Nutrition – Vitamin/Micronutrient Deficiencies
ESPEN Guidelines for Nutrition Screening 2002

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Nutrition support for adults: oral nutrition support, enteral tube feeding and parenteral nutrition

Clinical guideline
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ESPEN Guidelines on Enteral Nutrition: Gastroenterology

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DGEM: H. Lübke, S. Bischoff, N. Engelmann, P. Thul

ESPEN Guidelines on Parenteral Nutrition: Gastroenterology

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ESPEN guideline: Clinical nutrition in inflammatory bowel disease

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ESPEN Guideline

ESPEN guidelines on definitions and terminology of clinical nutrition

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Fig. 1. Overview of nutrition disorders and nutrition-related conditions.
Key questions to evaluate a patient’s nutritional status
Key questions to evaluate a patient’s nutritional status

• Is my patient (1) malnourished or is he (2) at risk for a malnutrition?
Nutritional Screening Tools to evaluate the **RISK** of Malnutrition

MUST (Malnutrition Universal Screening Tool)

(i) BMI (kg/m²)
- 0 ≥ 20.0
- 1 = 18.5-20.0
- 2 ≤ 18.5

(ii) Weight loss in 3-6 months
- 0 =< 5%
- 1 = 5-10%
- 2 ≥ 10%

(iii) Acute disease effect
Add a score of 2 if there has been or is likely to be no or nutritional intake for > 5 days

Add scores

**OVERALL RISK OF UNDERNUTRITION**

0 LOW
Routine Clinical Care
Repeat screening
Hospital - every week
Care Homes - every month
Community - every year for special groups, e.g., those >75 y

1 MEDIUM
Observe
Hospital - document dietary and fluid intake for 3 days
Care Homes (as for hospital)
Community - Repeat screening, e.g., from <1 mo to >6 mo (with dietary advice if necessary)

2 or more HIGH
Treat
Hospital - refer to dietician or implement local policies.
Generally food first followed by food fortification and supplements
Care Homes (as for hospital)
Community (as for hospital)

# Nutritional Screening Tools

## NRS-2002

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Initial screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is BMI &lt; 20.5?</td>
</tr>
<tr>
<td>2</td>
<td>Has the patient lost weight within the last 3 months?</td>
</tr>
<tr>
<td>3</td>
<td>Has the patient had a reduced dietary intake in the last week?</td>
</tr>
<tr>
<td>4</td>
<td>Is the patient severely ill? (e.g. in intensive therapy)</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Yes:** If the answer is ‘Yes’ to any question, the screening in Table 2 is performed.  
**No:** If the answer is ‘No’ to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Nutritional Screening Tools

NRS-2002

Table 2  Final screening

<table>
<thead>
<tr>
<th>Impaired nutritional status</th>
<th>Severity of disease (≈ increase in requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent Score 0</td>
<td>Normal nutritional status</td>
</tr>
<tr>
<td>Mild Score 1</td>
<td>Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. Chronic hemodialysis, diabetes, oncology</td>
</tr>
<tr>
<td>Moderate Score 2</td>
<td>Major abdominal surgery* Stroke* Severe pneumonia, hematologic malignancy</td>
</tr>
<tr>
<td>Severe Score 3</td>
<td>Head injury* Bone marrow transplantation* Intensive care patients (APACHE &gt; 10)</td>
</tr>
</tbody>
</table>

Score: + Score: = Total score
Age if ≥ 70 years: add 1 to total score above = age-adjusted total score

Score ≥ 3: the patient is nutritionally at-risk and a nutritional care plan is initiated
Score < 3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Key questions to evaluate a patient’s nutritional status

• Is my patient (1) malnourished or is he (2) at risk for a malnutrition?
• Evaluation of the patient:
  • BMI?
  • Weight loss in what time?
  • Muscular mass (brachial index)?
  • How much does my patient eat?
  • What are the comorbidities of my patient => will they change the caloric/proteic needs?
• Evaluation of the caloric/proteic intake?
• What nutritional method => ONS, NG/NJT, PN?
• When I begin a nutritional therapy, risk for renutrition syndrom?
NICE-guidelines

- Nutrition support should be considered in people who are malnourished, as defined by any of the following:
  - a body mass index (BMI) of less than 18.5 kg/m²
  - unintentional weight loss greater than 10% within the last 3–6 months
  - a BMI of less than 20 kg/m² and unintentional weight loss greater than 5% within the last 3–6 months.

