treatment and demographics**

<table>
<thead>
<tr>
<th>Tumor type</th>
<th>High risk of malnutrition</th>
<th>High risk of adiposity</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk of malnutrition</td>
<td>Presentation with and/or undergoing treatment for</td>
<td>Presentation with and/or undergoing treatment for</td>
</tr>
<tr>
<td>Solid tumor in advance stages</td>
<td>central nervous system tumors</td>
<td>Brain tumors</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>Craniopharyngioma</td>
<td>Female</td>
</tr>
<tr>
<td>Wilms tumor</td>
<td>Medulloblastoma</td>
<td>Greater than %BMI at diagnosis</td>
</tr>
<tr>
<td>Rhabdomyosarcoma</td>
<td>Astrocytoma</td>
<td>ALL &lt;10 years at diagnosis</td>
</tr>
<tr>
<td>Undergoing treatment for</td>
<td>Undergoing treatment for</td>
<td>Hispanic</td>
</tr>
<tr>
<td>Advanced stage Ewing sarcoma</td>
<td>ALL</td>
<td>Male</td>
</tr>
<tr>
<td>Multiple relapsed and some high-risk leukemia</td>
<td>Ependymoma</td>
<td></td>
</tr>
<tr>
<td>Head and neck tumors</td>
<td>Nasopharynx carcinoma</td>
<td></td>
</tr>
<tr>
<td>Diencephalic tumors</td>
<td>Sarcoma</td>
<td></td>
</tr>
<tr>
<td>Poststem cell transplantation (graft vs. host disease)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment modality</td>
<td>Irradiation to the GIT</td>
<td>Extensive brain surgery</td>
</tr>
<tr>
<td>Major abdominal surgery</td>
<td>High dose cranial/cranial spinal radiotherapy</td>
<td></td>
</tr>
<tr>
<td>Bone marrow transplant</td>
<td>Total body or abdominal radiotherapy</td>
<td></td>
</tr>
<tr>
<td>Intense frequent intervals of chemotherapy</td>
<td>Prolonged corticosteroid therapy with large doses or other drugs that can increase body fat stores</td>
<td></td>
</tr>
<tr>
<td>(&lt;3 weeks) in the absence of corticosteroids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient demographics</td>
<td>Infancy</td>
<td>Brain tumors</td>
</tr>
<tr>
<td>Low social-economic status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of family or health supports system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GIT=Gastrointestinal tumor; ALL=Acute lymphoblastic leukemia; BMI=Body mass index
Every day, 43 children are diagnosed with cancer.

60% of children who survive cancer suffer long-term side effects.

More than 40,000 kids are in cancer treatment each year.
NUTRITION-FOCUSED PHYSICAL EXAM (NFPE)

“Each RDN:
Obtains and assesses findings from NFPE (eg, indicators of vitamin/mineral deficiency/toxicity, edema, muscle wasting, subcutaneous fat loss, altered body composition, oral health, feeding ability [suck/swallow/breathe], appetite, and affect.)”

GETTING STARTED

TOOLS
- eyes; hands; tape measure; penlight; tongue depressor; oral swab, or gauze; dynamometer; gown and gloves

TECHNIQUES
- inspection, palpation, percussion, auscultation

BEFORE YOU BEGIN…
- Thorough medical record review
- Start with general survey
- Introduce yourself, explain process and rationale, ask permission
- Hand hygiene, universal precautions

TYPES OF NFPE
- Comprehensive
- OR
- Focused
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcutaneous Fat Loss</td>
<td>Eyes, cheeks, upper arms, torso/buttocks</td>
</tr>
<tr>
<td>Bilateral Muscle Wasting</td>
<td>Temples, chest, shoulders, back, thighs/knees, calves</td>
</tr>
<tr>
<td>Micronutrient Exam</td>
<td>Hair, eyes, mouth, skin, nails</td>
</tr>
<tr>
<td>Hydration/Fluid Status</td>
<td>Dehydration, edema (generalized, sacral, lower extremity)</td>
</tr>
<tr>
<td>Functional Status</td>
<td>Developmental milestones, baseline activity, grip strength</td>
</tr>
</tbody>
</table>
# Subcutaneous Fat Loss

