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Nutritional Assessment

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Continuing Education Activity

Evaluation of nutritional status is critical, either to identify if an individual has nutritional imbalance due to an underlying condition or to assess if an individual is likely to develop a pathological condition due to nutritional imbalance. A detailed, systematic evaluation of a patient's nutritional status conducted by healthcare providers in a team-based setting to diagnose malnutrition and identify underlying pathologies to plan intervention constitutes nutritional assessment. This article provides an overview of nutritional evaluation, including components of nutritional assessment, factors that affect nutritional status, and the role of interprofessional teams involved in managing patients at nutritional risks.

Objectives:

- Explain the significance of nutritional assessment and summarize its components.
- Identify factors that affect the nutritional status of individuals.
- Describe challenges involved in nutritional assessment.
- Summarize the role of interprofessional collaboration in performing the nutritional assessment of patients.

Access free multiple choice questions on this topic.

Introduction

Food and nutrition are basic indispensable needs of humans. Nutrition plays a critical role in maintaining the health and well-being of individuals and is also an essential component of the healthcare delivery system. The nutritional status of individuals affects the clinical outcomes. Essential nutrients are classified into six groups, namely carbohydrates, proteins, lipids, minerals, vitamins, and water.

Nutritional requirements of healthy individuals depend on various factors, such as age, sex, and activity. Hence, recommended values of dietary intakes vary for each group of individuals. In the United States, the Food and Nutrition Board of the Institutes of Medicine (IOM) under the National Academy of Sciences issues nutrition recommendations for populations throughout the life span called Dietary Reference Intakes (DRIs).[1]

An imbalance in nutritional intake leads to malnutrition. The word ‘malnutrition’ is defined in multiple ways, and there is still no consensus.[2] Traditionally, the term malnutrition has been used in the context of lack of energy intake or deficiencies of nutrients, under which two main conditions, namely marasmus, and kwashiorkor, are discussed. Marasmus primarily refers to energy or calorie deficiency, whereas kwashiorkor refers to protein deficiency characterized by peripheral edema.[3][4]

However, the term malnutrition now includes conditions caused by both insufficient as well as excess intake of macronutrients and micronutrients.[5] As per WHO guidelines, malnutrition encompasses three categories, namely,

- Undernutrition (low weight-for-height, low height-for-age, and low weight-for-age),
- Micronutrient (vitamins and minerals) deficiency or excess, and
- Overnutrition (overweight, obesity, and other diet-related health conditions such as type 2 diabetes mellitus, cardiovascular disorders, etc.).

The presentation of malnutrition can be acute, sub-acute, or chronic and may or may not be associated with underlying inflammation. Furthermore, the double burden of malnutrition has also been emphasized in various studies. This involves the dual manifestation of overnutrition and undernutrition, which makes the diagnosis of malnutrition a challenge.[6][7]

Hence, a comprehensive, multi-faceted evaluation of a patient's nutritional status is warranted. A comprehensive nutritional assessment, however, should be differentiated from nutritional screening. Nutritional screening is done to quickly identify individuals at risk of developing malnutrition.[8]

For example, the mini nutritional assessment (MNA) is used in the geriatric patient population to screen for individuals at risk of malnutrition. This screening tool consists of a questionnaire and has a scoring system that helps identify at-risk individuals. On the other hand, a comprehensive nutritional assessment is performed to evaluate the nutritional status of patients already identified at nutritional risk. Nutritional assessment allows healthcare providers to systematically assess the overall nutritional status of patients, diagnose malnutrition, identify underlying pathologies that lead to malnutrition, and plan necessary interventions.

Function

Nutritional Assessment

While performing nutritional assessment, it is important to understand that there is no single best test to evaluate nutritional status. Information should be collected systematically, and an evaluation of nutritional status should be done based on the overall data collected. As per the American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines, a comprehensive nutritional assessment involves a thorough clinical examination (history and physical examination), anthropometric measurements, diagnostic tests, and dietary assessments.[5]

Additional clinical examinations or diagnostic tests may be necessary for different groups of populations and individuals with specific underlying pathology. As per the International Consensus guidelines committee, the diagnosis of malnutrition in adults can be categorized as (i) starvation-related malnutrition (chronic, non-inflammatory), (ii) acute disease or injury-related malnutrition (mild to severe inflammation), or (iii) chronic disease-related malnutrition (chronic mild to moderate inflammation).[9]

Given below are the components of a comprehensive nutritional assessment that need to be performed while evaluating the nutritional status of individuals.