- Nutrition support should be considered in people at risk of malnutrition, defined as those who have:
  - eaten little or nothing for more than 5 days and/or are likely to eat little or nothing for 5 days or longer
  - a poor absorptive capacity and/or high nutrient losses and/or increased nutritional needs from causes such as catabolism.
CRITERES DIAGNOSTTIQUES chez l’adulte
Poids mesurable et fiable

<table>
<thead>
<tr>
<th></th>
<th>Dénutrition modérée</th>
<th>Dénutrition sévère</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perte de poids</td>
<td>&gt; 10%</td>
<td>&gt; 20%</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-70 ans</td>
<td>&lt; 18</td>
<td>&lt; 16</td>
</tr>
<tr>
<td>&gt; 70 ans</td>
<td>&lt; 21</td>
<td>&lt; 18</td>
</tr>
<tr>
<td>Poids non mesurable ou pas fiable (ascite, œdèmes)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Dénutrition modérée</th>
<th>Dénutrition sévère</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 25</td>
<td>&lt; p10</td>
<td>&lt; p5</td>
</tr>
<tr>
<td>BMI &gt; 25</td>
<td>&lt; p25</td>
<td>&lt; p10</td>
</tr>
</tbody>
</table>
Healthy adult:
- 30 kcal/kg
- 0.8-1 g protein/kg
What about the IBD patients

What is the risk of malnutrition in IBD; what are the consequences?

Recommendation 3 A:

Patients with IBD are at risk and therefore should be screened for malnutrition at the time of diagnosis and thereafter on a regular basis.

Grade of recommendation GPP – Strong consensus (96% agreement)

Recommendation 3 B:

Documented malnutrition in patients with IBD should be treated appropriately, because it worsens the prognosis, complication rates, mortality and quality of life.

Grade of recommendation GPP – Strong consensus (96% agreement)

Do patients with IBD have an altered micronutrient requirement?

Recommendation 6:

Patients with IBD should be checked for micronutrient deficiencies on a regular basis and specific deficits should be appropriately corrected.

Grade of recommendation GPP – Strong consensus (100% agreement)
Types of Malnutrition in IBD

**Macronutrient deficiency**
- Energy and protein
- Results in weight loss, loss of muscle mass
- Occurs with active, severe disease

**Micronutrient deficiency**
- Vitamins, minerals, trace elements
- Occurs also in mild diseases or diseases in remission
- Risk ++:
  - CD
  - Fistulas
  - Strictures
  - Prior resections
- Most frequent: iron + vitamin D
What are Micronutrients

- Required for tissue and cell growth, energy metabolism and direct antioxidant actions
- Essential elements, inner production is not sufficient

**Vitamins**
- Organic compounds
- Water-soluble (B/C)
  - Absorption through enterocyte by diffusion or active carrier-dependant transport
- Fat-soluble (A/D/E/K)
  - Dissolved by fat droplet, broken by lipase and combine to bile salts to make micelles with diffusion through the enterocyte

**Dietary minerals**
- Inorganic compounds
  - Macro-minerals (big amounts) => K, Ca, PO, Mg and iron
  - Trace elements => zinc, copper, selenium
- All absorbed by passive or active transportation
Nutrient Absorption

Nutrient Absorption After Gastric Bypass

- **Esophagus**
  - Water
  - Ethyl alcohol
  - Copper
  - Iodide
  - Fluoride
  - Molybdenum

- **Stomach**
  - Calcium
  - Phosphorus
  - Magnesium
  - Iron
  - Copper
  - Selenium
  - Thiamin
  - Riboflavin
  - Niacin
  - Biotin
  - Folate
  - Vitamins A, D, E, K
  - Lipids
  - Monosaccharides
  - Amino acids
  - Small peptides
  - Vitamin C
  - Folate
  - Vitamin B12
  - Vitamin D
  - Vitamin K
  - Magnesium
  - Others