<table>
<thead>
<tr>
<th>NFPE Region</th>
<th>Anatomical Landmarks</th>
<th>Well Nourished</th>
<th>Mild – Moderate Malnutrition</th>
<th>Severe Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orbital Fat Pads (Eyes)</strong></td>
<td>Orbital bones/eye socket and brow bone (supraorbital ridge)</td>
<td>Slightly bulged fat pads</td>
<td>Slightly dark circles</td>
<td>Hollow, depressed dark circles; loose skin, prominent brow bone, “hollow-eye” appearance</td>
</tr>
<tr>
<td><strong>Buccal Fat Pads (Cheeks)</strong></td>
<td>Cheek bones (zygomatic or malar bones) and upper lip</td>
<td>Full, round, filled out cheeks</td>
<td>Flat cheeks</td>
<td>Hollow, sunken, narrow face</td>
</tr>
<tr>
<td><strong>Triceps (Upper Arm)</strong></td>
<td>Back of upper arm midway between elbow and armpit when shoulder and elbow are flexed to 90°</td>
<td>Thick fat fold between the fingers</td>
<td>Some space between the fingers</td>
<td>Minimal space between fingers with fingers almost touching</td>
</tr>
<tr>
<td><strong>Torso/Trunk (Ribcage, Lower Back, Pelvis)</strong></td>
<td>Costal arch and intercostal spaces of front ribs, midaxillary line, thoracic and lumbar vertebrae, iliac crest of pelvis; buttocks (infants and children)</td>
<td>Ribs do not show in the front of the body when facing the patient; slight to no protrusion of iliac crest</td>
<td>Apparent ribs with slight depressions in intercostal spaces; iliac crest somewhat prominent</td>
<td>Very apparent depressions between ribs and around costal margin; iliac crest very prominent</td>
</tr>
</tbody>
</table>
ANATOMICAL LANDMARKS: FAT LOSS

[Images of anatomical landmarks with corresponding labels and references to sources such as OpenStax Anatomy & Physiology, Wikimedia Commons, and Pearson Scott Foresman.]
EXAMPLES OF FAT LOSS

Orbital Fat Loss
Buccal Fat Loss
Upper Arm Fat Loss
Trunk/Torso Fat Loss
MID-UPPER ARM CIRCUMFERENCE (MUAC)

PROCEDURE

• Position child facing away from you with elbow flexed to 90° angle in sagittal plane and palm facing up
• Palpate acromion process of the shoulder, then measure distance from posterior aspect to olecranon process of the elbow
• Average two measurements, mark the midpoint, and have child relax marked arm at side
• Use non-stretchable flexible tape to measure around arm at midpoint to nearest 0.1 cm

COMPARATIVE STANDARDS

• WHO MGRS data, including z scores, are available for ages 3 months to 5 years
  – Measurements taken on left arm
• NHANES MUAC data from 1999-2012 used to generate z scores for ages 2 months to 18 years (Abdel-Rahman et al. 2017.)
  – Measurements taken on right arm
• Both available at www.peditools.org

Photo: PHIL, CDC
## BILATERAL MUSCLE WASTING

<table>
<thead>
<tr>
<th>NFPE Region (Muscle)</th>
<th>Anatomical Landmarks</th>
<th>Well Nourished</th>
<th>Mild – Moderate Malnutrition</th>
<th>Severe Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temples (Temporalis)</td>
<td>Temporalis muscle</td>
<td>Well-defined muscle</td>
<td>Slight depression</td>
<td>Hollowing or scooping depression</td>
</tr>
<tr>
<td>Chest (Pectoralis Major)</td>
<td>Clavicle</td>
<td>Clavicle visible but not prominent; fingers should not slide under clavicle</td>
<td>Some protrusion of clavicle</td>
<td>Protruding, prominent clavicle</td>
</tr>
<tr>
<td>Shoulders (Deltoid)</td>
<td>Acromion process</td>
<td>Rounded, curved junction between shoulders and neck</td>
<td>Slight protrusion of acromion process; shoulders not square</td>
<td>Square shoulders with prominent bones</td>
</tr>
<tr>
<td>Back (Trapezius, Supraspinatus, Infraspinatus)</td>
<td>Scapula</td>
<td>Scapula not prominent, no evident depressions around scapular borders</td>
<td>Some areas of scapula are evident</td>
<td>Prominent scapula with depressions above, between, and below</td>
</tr>
<tr>
<td>Anterior Thigh and Knee (Quadriceps)</td>
<td>Patella</td>
<td>Quadriceps protrude, muscle is well-rounded without depressions, and patella is not prominent</td>
<td>Noticeable patella with little muscle mass; slight depression along inner thigh</td>
<td>Square, prominent knee with no muscle mass; obvious depression along inner thigh</td>
</tr>
<tr>
<td>Calf (Gastrocnemius)</td>
<td>Posterior calf</td>
<td>Firm, bulb-shaped muscle</td>
<td>Some shape and firmness</td>
<td>Thin, flat muscle without definition</td>
</tr>
</tbody>
</table>
EXAMPLES OF MUSCLE WASTING