Clinical History: Patients' clinical history is a crucial component of nutritional assessment. Clinical history aims to look for indications of malnutrition and identify underlying factors that may lead to malnutrition or increase the risk of malnutrition.

- Once patient identification markers (name, age, sex) are noted, take a detailed history of chief complaints.
- If not mentioned in chief complaints, ask for other constitutional symptoms, such as fever, fatigue, malaise, loss of appetite, or sleep disturbances. The presence of these symptoms can be an indication of underlying pathologies. For example, fever suggests active infection or inflammation.

- Inquire about the patient's usual weight and ask if there have been any weight changes. Weight loss of >10% of body weight can signify underlying pathology. Weight gain can be suggestive of various underlying endocrine pathologies. Weight gain can also lead to insulin resistance contributing to metabolic syndrome.
- Ask if there are any symptoms suggestive of malnutrition other than weight changes, such as rashes, sores in the mouth, dryness of skin and eyes, loss of night vision, hair loss, bleeding gums, poor healing of wounds, swelling of extremities, tingling, or numbness.
- Ask about eating habits and dietary preferences. For example, ask about the number of meals eaten in a day, approximate portion sizes, whether they are following any restrictive diets, whether they are vegan or vegetarian, or if they are allergic to any food items. This can help in diagnosing a possible nutritional deficiency. For example, a vegan diet may be associated with vitamin B12 (cobalamin) deficiency.[10] A detailed dietary assessment is also warranted and is discussed below. If patients are on parenteral or enteral diets, they should be interviewed accordingly.
- Ask about any factors affecting food intake, like poor dentition, ulceration in the oral cavity, difficulty in swallowing, loss of appetite, heartburn, nausea, and/or vomiting. Further, inquire about bowel habits, which help assess the general functioning of the gastrointestinal system. Also, ask if there is any abdominal pain, abdominal distention, diarrhea, flatulence, or constipation, which can indicate underlying gastrointestinal pathologies that affect nutritional status.
- Ask about any current major clinical or surgical illnesses, including mental illnesses. Also, ask if they are taking any medications, either prescribed or over the counter. Ask if there is any history of chronic illnesses, hospitalization, trauma, or malignancies. The impact of current or past illnesses on nutritional status is discussed below.
- In female patients, detailed menstrual history should be taken. Amenorrhea in child-bearing aged women can indicate pregnancy, chronic infection, chronic illness, eating disorder, etc., which can affect the nutritional status of patients. History suggestive of menorrhagia can reveal the presence of anemia. Also, a history of contraceptive use is essential. Women on oral contraceptive pills have different nutritional requirements. Oral contraceptive pills have been shown to deplete B vitamins, vitamin C, and some minerals, such as magnesium, selenium, and zinc.[11]
- Next, ask questions related to lifestyle habits (active vs. sedentary), daily physical activities, and exercise routine.
- History about social habits such as drinking, smoking, tobacco consumption, or other non-prescription drugs should also be taken.
- Since socioeconomic conditions can affect nutritional status, request information related to this as well.
- Finally, family history can also be useful for the early diagnosis of conditions that can affect a patient's nutritional status or help identify underlying predisposing conditions.

Dietary Assessment: Dietary assessment is necessary to ensure adequate nutrition and hydration intake. It is advised to consult a qualified registered dietitian-nutritionist (RDN), if available, to obtain a thorough dietary assessment.

- The information can be collected from various sources such as the patients themselves, family members, caregivers, or medical records.
- History about dietary habits, frequency of meals, and serving sizes needs to be collected. As mentioned earlier, details about food preferences, restrictive diets, and allergies should be noted.

- Current nutrient and fluid intake should be recorded. Methods such as the 24-hour recall method, food frequency questionnaire (FFQ), diet charts, observation, etc., can be used. Wearable monitoring devices, phone apps, or nutrition analysis software can be used as aids.[8]
- If patients are on any nutritional supplements, care must be taken to record the frequency and dosage to limit the risk of nutrient insufficiency and toxicity.
- If patients are on parenteral or enteral diets, information on feeding regimens (quantity and frequency) should be noted. Factors affecting these feedings, such as displacement of feeding tubes, site irritation, or infections, should be considered.

Physical examination: The next component of the nutritional assessment is physical examination. The physical examination aims to identify signs of malnutrition and factors affecting nutritional status.