- **Duodenum** = 30cm or 1-foot
  - Thiamin
  - Riboflavin
  - Niacin
  - Pantothenate
  - Biotin
  - Folate
  - Vitamin B6
  - Vitamin C
  - Vitamin A, D, E, K
  - Calcium
  - Phosphorus
  - Magnesium
  - Iron
  - Zinc
  - Chromium
  - Manganese
  - Molybdenum
  - Lipids
  - Monosaccharides
  - Amino acids
  - Small peptides

- **Jejunum** = 244cm or 8-feet
  - Bile salts and acids
  - Sodium
  - Chloride
  - Potassium
  - Short-chain fatty acids

- **Ileum** = 365cm or 12-feet
  - Bilirubin
  - Biliverdin
  - Biliverdin
  - Bilirubin

- **Large Intestine** = 150cm or 5-feet
  - Water
  - Vitamin K
  - Biotin

*Many additional nutrients may be absorbed from the ileum depending on transit time.*

**Short bowel syndrome**

The short bowel syndrome resulting in dehydration and malabsorption occurs as a result of massive intestinal resection, especially of the jejunum with or without the colon. Resection of up to 100 cm of jejunum causes diarrhea because there are progressively greater degrees of bile salt malabsorption. Malabsorbed bile salts enter the colon where they cause water secretion by activating cyclic adenosine monophosphate. When the resection exceeds 100 cm, there is progressively more fatty acid loss in the colon, which also adds to water secretion and diarrhea. There is also malabsorption of vitamin B12. In addition, there is loss of energy in the form of increased fat loss. However, as the length of the resection increases, there is malabsorption of all macronutrients, namely, fat, carbohydrate and protein. The malabsorbed carbohydrate entering the colon is fermented to produce fermentation and diarrhea. In addition, there is malabsorption of vitamins and trace elements such as zinc.
Risk factors for deficiencies in IBD patients

- Decreased food intake
  - Anorexia (TNF-alpha mediated)
  - Avoidance of high residual food (diarrhea, pain)
  - Avoidance of lactose-containing food
- Increased intestinal loss => loss of functioning enterocytes
  - Diarrhea (loss of zing, K, Mg)
  - Occult bloos loss (Fe)
  - Exudative enteropathy (loss of proteins and albumin binding proteins)
  - Steatorrhea (fat and fat soluble vitamins)
- Hypermetabolic state
- Drug interactions
  - Sulfazalasine and MTX inhibits folate absorption
  - Steroids impair calcium, zinc and phosphore absorption
  - PPI impair iron absorption
  - Cholestyramine impair fat and fat-soluble vitamin absorption
- Long term parenteral nutrition (typical B1, A, trace elements)
What is the reference for nutritional intake?

