Learning Objectives

• To understand nutritional screening and assessment;
• To assess a patient for general nutritional status;
• To realize the signs and the symptoms of nutritional problems;
• To be familiar with nutritional screening;
• To understand different methods used for the nutritional assessment;
• To know limitations of different methods for nutritional assessment;
• To know the benefits and limits of laboratory and balance-studies for nutritional assessments.

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Key Messages

• To understand how important to get the history taking and physical examination on the definition of nutritional problems;
• Nutritional screening and assessment are important part of patient care to identify patients requiring nutritional support;
• Nutrition screening is an important tool for rapid and simple evaluation of an individual nutritional status;
• Nutrition assessment is important for detailed diagnosis of acute and chronic malnutrition (over- and undernutrition);
• Nutrition screening and assessment are important in clinical medicine because acute and chronic malnutrition (over- and undernutrition) are prevalent.
1. Nutritional screening and assessment

Nutrition screening is an important tool for rapid and simple evaluation of an individual nutritional status.

- Nutrition assessment is important for detailed diagnosis of acute and chronic malnutrition (over- and undernutrition).
- Nutrition screening and assessment are important in clinical medicine because acute and chronic malnutrition (over- and undernutrition) are prevalent (1, 2, 3).

1.1 Screening

Screening is a simple and rapid process, to select subjects who are malnourished or at risk of malnutrition. It can be carried out by busy admitting nursing and medical staff. It should be sensitive enough to detect all or nearly all the patients at nutritional risk. Most screening tools address four basic questions (4):

- recent weight loss
- recent food intake
- current body mass index
- disease severity

ESPIN published guidelines for nutrition screening in the community, in the hospital and among elderly in institutions. Screening tools recommended by ESPEN for:

- Community: Malnutrition Screening tool (MUST) (5);
- Hospital: Nutritional Risk Screening.

Fig. 2 Malnutrition Universal Screening Tool (MUST) for adults
### Table 1  Nutritional Risk Screening (NRS 2002)

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

**Yes:** If the answer is ‘Yes’ to any question, the final screening 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.

### Table 2  Final screening II

<table>
<thead>
<tr>
<th>Impaired nutritional status</th>
<th>Severity of disease (increase in requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent Normal nutritional status</td>
<td>Absent Normal nutritional requirements</td>
</tr>
<tr>
<td>Mild Score 1 Wt loss &gt; 5% in 3 mos or Food intake below 50-75% of normal requirement in preceding week</td>
<td>Mild Score 1 Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. Chronic hemodialysis, diabetes, oncology</td>
</tr>
<tr>
<td>Moderate Score 2 Wt loss &gt; 5% in 2 mos or BMI 18.5 - 20.5 + impaired general condition or Food intake 25-60% of normal requirement in preceding week</td>
<td>Moderate Score 2 Major abdominal surgery* Stroke* Severe pneumonia, hematologic malignancy</td>
</tr>
<tr>
<td>Severe Score 3 Wt loss &gt; 5% in 1 month (&gt; 15% in 3 mos) or BMI &lt;18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week</td>
<td>Severe Score 3 Head injury* Bone marrow transplantation* Intensive care patients (APACHE 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.
### Table 3  Elderly: Mini Nutritional Assessment (MNA) (6)

<table>
<thead>
<tr>
<th>Initial Screening in Mini Nutritional Assessment (MNAr) for the Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>0 = severe loss of appetite</td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td>0 = weight loss greater than 3 kg</td>
</tr>
<tr>
<td><strong>C</strong></td>
</tr>
<tr>
<td>0 = bed or chair bound</td>
</tr>
<tr>
<td><strong>D</strong></td>
</tr>
<tr>
<td>0 = yes</td>
</tr>
<tr>
<td><strong>E</strong></td>
</tr>
<tr>
<td>0 = severe dementia or depression</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td>0 = BMI less than 19</td>
</tr>
</tbody>
</table>

#### Screening score (total max. 14 points)

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Normal - not at risk</td>
</tr>
<tr>
<td>11</td>
<td>Possible malnutrition</td>
</tr>
</tbody>
</table>

### 1.2 Assessment

Assessment is a **diagnostic process** which characterizes degree of malnutrition and risk of complications related to malnutrition. The process of nutritional assessment is much more complex than screening and it should include the following principles:

- history and examination;
- factors leading to malnutrition;
- natural history of the patient’s condition;
- weight loss;
- appetite;
- gastrointestinal symptoms;
- fever;
- medical and drug history;
- diet history:
  - disease status,
  - temperature,
  - pulse rate,
  - blood pressure,
  - laboratory tests of inflammation,
• nutrient losses from wounds, fistulae etc.;
• functional assessment;
• energy expenditure;
• mental and physical dysfunction;
• muscle strength;
• mental scoring system;
• mood status;
• laboratory tests;
• quantifying inflammation and disease severity;
• plasma protein levels (transthyretin, transferrin etc.);
• plasma changes in minerals (e.g. K, Ca, Mg, P, Zn, Fe);
• plasma levels of vitamins;
• fluid balance.