- General condition: General condition and appearance of the patient should be observed. Look for any signs of emaciation. Note whether the patient is conscious, alert, and ambulatory. Make a note of whether a patient is being examined in a hospital or outpatient setting. An initial observation of the patient's cognitive, mental, and emotional status should be noted. Also, note any parenteral or enteral feeding devices being used. A patient's general condition can help determine whether a patient can meet their nutritional needs and/or whether their condition is causing their malnutrition or putting them at a higher risk of nutrition deficiencies.
- Vital signs: Vital signs (body temperature, pulse, blood pressure, and respiratory rate) should be checked. Temperature > 100.4 degrees Fahrenheit or 38 degrees Celsius can signify active inflammation/infection. Hypothermia (temperature < 95 degrees Fahrenheit or 35 degrees Celsius) can be associated with conditions causing impaired nutritional status, such as sepsis, trauma, burns, stroke, alcohol intoxication, and metabolic disorders like hypothyroidism, adrenal insufficiency, and Wernicke encephalopathy.[12] High pulse rates, apart from cardiac conditions, can indicate hyperdynamic circulation. Some causes of hyperdynamic circulation that are associated with altered nutritional status are fever, anemia, pregnancy, hyperthyroidism, septic shock, Beriberi, and anxiety. High blood pressure or hypertension is one of the risk criteria for metabolic syndrome. Abnormal rate and patterns of respiration can be indicative of various pathologies. For example, Kussmaul's breathing is associated with diabetic ketoacidosis (DKA).
- Height and Weight: Measure the height and weight of the patient. Body mass index (BMI) calculated from these variables can help determine whether an individual is undernourished or overnourished. Details about BMI and other anthropometric measurements are discussed later.
- Eyes: Look for pallor, which may be indicative of various nutrient deficiencies (iron, vitamin B12, folic acid, vitamin B6, vitamin C, or protein deficiency), as well as various chronic illnesses. Look for icterus, suggesting metabolic disturbances associated with the hepatobiliary system. The presence of Bitot spots and xerosis is indicative of vitamin A deficiency. Xanthelasmas, yellow-colored plaques on eyelids, can suggest obesity, hypercholesterolemia, or diabetes mellitus.
- Oral cavity and perioral region: Assess the general health of the oral cavity and look for pathologies that can affect the adequate intake of nutrients. Also, look for glossitis, angular stomatitis, and cheilosis, which can indicate vitamin B complex deficiency. Bleeding gums and gingivitis are suggestive of vitamin C deficiency. Again, look for pallor. If an eating disorder is suspected, look for vomiting-related oral damage, for example, discoloration of teeth, loss of enamel, cavities, and enlarged salivary glands.[13] A consultation with a dentist may be helpful. Look for loss of buccal fat pads or sunken facial appearance. This can be associated with various conditions such as eating disorders, marasmus, tuberculosis (TB), or HIV/AIDS.
- Skin: Assess the general health of the skin. Xeroderma (extremely dry skin) can signify vitamin A and/or essential fatty acid deficiencies. Petechia, purpura, and ecchymosis may be associated with vitamin C and

vitamin K deficiencies. Vitamin C deficiency can also present with perifollicular hemorrhage. Poorly healed wounds indicate vitamin C, protein, and/or zinc deficiencies. Pigmentation and rashes in sun-exposed areas (around the neck and on extremities in glove and stocking patterns) can be due to niacin deficiency.[14] The yellow-orange discoloration of the skin can be detected in cases of excessive consumption of carotenoids (pigments found in carrots, pumpkin, tomatoes, etc.). Xanthomas, which are localized lipid deposits, can be seen in individuals with obesity, hypercholesterolemia, or diabetes mellitus. Look for loss of subcutaneous adipose tissue in axillary folds, buttocks, and extremities. This can be associated with energy-deficient states like marasmus, TB, HIV, and eating disorders.