Temporals, Pectorals Major, Deltoids, Back Muscles, Quadriceps, and Gastrocnemius Wasting

Images: Wikimedia Commons, Fridtjof Nansen (left); Wikimedia Commons, unknown (center); Flickr, Public Domain (right)
MICRONUTRIENT EXAM

- Look for signs and symptoms of specific nutrient deficiencies
  - Primary deficiency (inadequate intake)
  - Secondary deficiency (altered utilization)
    - Medical condition or illness, medications including chemotherapy, treatments including radiation and surgery, etc.
- Use in conjunction with serum/laboratory markers
  - Presence of inflammation can skew values and may influence timing of collection and/or interpretation of results
- Collaborate with subspecialists as indicated
  - Ophthalmology, dentistry, dermatology, others…
American Childhood Cancer Organization: https://www.acco.org/drugs-chemotherapy-drugs-and-other-pharmaceuticals
## HAIR

### Signs | Possible Micronutrient Deficiency
---|---
Alopecia (thin, sparse, patchy) | Iron, zinc*, biotin
Color changes, depigmentation, lackluster | Manganese, selenium*, copper
Easily pluckable | Essential fatty acids, zinc*
Corkscrew hair (coiled, swan-necked) | Vitamin C*
Flag Sign | Protein-calorie malnutrition
Lanugo | Calorie deficiency

### Technique
Starting at scalp, inspect hair from root to tip looking for alterations in color, pigmentation, distribution pattern, shine, texture, and quantity.

Photos: (left, bottom left) Creative Commons, Feed My Starving Children (FMSC); (bottom right) ADAM, NIH
# EYES

## Signs

<table>
<thead>
<tr>
<th>Signs</th>
<th>Possible Micronutrient Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular blepharitis</td>
<td>Riboflavin, biotin, vitamin B6, zinc*</td>
</tr>
<tr>
<td>Pale conjunctiva</td>
<td>Vitamin B6, vitamin B12, folate, iron, copper, anemias</td>
</tr>
<tr>
<td>Night blindness, dry membranes, dull/milky cornea, keratomalacia, Bitot’s spots</td>
<td>Vitamin A*</td>
</tr>
<tr>
<td>Ophthalmoplegia</td>
<td>Thiamin, phosphorus</td>
</tr>
<tr>
<td>Angular palpebritis; red, inflamed conjunctiva; swollen eyelids</td>
<td>Niacin, riboflavin, iron, vitamin B6</td>
</tr>
</tbody>
</table>

## Technique

1. Have patient look left, right, and up while inspecting sclera for color, dryness, or plaques using penlight in a wide “W” motion
2. Gently pull lower eyelid down to assess conjunctiva for color/paleness

Photos: PHIL, CDC
# MOUTH

**Technique**

Inspect (1) mouth/lips, (2) teeth/gums, and (3) tongue for oral hygiene, dry or cracked lips, sores, cavities, bleeding gums, and color/texture of tongue

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<table>
<thead>
<tr>
<th>Signs</th>
<th>Possible Micronutrient Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angular stomatitis or cheilitis</td>
<td>Riboflavin, niacin, iron, vitamin B6, vitamin B12</td>
</tr>
<tr>
<td>Smooth, beefy red tongue</td>
<td>Vitamin B12, niacin</td>
</tr>
<tr>
<td>Purplish/magenta tongue</td>
<td>Riboflavin</td>
</tr>
<tr>
<td>Glossitis</td>
<td>Riboflavin, niacin, vitamin B6, vitamin B12, folate, severe iron deficiency</td>
</tr>
<tr>
<td>Pale tongue</td>
<td>Vitamin B12, folate, iron</td>
</tr>
<tr>
<td>Gingivitis, bleeding gums</td>
<td>Vitamin C*, niacin, folate, zinc*, severe vitamin D deficiency*</td>
</tr>
</tbody>
</table>