<table>
<thead>
<tr>
<th>Signs &amp; Symptoms</th>
<th>Deficiencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hair</strong></td>
<td></td>
</tr>
<tr>
<td>Alopecia</td>
<td>Biotin/B7, Protein-energy malnutrition</td>
</tr>
<tr>
<td>Brittle</td>
<td>Biotin/B7, Protein-energy malnutrition</td>
</tr>
<tr>
<td>Color change</td>
<td>Protein-energy malnutrition</td>
</tr>
<tr>
<td>Dryness</td>
<td>Vitamins E and A</td>
</tr>
<tr>
<td>Easy pluckability</td>
<td>Protein-energy malnutrition</td>
</tr>
<tr>
<td>Corkscrew Hairs</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Perifollicular Petechiae</td>
<td>Vitamin C</td>
</tr>
<tr>
<td><strong>Eyes</strong></td>
<td></td>
</tr>
<tr>
<td>Angular palpebritis</td>
<td>Riboflavin/B2</td>
</tr>
<tr>
<td>Corneal revascularization</td>
<td>Riboflavin/B2</td>
</tr>
<tr>
<td>Bitot’s spots</td>
<td>Vitamin A</td>
</tr>
<tr>
<td>Conjunctival xerosis, keratomalacia</td>
<td>Vitamin A</td>
</tr>
<tr>
<td>Night blindness</td>
<td>Vitamin A, Manganese, Zinc</td>
</tr>
<tr>
<td>Ophthalmoplegia</td>
<td>Vitamin E, Phosphorous</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Thiamine/B1</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>Biotin</td>
</tr>
<tr>
<td>Peri-orbital rash</td>
<td>Zinc</td>
</tr>
<tr>
<td><strong>Mouth</strong></td>
<td></td>
</tr>
<tr>
<td>Dysguesia/Impaired Taste</td>
<td>Zinc</td>
</tr>
<tr>
<td>Angular stomatitis</td>
<td>Vitamin B12, Riboflavin/B2, Pyridoxine/B6</td>
</tr>
<tr>
<td>Atrophic papillae</td>
<td>Niacin/B3</td>
</tr>
<tr>
<td>Bleeding gums</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Cheilosis</td>
<td>Riboflavin/B2, Pyridoxine/B6</td>
</tr>
<tr>
<td>Glossitis (smooth tongue)/burning mouth</td>
<td>Niacin/B3, Folate, Vitamin B12, Vitamin B2, Pyridoxine/B6, Iron, Vitamin C (less common)</td>
</tr>
<tr>
<td></td>
<td>Riboflavin/B2</td>
</tr>
<tr>
<td><strong>Skin</strong></td>
<td></td>
</tr>
<tr>
<td>Acneiform lesions</td>
<td>Vitamin A</td>
</tr>
<tr>
<td>Follicular hyperkeratosis</td>
<td>Vitamin A</td>
</tr>
<tr>
<td>Xerosis (dry skin)</td>
<td>Vitamin A</td>
</tr>
<tr>
<td>Ecchymosis</td>
<td>Vitamin C or K</td>
</tr>
<tr>
<td>Intradermal petechiae</td>
<td>Vitamin C or K</td>
</tr>
<tr>
<td>Erythema (especially where exposed to sunlight)</td>
<td>Niacin/B3</td>
</tr>
<tr>
<td>Hyperpigmentation</td>
<td>Niacin/B3</td>
</tr>
<tr>
<td>Seborrheic dermatitis (nose, eyebrows, eyes)</td>
<td>Riboflavin/B2, Pyridoxine/B6, Niacin/B3 (pellagra), Biotin, Manganese</td>
</tr>
<tr>
<td>Scrotal dermatitis</td>
<td>Niacin/B3 (pellagra), Riboflavin/B2, Pyridoxine/B6</td>
</tr>
<tr>
<td>Poor wound healing</td>
<td>Vitamin C, Zinc</td>
</tr>
<tr>
<td>Dermatitis</td>
<td>Zinc (acrodematitis; hands, mucus membranes/orifices), Niacin/B3 (pellagra: dorsum hands/feet, butterfly facial rash,</td>
</tr>
<tr>
<td>Signs &amp; Symptoms</td>
<td>Deficiencies</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Musculoskeletal/Neuro</strong></td>
<td></td>
</tr>
<tr>
<td>Genu valgum or varum, metaphyseal widening (rickets)</td>
<td>Vitamin D, Calcium</td>
</tr>
<tr>
<td>Loss of pain sensation in distal extremities</td>
<td>Vitamin B12, Pyridoxine/B6, Copper</td>
</tr>
<tr>
<td>Loss of deep tendon reflexes</td>
<td>Thiamine/B1, Vitamin B12, Vitamin E</td>
</tr>
<tr>
<td>Increased deep tendon reflexes</td>
<td>Copper</td>
</tr>
<tr>
<td>Impaired Vibration &amp; Proprioception</td>
<td>Vitamin B12, Copper</td>
</tr>
<tr>
<td>Peripheral Neuropathy/Paresthesia</td>
<td>Thiamine/B1 (dry Beri-Beri), Pantothenic Acid/B5, Vitamin E, Potassium, Chromium, Calcium, Copper</td>
</tr>
<tr>
<td>Encephalopathy/Dementia/Confabulation</td>
<td>d-Lactic acidosis, Niacin/B3 (pellagra), Thiamine/B1 (Wernike-Korsakoff), Pyridoxine/B6, Biotin/B7, Vitamin C, Biotin, Molybdenum, Copper, Zinc, Chromium, Manganese, Calcium</td>
</tr>
<tr>
<td>Muscle weakness/fatigue</td>
<td>Selenium, Carnitine, Vitamin C, Vitamin E, Vitamin D, Iron, Niacin/B3, Pantothenic Acid/B5, Copper, Magnesium, Potassium, Calcium</td>
</tr>
<tr>
<td>Myalgias</td>
<td>Vitamin C, Biotin, Magnesium, Calcium</td>
</tr>
<tr>
<td>Ataxia, wide-based gait</td>
<td>Vitamin E, Thiamine/B1, Vitamin B12, Niacin/B3 (Hartnup disease, cerebellar ataxia), Copper</td>
</tr>
<tr>
<td>Osteomalacia, osteoporosis</td>
<td>Vitamin D, Calcium, Copper</td>
</tr>
<tr>
<td>Headache</td>
<td>Manganese, Molybdenum</td>
</tr>
<tr>
<td>Tetany</td>
<td>Magnesium, Vitamin D, Calcium</td>
</tr>
<tr>
<td><strong>Cardiac</strong></td>
<td></td>
</tr>
<tr>
<td>CHF/cardiomyopathy</td>
<td>Selenium, Thiamine/B1 (high output, wet Beri-Beri)</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Refeeding syndrome, Thiamine/B1 (wet Beri-Beri), Iron</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>Potassium, Magnesium, Calcium</td>
</tr>
<tr>
<td><strong>Hematologic</strong></td>
<td></td>
</tr>
<tr>
<td>Anemia</td>
<td>Folate (macrocytic), Vitamin B12 (macrocytic), Vitamin E (hemolysis), Phosphorous (hemolysis), Copper (microcytic), Iron (microcytic)</td>
</tr>
<tr>
<td>Neutropenia</td>
<td>Copper, Folate</td>
</tr>
<tr>
<td>Petechiae/bleeding</td>
<td>Vitamin C, Vitamin K</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
</tr>
<tr>
<td>Hypogonadism</td>
<td>Zinc</td>
</tr>
<tr>
<td>Impaired Immune Function</td>
<td>Zinc</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>Chromium</td>
</tr>
<tr>
<td>Inappropriately low alkaline phosphatase</td>
<td>Zinc</td>
</tr>
<tr>
<td>Growth retardation</td>
<td>zinc</td>
</tr>
<tr>
<td>Hypothyroidism, goiter</td>
<td>Iodine</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>Manganese</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Zinc, Riboflavin/B2, Niacin/B3 (pellagra), Copper</td>
</tr>
</tbody>
</table>
A few typical cases..
Best of Five MCQs