There are many methods and indexes which are based on above mentioned assessment methods, however their interpretation and correlation is still difficult - see Nutr. Rev. 2000.

2. Techniques used in nutritional assessment

2.1 History
The history is the starting point for any nutritional assessment. Specific features of note include a recent weight changes; dietary habits and alteration in dietary intake; allergies and food intolerance; medications that may effect appetite, gastrointestinal functions and symptoms; current functional capacity, including recent limitations; and previous medical conditions (any chronic or acute disease state).

2.2 Physical examination
Physical examination is the next step in nutritional assessment. This assessment predominantly relies on subjective and descriptive information. Although not quantitative, a physical examination may still influence the nutritional management of a patient.

The main objective of a physical examination is to establish signs and symptoms of nutrient deficiencies or toxicities, and tolerance of current nutritional support. A systems approach should be applied using the examination techniques of inspection, palpation, percussion, and auscultation.

The physical examination should include (7):
• Assessment of muscle mass and subcutaneous fat stores;
• Inspection and palpation for edema and ascites. These two conditions are important physical indicators of diminished visceral protein levels and hepatic dysfunction;
• Inspection and evaluation for sings and symptoms of vitamin and mineral deficits, such as dermatitis, glossitis, cheilosis, neuromuscular irritability, and coarse, easily pluckable hair;
• The patient’s prescribed medication should be examined for potential drug-nutrient interactions, increased macro-or micronutrient requirements, and nutritionally related side effects such as constipation, diarrhea, nausea, vomiting.

The simplest validated nutritional assessment is the SGA, which is based on patient’s history and physical examination. Clinicians prefer SGA because of its simplicity, feasibility and sensitivity that is almost equivalent to objective tests.

Nutritional assessment of patients is not an easy procedure. Although, lots of the clinical and laboratory measurements are available for nutritional assessment, all of them have lots of deficiencies. Nutritional assessment is an art more than science. At the current state of the art, in addition to the physical examination and clinical history, many experienced clinicians solve this problem by using a few laboratory tests.

2.3 Functional tests
• Hand dynamometry;
• Direct muscle stimulation;
• Peak flow and FEV;
• Immune function;
• Skin responses to intradermal antigens;
• Lymphocyte count;
• Proportion and number of T-lymphocytes.

Immune function can be tested by lymphocyte counts and by cutaneous applied skin tests. In most hospitalized patients, delayed hypersensitivity reactivity and total lymphocyte counts are not very useful components of a nutrition assessment profile.

2.4 Laboratory parameters
• The serum albumin;
• The shorter half time proteins;
• Transthyretin (formerly prealbumin) - 2 days;
• Transferrin - 7 days;
• Creatinine height index (CHI);
• Nitrogen balance.

A complete nutritional assessment consists of a combination of subjective and objective parameters, but up to now, no single parameter has been shown to be useful in all patients. Most nutritional parameters lack sensitivity and specificity; therefore, methods of identifying malnourished patients are not entirely satisfactory.

Laboratory testing is useful for assessment of the nutritional status and monitoring of nutritional interventions.

Serum proteins, total lymphocyte counts, vitamins and minerals
Several laboratory parameters (serum proteins, total lymphocyte counts, vitamins and minerals) are used. Serum proteins have different half-life times. Serum albumin is a good predictor for outcome and reflects disease severity. On the other hand, it is a bad marker to assess nutritional status. Serum albumin can be used for long term control.

To assess short term changes, prealbumin or transferrin is more useful. Serum proteins have many limitations. The serum concentrations of visceral proteins decline with overhydration and increase with dehydration independent of nutritional status. Low serum albumin levels exacerbate ascites, lower extremity edema, and gut edema because of depressed colloid oncotic pressure. Serum transferrin is the less affected protein by other factors.