- Hair: Various nutrients are required to maintain the health of hair and hair follicles. Dry hair can be a sign of vitamin A or vitamin E deficiency. Biotin deficiency can make hair brittle. Severe undernutrition, especially protein deficiency, can lead to discolored and easily pluckable hair, eventually resulting in hair loss. Rapid hair loss can also be indicative of underlying systemic illnesses.
- Nails: Assess the general health of nails and nailbeds. Dry and brittle nails can be associated with various nutritional deficiencies, such as deficiencies in biotin, zinc, and proteins. Discoloration of nails is another sign of poor nutrition.[15] Koilonychia can be a sign of iron deficiency anemia. While clubbing is associated with many pathologies, it may also be observed with malnutrition, chronic alcohol use disorder, and chronic laxative use, often seen in individuals with eating disorders.
- Extremities: Examine all extremities carefully. Protein or thiamine deficiency can lead to edema. Vitamin B12, thiamine, vitamin E, and vitamin B6 deficiencies can present with paresthesia and muscle weakness. Loss of vibration and position sensation can also be observed in individuals with vitamin B12 and/or vitamin E deficiencies. Patients with diabetes mellitus may also show signs of peripheral neuropathy, foot ulceration, or gangrene. Severe undernutrition, as well as chronic illnesses, can lead to muscle atrophy and wasting. Bowing of lower limbs can be seen in children with vitamin D deficiency rickets.
- Odors: Certain odors can be suggestive of specific disorders or substance use. Detection of fruity acetone odor in patients with ketoacidosis, musty odor in patients with phenylketonuria, sweet burnt sugary odor in patients with Maple syrup disorder, or the smell of alcohol can also be helpful during the examination of patients.
- Functional assessment: It is essential to do a functional assessment of patients. Observe whether patients are ambulatory and whether they can eat and drink with or without assistance. Examine the strength of extremities to determine whether they can perform activities of daily living (ADLs) or other physical activities. Mental assessment is also crucial, along with physical assessment. For example, elderly patients with severe malnutrition may be physically (due to weakness) and mentally (due to dementia) incapable of maintaining healthy nutritional status. Similarly, patients with thiamine deficiency may develop Wernicke encephalopathy and Korsakoff psychosis and may become incapable of meeting their own dietary needs.
- Systemic evaluation: An appropriate systemic examination should be performed based on the history and general examination findings.

Anthropometric Measurements

- Height, weight, and BMI: Measure the weight and height of the patient, as mentioned above. Patients should be advised to avoid wearing heavy garments or shoes while these measurements are taken. Bed or chair scales may be needed if patients are not ambulatory or cannot stand. In pediatric age groups, these parameters are plotted on growth charts to assess growth and nutritional status. BMI (weight in kilograms divided by height in meters squared) is also calculated using these parameters, and the state of nutrition can be assessed. In adults, BMI < 18.5 kg/m^2: underweight; BMI = 18.5 to 24.9 kg/m^2: within normal range; BMI > 24.9 to 29.9 kg/m^2: overweight; and BMI ≥ 30 kg/m^2: obesity.[16]

- Factors such as edema and hydration should be considered while making these determinations, as they can affect the weight and BMI values. BMI cannot differentiate between muscle mass and adipose tissue/fat mass. And finally, BMI does not take into account micronutrient deficiencies.
- Other anthropometric measurements: Circumference (arm, abdomen, and thigh) measurements and skinfold (biceps skinfold, triceps skinfold, subscapular skinfold, and suprailiac skinfold) thickness measurements can also help with the evaluation of nutritional status. Skinfold thickness measurements are considered indicators of energy stores (mainly lipid stores). Circumference measurement, namely midarm circumference (MAC), can be used to derive midarm muscle circumference (MAMC=MAC-3.1414 X triceps skinfold thickness), which is an indicator of protein stores. While these tests can quickly be done at the bedside without additional cost, subjectivity in terms of measurements and the applicability of results across various populations can make these tests less reliable.
- A complete anthropometric assessment may also involve body composition measurements, which are discussed in diagnostic tests.

Diagnostic tests: The next component of the nutritional assessment is diagnostic tests, which are done to validate the results of the clinical presentation.