A 24-year-old woman is 16 weeks pregnant. Although healthy prior to pregnancy, her pregnancy has been complicated by the unremitting nausea and emesis of hyperemesis gravidarum. She has been admitted to hospital on three occasions due to dehydration. Despite antiemetic therapy, she has actually lost 10 pounds from her pre-pregnancy weight. She presents now to urgent care once again dehydrated, and acutely complaining that her feet are burning. She seems mildly disoriented and her gait is shuffling. Physical exam is notable for nystagmus. Despite IV hydration with glucose and saline, her confusion only seems to worsen. Lab work reveals normal electrolytes and glucose levels.

A deficiency in which micronutrient would be associated with this clinical presentation?

A) Zinc  
B) Vitamin C  
C) Vitamin B12  
D) Thiamine (B1)  
E) Vitamin A

Niebyl JR. 2010 Nausea and Vomiting in Pregnancy. NEJM 363:1544-50
Best of Five MCQs

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D) Thiamine (B1)
E) Vitamin A
Vitamin B1-deficiency

- **Role:** catabolism of sugars and aminoacids
- **Risk factors:** gastric bypass surgery, alcohol intake, hyperemesis gravidic, Crohns disease
- **Sources:** egg, meats, bread, nuts
- Stores are very limited => **depletion in a few weeks**
- Clinically => Béri-Béri syndrom
  - **Wet**
    - Dilatative Cardiomyopathy
  - **Dry**
    - Peripheral neuropathy (symmetrically burning paresthesias of the lower extremities)
    - Gait ataxia
    - Nystagmus include
    - +/- Wernicke's encephalopathy with confusion and delirium
Vitamin B1-deficiency