Creatinine height index (CHI)
The somatic protein compartment can be evaluated by the creatinine height index (CHI). Creatinine excretion correlates with lean body mass and body weight. The CHI is dependent on urine creatinine excretion. Renal insufficiency, meat consumption, physical activity, fever, infections and trauma influence urine creatinine excretion.
Role and Limitations of Nitrogen Balance

- Nitrogen balance = N input – N output
  - Neg. N-balance
    - The rate of protein catabolism exceeds the role of protein anabolism
  - Pos. N-balance
    - Indicative of nitrogen retention

- Research tool
- In clinical conditions
  - Intake is often overestimated
  - Losses in urine, faeces, skin, wounds is often underestimated

Nitrogen balance studies

Nitrogen balance studies are often used to assess protein catabolism. In non-stressed conditions, urea composes 30-90% of total urea nitrogen. For usual clinical purposes, nitrogen balance calculation done with urinary balance nitrogen instead of total urinary nitrogen is adequate. It has to be considered that nitrogen excretion calculated from urinary urea nitrogen is affected by increased stress, which can alter urea production and/or increase of non-urea nitrogen by-products. The validity of nitrogen balance is affected by severe nitrogen retention disorders, accuracy of the 24-hour-urine collection and completeness of protein or amino-acid intake data.

The calculation of nitrogen balance is shown on Fig. 5.

A simple assessment to assess catabolic states is also the urea production rate and the urea/creatinine quotient.

Nutritional monitoring and reasons of response can be measured in vivo (by weight gain, N-balance, complication rates) and in vitro measurements by plasma-serum concentration of proteins. The calculation of urea-production rate is shown on Fig. 6.

For identifying patients with pre-existing malnutrition or those at most risk, a combination with a comprehensive nutritionally focus physical exam together with carefully selected objective parameters provide the best information.

Nitrogen balance

\[
\text{N-balance} = \text{Protein-intake} - \text{UUN} + \text{fecal losses} + \text{obligatory losses}
\]

\[
\text{g/d} = \frac{6.25 * \text{UUN}}{2.4 \text{ g/d}}
\]

*specialized enteral or parenteral formulations have often a different conversion coefficient

**urinary urea nitrogen

\[
\text{UUN} x (1.25) = \text{TUN}
\]

Urea-production rate

\[
\text{UPR (g/24 h)} = \text{UUN (g/24 h)} + (d\text{-serum-crea (mg/dl)} x 0.0099 x \text{BW factor})
\]

*? 0.55
*? 0.6

Interpretation: UPR > 30 g/24 = catabolic

Fig. 4

Fig. 5

Fig. 6
2.5 Assessment of food intake

Quantifications of food intakes and their comparison with energy expenditures can not only describe current status but also predict whether the patient’s nutritional status is likely to improve or deteriorate.

Nutrient balance = intake (e.g. food intake charts) - expenditure

Food intake assessment estimates food intakes and is among the main tools for assessing nutritional status. Food intake measurements are used not only for the determination of patient’s nutritional status, but also characterization of the nutritional status of a population for monitoring and surveillance.

Assessment of dietary intake has considerable challenge and prone to significant error and bias. Food balance sheets and household budget surveys are indirect methods of food consumption studies. Food records and dietary recalls measure food intake on specified periods, usually 1-7 days. Because of day to day variability, several days of records may be required to estimate usual food intake. Food frequency questionnaires are developed to describe standardized data on usual long-term diet.

The determination of the consumption of nutrients can be achieved either by analyzing the foods consumed directly or by using food composition tables. Most food composition tables are organized according to the classification of foods into food groups. Dietary reference intakes (DRI) provide standards to serve as a goal for good nutrition.

Questionnaires are in common use in the medical practice and in nutrition assessment as well as in decisions making process. Every questionnaire has to pass validation to certain “Gold Standard”, and reliability tests.

The data in questionnaire may be of different types:

- Dietary data, either before analysis or specific components after dietary analysis;
- Anthropometrics data like height, weight, BMI, or body composition;
- Laboratory results and special tests done;
- Eating habits like timing of meals and where they are taken;
- General health questions;
- Medical data like diagnoses, surgical treatments and drugs;
- Demographic and socio-economic data.

It is very important to evaluate the objective of the questionnaires. Many questionnaires are designed as epidemiological surveys, and others as clinical tools for specific purposes, some are designed for every person and some for specific populations, some are for the detection of malnutrition while other concentrate on risk evaluation due to metabolic diseases as diabetes, hyperlipidemia and obesity.

Energy expenditure can be measured (indirect calorimetry) or estimated from different formulas - see module energy metabolism.

Energy intake is measured using either 3-7 day food diaries kept by the patient or food intake charts kept by nursing staff and used by the dietician to calculate energy and protein intake.

References

3. Weekes et al. The development, validation and reliability of a nutrition screening tool based on the recommendations of BAPEN. Clin Nutr 2004; 23: 1104
7. Detsky et. al. What is subjective global assessment of nutritional status. JPEN 1987; 11:8