Laboratory Tests

- Routine clinical tests: Routine clinical tests can help evaluate the patient's overall status (as well as nutritional status).[17] These include serum electrolytes, blood urea nitrogen (BUN), creatinine, blood glucose levels, lipid profile, liver enzymes, and complete blood count. Serum electrolytes and hydration status may be deranged in malnourished individuals. BUN and serum creatinine are also predictors of nitrogen balance along with being indicators of renal function, and lower levels of these can be seen in malnourished patients. Low levels of serum creatinine can be indicative of lower muscle mass. Both BUN and creatinine levels, however, can be affected by hydration levels and kidney function. Elevated blood glucose levels and lipid profile (triglycerides and cholesterol) levels are indicators of metabolic syndrome. Hyperglycemia can also be a nonspecific indicator of the inflammatory response.[18]
- Low cholesterol levels can be seen in undernourished individuals. Low hemoglobin is suggestive of anemia. Lymphocyte functioning and proliferation are affected in chronic malnutrition and may manifest as decreased lymphocyte count.[19] Undernutrition and protein deficiency, in general, lead to impaired immune response. Taken together, an impaired, delayed hypersensitivity response (anergic or no reaction) may be seen in undernourished individuals. For example, malnourished individuals with TB may show an anergic tuberculin skin test.[20]
- Visceral proteins:[21] Levels of visceral proteins such as albumin, prealbumin, transferrin, and retinol-binding protein can help evaluate nutritional status. However, none of these tests alone are specific for detecting malnutrition, and their levels can be affected by multiple factors. For example, low serum albumin levels suggest protein deficiency due to malnutrition and other pathologies that affect the protein status, such as liver cirrhosis or nephrotic syndrome. High levels of serum albumin could be associated with dehydration. Albumin has a long half-life (up to 20 days) and, hence, cannot be used for monitoring frequent changes in nutritional status during refeeding. Prealbumin (or transthyretin), a thyroid hormone carrier, is preferred in such cases as it has a shorter half-life (2 to 3 days), which allows for the detection of acute alterations in nutritional status. Retinol-binding protein is another protein with a very short half-life (12 hours) and can be used for monitoring changes in nutritional status. However, its levels are affected by vitamin A levels. Transferrin, an iron transport protein, is another nutritional indicator as well as an acute phase reactant. It has a half-life of approximately ten days, and its levels are affected by serum iron levels.

- Micronutrient levels: If specific micronutrient deficiencies are suspected, individual micronutrient levels can be measured. For example, levels of B vitamins (thiamine, riboflavin, niacin, pyridoxine, folic acid, B12), vitamins A, C, D, E, and K, iron, zinc, selenium, homocysteine, etc., can be measured. More specific tests such as the Schilling test for B12 deficiency or iron panel to differentiate between different types of anemia can also be performed based on clinical presentation.
- Other non-nutrition-specific markers can also be used; for example, C-reactive protein (CRP) can be used to indicate inflammation.[21]

Body Composition Studies

Apart from laboratory tests, body composition studies can be performed to estimate the body's composition in terms of water, air, muscle, bones, and fat mass.

- Bioelectrical impedance analysis (BIA): This helps analyze the body composition based on the ability of different body tissues to conduct electricity. Conductance is higher in tissues with more water and electrolytes (for example, blood) and less in adipose and bone tissues. This is an easy, non-invasive test that can be done at the bedside using low-cost equipment. However, in patients with extremely high BMI or fluid overload, the results may be less accurate.
- Dual-Energy X-ray absorptiometry (DEXA or DXA): This is a standard method used to determine body composition and is also used as a reference to compare other body composition tests. However, it is expensive, requires a specialized machine, and involves exposure to X-rays. It is more commonly used in clinical research than in routine clinical practice.[22]
- Other tests, such as computed tomography (CT) scan and magnetic resonance imaging (MRI), can also be used to determine body composition but are expensive options for routine nutritional assessment. Body composition, however, can be determined when imaging is done for other diagnostic purposes.

Issues of Concern

Despite multiple studies on malnutrition and the knowledge that malnutrition affects clinical outcomes, the term malnutrition still has different interpretations and usages. In the consensus statement focusing on undernutrition by the Academy of Nutrition and Dietetics and ASPEN, adult malnutrition was used interchangeably with adult undernutrition for discussion.[23]

Also, there is no single best test that can give a complete picture of an individual's nutritional status. Additionally, various factors may affect the interpretation of individual tests or examinations, or the tests may have some shortcomings. Furthermore, the nutritional status of individuals itself is affected by multiple interdependent factors discussed below. Hence a holistic, team-based approach that takes into consideration overall data from clinical examination, dietary assessment, and diagnostic tests is necessary to determine the comprehensive nutritional status of a patient. At the same time, different nutritional screening or assessment tools may be required for different types of patient populations (i.e., children vs. elderly) or settings (i.e., hospital vs. outpatient).

Specialized tests may also be required in any patient, based on the underlying pathology. Another challenge with nutrition evaluation is dual manifestations of malnutrition, in which overnutrition and undernutrition can coexist. This further complicates the diagnostic process. The entire team of healthcare providers should be aware of these concerns to enhance the outcomes of nutritional screening and assessment.

Factors Affecting Nutritional Status

It is important to consider the following factors affecting the nutritional status of individuals while performing a comprehensive nutritional assessment. It is also crucial to remember that these factors can be interdependent. The

factors can be classified as physiological, pathological, and psychosocial factors.