- Typical acceleration in patients given glucose infusion before B1 supplementation
- Diagnosis: clinical.
- Measurement only if severe case suspected.
Vitamin B1-deficiency in IBD

- 30% of CD

- Risk factors: active CD in the small intestine, multiple small bowel resections

- Beri-Beri: supplementation iv 300mg for 3 days then 100mg.
Best of Five MCQs

A 50-year-old alcoholic man is referred to the GI clinic to evaluate a positive fecal occult blood test. He still actively drinks. He denies melenic stools or frank hematochezia. He does, however, note daily bleeding from the gums. He denies diarrhea, abdominal pain, dysphagia, dyspnea, or loss of appetite. He has a BMI of 16.8 kg/m2, and is noted to have bruises, peripheral edema, excessively dry skin, petechiae at the base of hair follicles, and a severely receded and bleeding gum line. There is no jaundice, no ascites, and no hepatosplenomegaly. Referral documentation includes a report of a recently normal abdominal ultrasound, a normal complete blood count, electrolyte profile, renal function tests and liver biochemistries.

What single nutrient deficiency can explain the above findings?

A) Thiamin deficiency (B1)
B) Zinc deficiency
C) Vitamin C deficiency
D) Protein deficiency
E) Vitamin K deficiency

Best of Five MCQs

A 50-year-old alcoholic man is referred to the GI clinic to evaluate a positive fecal occult blood test. He still actively drinks. He denies melenic stools or frank hematochezia. He does, however, note daily bleeding from the gums. He denies diarrhea, abdominal pain, dysphagia, dyspnea, or loss of appetite. He has a BMI of 16.8 kg/m2, and is noted to have bruises, peripheral edema, excessively dry skin, petechiae at the base of hair follicles, and a severely receded and bleeding gum line. There is no jaundice, no ascites, and no hepatosplenomegaly. Referral documentation includes a report of a recently normal abdominal ultrasound, a normal complete blood count, electrolyte profile, renal function tests and liver biochemistries.

What single nutrient deficiency can explain the above findings?

A) Thiamin deficiency (B1)
B) Zinc deficiency
C) Vitamin C deficiency
D) Protein deficiency
E) Vitamin K deficiency

Vitamin C deficiency

- **Pathophysiology**: inadequate dietary intake
- **Role**: antioxidant, cofactor in enzyme reactions, including collagen synthesis (wound healing)
- **Sources**: kiwi, oranges, green pepper, cauliflower, broccoli
- No intrinsic production!
- Significant deficiency is rare!
- Clinically => Scurvy
  - Poor wound healing
  - Gingivitis
  - Scaly skin => hyperkeratosis of the hair follicles
  - Hematomas
  - Arthralgias
Vitamin C-deficiency

- Diagnosis: clinical.
- Measurement only if severe case suspected => no clear threshold and validated method
Vitamin C deficiency in Crohn’s disease

• 50% of CD => subnormal serum vitamin C levels
• Risk factors: fistulas or recent surgery => less dietary intake
• No measurement, only if clinically suspicious
Best of Five MCQs

A 60-year-old woman complains of progressive weakness and fatigue, and a stumbling gait. She has 3 soft, loose stools each day, which has been a stable pattern since her gastric bypass (standard bariatric gastrojejunostomy) 10 years ago. Her physical exam is only notable for some pallor of the mucosal membranes, diminished touch sensation of the extremities, and an abnormal gait with impaired tandem walking and balance. There was no glossitis or rash. Stool testing was negative for occult blood. Initial lab tests revealed a moderate microcytic anemia, normal electrolytes, renal function and liver tests. Iron supplementation was provided for 3 months, after which the microcytic anemia was noted to have worsened despite normal iron values on follow-up testing.

A deficiency in which of the following is most likely?