Photos: PHIL, CDC
## Skin

<table>
<thead>
<tr>
<th>Signs</th>
<th>Possible Micronutrient Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eczema</td>
<td>Riboflavin, zinc*</td>
</tr>
<tr>
<td>Follicular hyperkeratosis</td>
<td>Vitamin A* or vitamin C*</td>
</tr>
<tr>
<td>Pallor</td>
<td>Iron, vitamin B12, folate, anemia</td>
</tr>
<tr>
<td>Pellagra</td>
<td>Niacin, tryptophan, vitamin B6</td>
</tr>
<tr>
<td>Perifollicular hemorrhage</td>
<td>Vitamin C*</td>
</tr>
<tr>
<td>Petechiae</td>
<td>Vitamin C*, vitamin K</td>
</tr>
<tr>
<td>Poor wound healing, pressure ulcers</td>
<td>Zinc*, vitamin C*</td>
</tr>
<tr>
<td>Purpura</td>
<td>Vitamin C*, vitamin K, excessive vitamin E</td>
</tr>
<tr>
<td>Seborrheic dermatitis</td>
<td>Biotin, vitamin B6, zinc*, riboflavin, essential fatty acids, vitamin A excess or deficiency*</td>
</tr>
<tr>
<td>Xerosis, abnormal dryness</td>
<td>Vitamin A*, essential fatty acids</td>
</tr>
</tbody>
</table>

**Technique**

Inspect for color changes, texture, lesions, rashes, turgor, hygiene, temperature, and integrity.
## NAILS

**Technique**
Inspect for color, length, shape, symmetry, texture, and capillary refill. Findings related to nutritional deficiencies are typically found on all nails.

<table>
<thead>
<tr>
<th>Signs</th>
<th>Possible Micronutrient Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koilonychia (spoon-shaped, concave)</td>
<td>Iron, anemia</td>
</tr>
<tr>
<td>Mottled, poor blanching, pale</td>
<td>Vitamin A*, vitamin C*</td>
</tr>
<tr>
<td>Beau’s lines (transverse ridges, horizontal grooves)</td>
<td>Severe zinc* deficiency, hypocalcemia</td>
</tr>
<tr>
<td>Muehrcke’s lines (transverse white lines)</td>
<td>Malnutrition, hypoalbuminemia</td>
</tr>
<tr>
<td>Central ridges</td>
<td>Iron, folate</td>
</tr>
<tr>
<td>Splinter hemorrhage</td>
<td>Vitamin C*</td>
</tr>
<tr>
<td>Brittle, soft, dry, weak or thin, split easily</td>
<td>Magnesium*, severe malnutrition, vitamin A and selenium toxicity</td>
</tr>
</tbody>
</table>

Photos: Wikimedia Commons: (top L) Lyrl, (top R) Elipongo, (bottom L) Yannick Trottier, (bottom R) Splarka
DEHYDRATION

• Lab Findings
  – Increased sodium, chloride, BUN, Cr, serum osmolality, urine specific gravity

• Clinical Findings
  – Hypotension, tachycardia, delayed capillary refill

• Physical Findings
  – Weight loss, sunken eyes, dark urine or decreased urine output, dry mucous membranes, thick saliva, clammy skin, cracked lips, poor skin turgor

OVERHYDRATION

• Lab Findings
  – Decreased sodium, chloride, BUN, Cr, serum osmolality, urine specific gravity

• Clinical Findings
  – Hypertension, elevated central venous pressure (CVP)

• Physical Findings
  – Weight gain, puffy eyes, light colored urine, moist skin, anasarca, dyspnea, lung crackles
  – Edema: generalized, sacral, lower extremity

# EDEMA AND MALNUTRITION

<table>
<thead>
<tr>
<th>Well Nourished</th>
<th>Mild – Moderate Malnutrition</th>
<th>Severe Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fluid accumulation</td>
<td>Mild to moderate pitting (up to 4 mm) that persists for up to 30 seconds</td>
<td>Deep pitting (4-8 mm) lasting greater than 30 seconds</td>
</tr>
</tbody>
</table>

**Exam Area:** Anterior surface of foot OR sacral area over posterior pelvis in non-ambulatory individuals

**NFPE Technique:** Press on middle to distal surface of foot for 5 seconds; observe for pitting

Photo: PHIL, CDC
FUNCTIONAL STATUS

BASELINE ACTIVITY LEVEL
- Ask questions about usual energy and activity levels
- Assess for severity of dysfunction, worsening impairment, and changes in function over previous two weeks
- View changes in comparison with child’s own baseline rather than with age-matched peers

DEVELOPMENTAL MILESTONES
- Note developmental delays, but evaluate functional impairment through changes in activity level or regression in skills from child’s own baseline