Physiological factors: Physiological factors such as age, sex, growth, pregnancy, and lactation can influence nutritional needs and should be considered while performing a nutritional assessment. For example, as a child grows, its nutritional requirements will increase. The recommended nutritional requirements for male and female children of the same age are equal early in life, but as they approach adolescence, males require additional nutritional intake. On reaching adulthood, the rise in nutritional requirements of individuals plateaus off in their respective ranges. However, the caloric and nutritional needs of females increase during pregnancy and lactation. Hence, along with a balanced diet, a pregnant or lactating mother may also require additional supplementation of micronutrients, such as iron, folic acid, calcium, and vitamin D.[24] Maternal age at the time of pregnancy can further affect these requirements. For example, the calcium requirements of pregnant teens are higher than those of pregnant adults.[25] Physical activity also determines the recommended macronutrient (carbohydrate, protein, and/or fat) nutritional requirements. Individuals with an active lifestyle require higher nutritional needs than individuals with a sedentary lifestyle. Failure to meet the additional nutritional needs in any of the situations mentioned above increases the risk of malnutrition, especially if other health conditions coexist. On the other hand, as age advances, the energy needs of elderly individuals decrease due to less mobility and loss of lean tissue leading to decreased appetite. Factors such as poor dentition, increased prevalence of chronic conditions, and adverse effects of polypharmacy combined with psychosocial factors, like poor socioeconomic conditions or dementia, can further decrease intake of nutritious food, thus leading to impairment of nutritional status.[26]

Pathological factors: While performing nutritional assessment, it is important to understand how underlying pathologies can affect nutritional status. Some of these factors are discussed below.

- Genetics: Genetics play a significant role in maintaining an individual's nutritional status. Genetic predisposition combined with lack of physical activity and a high-energy diet can lead to obesity and metabolic syndrome, thus putting individuals at higher risk of developing cardiometabolic diseases. In various genetic disorders, multiple factors could be responsible for the pathogenesis of malnutrition. For example, in cystic fibrosis, malabsorption of nutrients results from decreased uptake by the intestines and reduced secretion of pancreatic enzymes. This, coupled with increased energy needs, can contribute to malnutrition in these patients.[27] Similarly, many other genetic disorders, such as phenylketonuria, Prader-Willi syndrome, maple syrup urine disease, abetalipoproteinemia, and lysosomal storage disorders, significantly affect the nutritional status of individuals.
- Infections: Malnourished individuals are more susceptible to infections and related complications. Interestingly, both acute and chronic infections adversely affect the nutritional status of individuals and can precipitate malnutrition. For example, in measles, an acute viral infection, severe deterioration of the nutritional status of children is observed due to acute inflammatory response, increased energy needs, and decreased intake of nutrients due to sore throat or oral lesions. The coexistence of malnutrition increases the severity of measles infection, susceptibility to secondary infections, and mortality rate. Measles is also associated with vitamin A deficiency, which can lead to xerosis, keratomalacia, and corneal ulceration, contributing to ophthalmological complications.[28] Chronic infections, such as tuberculosis (TB) and human immunodeficiency virus (HIV) infection, are associated with anorexia and cachexia. The underlying proinflammatory cytokine response and metabolic alterations are mainly responsible for this.[29] Other factors, like the adverse effects of drugs, can also contribute to this, thus aggravating malnutrition. Malnutrition, on the other hand, increases the severity of the infection, leading to a bidirectional relationship between infection and malnutrition. Parasitic infestations also severely affect the nutritional status of individuals.[30] For example, intestinal parasite infestation, such as ascariasis, leads to a deficiency of macronutrients and micronutrients.
- Medical and surgical illnesses: Various medical and surgical illnesses affect the nutritional status of individuals through multiple mechanisms and may lead to malnutrition. An important mechanism that leads to malnutrition