A) Riboflavin
B) Copper
C) Zinc
D) Iron
E) Vitamin B12

Kumar N. 2006 Copper Deficiency Myelopathy Mayo Clin Proc. 81 (1 0): 1371
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Copper deficiency

- **Role:** biological electron transport and oxygen transportation
- Absorption => primarily in the stomach and proximal small intestine. Partial excretion in the bile.
- **Risk factors:**
  - Typically => gastric bypass surgeries.
  - Chronic external biliary drains may also develop copper deficiency.
  - Zinc toxicity => competitive absorption
  - Extensive enteropathy (Crohn's disease, celiac disease, short gut syndrome, or HIV enteropathy)
- **Sources:** animal products, chocolates, nuts and cereal grains
- Stores are extensive in liver, muscle and bone => deficiency is rare
Copper deficiency

- Clinically:
  - Anemia
  - Neutropenia
  - Myelopathy (muscle weakness, gait abnormality) and peripheral neuropathy
- CAVE!!
  - Interpretation of results is difficult
  - Copper doesn’t exist as a free ion in the body
  - 90% in ceruloplasmin and 10% to albumin
  - Reduced in inflammatory states => active phase reactant
Can mimic SMD
Substitution modalities

- Oral administration
- No concomitant administration with zinc

- Posology
  - Copper Gluconate: 2 mg 3 x / d for 5 days, then 2 mg 2 x / d for 1 week
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A deficiency in which of the following is most likely?

A) Selenium  
B) Thiamine  
C) Fluoride  
D) Magnesium  
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Selenium deficiency

• **Role:** antioxidant function

• **Risk factors:**
  • In CD patients => long term TPN

• **Sources:** seafood and organ meats, muscle meats, cereals and grains.
Selenium deficiency

• Clinically:
  • Cardiomyopathy
  • Cartilage degeneration with joint pain
  • Hypothyroidism

• In IBD => unknown prevalence but mean levels lower in both CD/UC

• Maximum risk in case of low supplementation in TPN
Substitution modalities

- Severe deficiency if < 570 nmol/l with important risk of cardiomyopathy
- Posology: 50-100 µg / d; the dose can be increased to 500 µg / day

Oral:
- SELENASE peroral sol 100 mcg (selenite de sodium): 1 ampoule buvable de 2 ml contient 100 µg de sélénium
- SELENASE peroral sol 500 mcg (selenite de sodium): 1 ampoule buvable de 10 ml contient 500 µg de sélénium
Zinc deficiency

• **Role:** catalytic activity of >100 enzyme metalloproteinases, immune function, protein and collagen synthesis

• **Sources:** meats, poultry and milk. Breads and cereal-based products are often fortified => deficiency is not common in the general population

• High concentrations in kidney, liver, muscle, bone, pancreas, hair and skin

• **Risk factors:**
  • Common in chronic diarrhea, malabsorption and hypermetabolic states

• Common in IBD patients
• Measurement is difficult since very little zinc is in the serum => check also the clinics and presentation!
Zinc deficiency

- Clinical presentation:
  - Acrodermatitis
  - Perioral lesions
  - Delay in wound healing
  - Alopecia
  - Diarrhea
  - Night vision reduced
  - Poor taste
  - Dementia
Substitution modalities

• 1 hour before or 2 hours after a meal
• Posology: 10 -50 mg /d
  • 15 mg / d in case of moderate deficiency
  • 2 x 15 to 3 x 15 mg / d ou 2 x 30 mg /j if severe deficiency

• Oral:
  • Zinc Burgerstein – tbl - 15 mg (HC) : zinc gluconate, 15 mg zinc élémentaire
  • Zinc Burgerstein - tbl - 30 mg (HC) : gluconate de zinc, 30 mg zinc élémentaire
Take home messages

• Understanding/knowing your patients micronutrient deficiency risk factors will give you a clue in treatment
Further Reading

• Berger. M. Vitamin C requirements in Parenteral Nutrition. Gastroenterology 2009;137:s70-s78
• Shenkin. A. Selenium in Intravenous Nutrition. Gastroenterology. 2009;137:s61-s69
• Nielsen. F. Micronutrients in Parenteral Nutrition: Boron, Silicon, & Flouoride. Gastroenterology 2009;137:s55-s60