HANDGRIP STRENGTH (HGS)
- Studies in adult populations have found HGS shows an earlier response to nutritional changes than labs or anthropometrics
- Comparative standards for absolute and normalized (grip strength [kg]/weight [kg]) published in 2015 for 6 – 80 years of age based on NHANES 2011-12 data
- HGS does not quantify malnutrition, but changes over time for an individual can be suggestive of improvement or deterioration of nutrition status
- Requires calibrated equipment, trained clinicians, ability of patient to follow directions, and use of age and sex-specific reference data
### DEVELOPMENTAL MILESTONES

<table>
<thead>
<tr>
<th>Age</th>
<th>Developmental Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>Mimics sounds, looks at self in mirror, rolls from front to back and back to front, begins to sit unsupported, likes to interact with others, responds to name, babbles vowel sounds (ah, eh, oh), begins to say consonant sounds (m, b), shows curiosity</td>
</tr>
<tr>
<td>12 months</td>
<td>Uses and copies simple gestures (shaking head no, waving goodbye), responds to simple spoken requests, can say “mama” and “dada,” pulls to stand, may walk holding onto furniture or stand alone, may show stranger anxiety, has favorite things and people</td>
</tr>
<tr>
<td>18 months</td>
<td>Walks independently, drinks from a cup, eats with a spoon, identifies common objects and their uses (phone, spoon), speaks several single words, points to show interest, plays pretend such as feeding a doll, may have temper tantrums, scribbles</td>
</tr>
<tr>
<td>2 years</td>
<td>Speaks 2-4 word sentences, shows excitement around other children, follows simple instructions, can kick a ball and stand on tiptoe, identifies objects or pictures by pointing when named, might use one hand more than the other, may show defiant behavior</td>
</tr>
<tr>
<td>3 years</td>
<td>Mimics actions of others, converses using 2-3 sentences at a time, climbs, runs, plays make-believe, shows affection, dresses and undresses self, may get upset with changes in routine</td>
</tr>
<tr>
<td>4 years</td>
<td>Hops and stands on one foot for up to 2 seconds; pours, cuts with supervision, and mashes own food; tells stories, sings songs, recites simple rhymes, uses “he” and “she” correctly; enjoys playing with other children and can play cooperatively; draws a stick figure; uses scissors</td>
</tr>
<tr>
<td>5 years</td>
<td>Speaks clearly, knows name and address, understands real and make-believe, counts 10 or more things, can print some letters or numbers, copies geometric shapes, uses a fork and spoon, can use the bathroom on his/her own, swings and climbs, hops or skips</td>
</tr>
</tbody>
</table>
HEAD-TO-TOE APPROACH

Start at the top and work down:

- Hair
- Eyes
- Mouth (lips, tongue, teeth/gums)
- Temples
- Cheeks
- Chest, shoulders
- Arms, skin, nails
- Ribcage, back, pelvis
- Thighs, knees, calves
- Feet, ankles

Photo: Holly Van Poots
NFPE
Head-to-Toe Demo
Putting It All Together
NFPE FOCUS AREAS FOR THE PEDIATRIC ONCOLOGY POPULATION

- High-risk subsets by tumor type, treatment modality, and demographics
  - MUAC as an early and sensitive indicator
    - Chemotherapy side effects
    - Timing of interventions

Diagnosis

Comprehensive NFPE as able

Treatment

Muscle wasting (esp. upper body), MUAC, HGS, mouth, eyes, skin, nails

Survivorship

Consider late effects of treatment on teeth, eyes, skin, growth/endocrine function, and bone health as well as limb salvage/amputation
IN CONCLUSION...

Children undergoing cancer treatment are especially vulnerable to the development of illness-related malnutrition.

Malnutrition (and overnutrition) are negatively associated with quality of life measures.

NFPE can help RDNs to identify the presence of malnutrition sooner, intervene earlier, and minimize deterioration of nutrition status with the goal of improving outcomes.

NFPE helps you as the RDN to provide the best possible nutrition care for your patients.
ACKNOWLEDGEMENTS

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KELLY GREEN CORKINS, MS, RD-AP, CSP, LDN
THANK YOU!

QUESTIONS, COMMENTS, SUGGESTIONS?
REFERENCES

Malnutrition

Subjective Global Assessment

NFPE
• Collins N, Harris C. The physical assessment revisited: inclusion of the nutrition-focused physical exam. Ostomy Wound Manage. 2010;56(11):18-22
REFERENCES, cont.

NFPE, cont.

Handgrip Strength


Miscellaneous

REFERENCES, cont.

MUAC