in patients with systemic disorders is the underlying inflammatory response. Many conditions like cardiovascular diseases, chronic obstructive pulmonary disorders, rheumatoid arthritis, chronic pancreatitis, neuromuscular disorders, etc., have some underlying chronic inflammatory response, which leads to an altered metabolic state. Another mechanism that could lead to nutritional disturbances is malabsorption. Many gastrointestinal pathologies such as inflammatory bowel disease, pernicious anemia, celiac disease, gastrointestinal obstruction, pancreatitis, and liver cirrhosis can lead to malnutrition through this mechanism. Malabsorption can also occur because of conditions affecting other organ systems. For example, right-sided congestive cardiac failure may be associated with intestinal edema, resulting in malabsorption and malnutrition in these patients. The next mechanism is metabolic disturbances observed in conditions characterized by dysfunction of the liver, gallbladder, and pancreas and endocrine disorders like diabetes mellitus, Cushing syndrome, and hyperthyroidism. Malnutrition also occurs due to decreased nutrient intake or loss of nutrients. Poor intake of nutrients can be seen in local pathologies affecting ingestion of food, as well as diseases that have dementia as one of the clinical features, such as Parkinson and Alzheimer diseases.[31] Recurrent nausea or vomiting, which leads to either decrease in the nutrient intake or loss of nutrients, can be seen in gastrointestinal pathologies, cyclic vomiting syndrome, brain tumors, Meniere disease, allergies, migraines, and motion sickness. Similarly, conditions characterized by recurrent diarrhea or steatorrhea can also be associated with malnutrition due to loss of nutrients. Mental illnesses (also discussed in psychosocial factors) affect nutritional status too. The mental status of these patients, adverse reactions to prescription drugs, loss of appetite as part of the disease process, etc., can all lead to malnutrition in these individuals.[32]

- Surgery: Malnutrition before surgery can increase the risk of complications, including increased need for ICU admission, longer recovery time, infections, and higher rates of morbidity and mortality. Hence, a nutritional assessment before surgery is crucial. Surgery alone can be a risk factor for malnutrition due to various factors, such as pre- and post-operative fasting, hypermetabolism, adverse effects due to drugs, pain, and other factors specific to the type of surgery.[33][34][33]
- Trauma: Severe trauma cases, including head injuries, burns, and multiple fractures, can put patients at high risk of malnutrition. The initial acute inflammatory response and increased energy needs following trauma lead to a hypermetabolic phase.[35] This, followed by a prolonged period of immobility, leads to muscle atrophy and protein breakdown, causing additional metabolic disturbances. The severe condition of these patients also affects food intake. Altogether, these factors often lead to malnutrition. Furthermore, malnutrition can adversely affect the recovery phase and increase the risk of complications, thus worsening clinical outcomes.[36]
- Malignancies: Malnutrition in malignancies is multi-factorial. Inflammatory mediators, increased energy needs, adverse effects of drugs/therapy (like mouth ulceration, nausea, and vomiting), mental stress, anxiety, and depression can lead to deterioration of nutritional status. Furthermore, malnutrition can inhibit the effectiveness of therapy and worsen the prognosis of the disease.[37]
- Medications: Adverse effects of various drugs, such as nausea, gastric irritation, or loss of appetite, can contribute to decreased food/nutrient intake. Commonly taken over-the-counter (OTC) drugs, such as NSAIDs, can lead to gastrointestinal irritation. Similarly, iron tablets can also cause gastrointestinal irritation and constipation as side effects. Some medications can lead to specific deficiencies, such as the drug isoniazid, which can lead to vitamin B6 (pyridoxine) deficiency. Hence, detailed drug-related history is needed as some drugs can cause drug-nutrient interactions.

Psychosocial factors: Often, the above-mentioned physiological and pathological factors may coexist with psychosocial elements, resulting in further deterioration of nutritional status and eventually leading to malnutrition.

- Factors such as socioeconomic conditions, natural and man-made calamities, cultural norms, religious beliefs, etc., can affect nutritional intake. Undernutrition is the major concern in impoverished areas, famine-stricken,

war zones, or refugee camps. Though it may seem obvious that overnutrition is mainly observed in affluent groups due to access to resources, the relationship between obesity and socioeconomic status is complicated. While undernutrition is one of the outcomes of lower socioeconomic status, paradoxically, individuals from these groups are also susceptible to developing obesity. This is due to limited access to fresh, nutrient-dense, and relatively more expensive food on the one hand and easy availability of less expensive, energy-dense food on the other hand. Malnutrition with dual manifestation may especially be seen in these groups of individuals.

- Other factors such as eating disorders, mental illnesses, and unhealthy diet trends can also drastically affect nutritional status and increase the risk of malnutrition.
- Alcohol and substance use are other major factors that need to be considered. Excessive alcohol consumption affects macronutrient and micronutrient metabolism, leading to nutritional deficiencies.[38] Excessive alcohol consumption is associated with multi-organ tissue injury, which leads to inflammation. Alcohol consumption can also affect fluid balance. Furthermore, patients' food habits with chronic alcohol use disorder may further contribute to malnutrition. Similarly, illicit drugs affect the metabolism of nutrients as well. Substance use also affects patients' food habits and emotional and mental status, potentially contributing to malnutrition.

Clinical Significance

Imbalanced nutritional status adversely affects the health and wellness of individuals. By evaluating the nutritional status of individuals early on, nutritional screening and assessment allow for timely intervention and thus help maintain the health and wellness of individuals and improve quality of life. Timely interventions, especially in specific groups of individuals, such as infants, growing children, pregnant and lactating mothers, etc., help prevent long-term complications.

Nutritional assessment and intervention together break the vicious cycle between malnutrition and various diseases or conditions, in which malnutrition aggravates a disease/condition, and the disease/condition, in turn, precipitates malnutrition. Breaking this cycle helps in improving clinical outcomes. Nutritional and clinical management based on comprehensive nutritional assessment results in positive healthcare outcomes by reducing the recovery period, hospital length of stay, risk of complications, susceptibility to infections, and mortality associated with clinical and surgical illnesses. The use of standardized, systematic nutrition risk screening and assessment in the clinical setting also helps in reducing overall healthcare costs.

Enhancing Healthcare Team Outcomes

Malnutrition adversely affects the health status of individuals, clinical outcomes, and overall healthcare costs. Since malnutrition is a public health concern, it should be addressed accordingly. To prevent this condition, efforts should be made at multiple system levels (public health, community, and individual). Establishing sustainable food systems, educating individuals about healthy diets and lifestyles, maintaining governmental and local food assistance programs, and arranging nutritional screening programs at schools, housing shelters, nursing facilities, and retirement homes, are just a few ways to improve nutritional status and reduce the burden of malnutrition on the healthcare system.

From a clinical standpoint, a systematic team-based nutritional evaluation helps detect malnutrition or factors causing it early, which allows for early intervention and better clinical outcomes. This requires the involvement of physicians (generalists and specialty care physicians), nurses, dietitians, nutrition specialists/technicians, pharmacists, dentists, and laboratory personnel. The primary attending physician is responsible for overall patient care. Since nutritional status is an important predictor of healthcare outcomes, the primary attending physician’s involvement in nutritional assessment and intervention is critical.

Nutrition specialists/technicians and dietitians also play vital roles in nutritional assessment. For example, dietetic technicians, registered (DTRs) are qualified to assist with general nutrition screenings and may also assist dietitians and other members of the healthcare team with identifying patients at risk for malnutrition in the clinical setting. Clinical dietitians or RDNs are trained to perform medical nutrition therapy (MNT) using the Nutrition Care Process (NCP), which includes nutrition assessment as the first step in identifying potential nutrition problems in patients, such as the risk factors of malnutrition mentioned throughout this article. Many of the components of nutritional assessment in the NCP are synonymous with those mentioned above.

The five domains of nutrition assessment outlined in the NCP include 1) food or nutrition-related history, 2) biochemical data, medical tests, and procedures, 3) anthropometric measurements, 4) nutrition-focused physical findings, and 5) client history.[39] By being involved in the diagnostic process and contributing to the planning and monitoring of steps of the intervention, nutrition specialists/technicians and dietitians help enhance overall healthcare outcomes.

Nurses also help with early nutritional screening to identify nutrition risk factors and monitor the patient's condition to maintain timely documentation records of clinical status. Pharmacists may also provide information about potential drug side effects or conditions that may impact the risk of malnutrition. They may also provide suggestions to help prevent drug-nutrient interactions that could influence a patient's nutrition status (i.e., antiepileptic drugs and potential impact on vitamin D levels).

Dental professionals can also play a unique role in identifying malnutrition risk factors in patients. For example, a child or adult with multiple dental caries and poor dentition will likely be at higher risk for malnutrition due to limitations with oral intake; a dental professional can assist with alleviating these concerns, thus promoting better overall nutrition. Consultations with specialty physicians may be required not only for the management of underlying conditions but also for the improvement of the nutritional status of patients. Other healthcare team members' services and expert opinions are also essential based on a patient's clinical presentation.

Overall, effective collaboration between each healthcare team member is essential to provide a thorough, comprehensive nutritional assessment. While each collaborating member may not function within the same healthcare system, modern technology and dynamic electronic medical records allow clinicians to communicate remotely to provide better overall care, which can manifest into more detailed nutritional assessment data collection and utilization.

As this article highlights, there are many different components of nutritional assessment, and it would be an overwhelming task for one member of the healthcare team to assume responsibility for performing all of these components alone. Therefore, it is to the benefit of the physicians, nursing staff, and allied health professionals to coordinate the facilitation of obtaining appropriate nutrition assessment data that can be used to enhance healthcare outcomes for patients' health and safety.

Review Questions

- Access free multiple choice questions on this topic.
- Comment on this article.

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