Nutritional Strategies for Wound and Pressure Ulcer Management

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Introduction

No one will argue the importance of adequate nutrition for preserving skin and tissue viability and promoting tissue repair processes like wound healing. Good nutritional status generally reflects a healthy condition and adequate body power. However, despite this assumption, little scientific evidence about the relationship between nutrition or nutrition intervention and wound healing is available. Most studies that have been performed are related to the problem of pressure ulcers. Hence, this chapter focuses on nutritional strategies for pressure ulcer management.

Prevalence of Pressure Ulcers

Pressure ulcers are common across all healthcare sectors throughout the world and have been described as one of the most costly and physically debilitating care problems. A survey by the European Pressure Ulcer Advisory Panel (EPUAP) found an overall prevalence of 18.1% in 5 different European countries, and a study of the National Pressure Ulcer Advisory Panel (NPUAP) found a similar prevalence of 15% together with an incidence of 7% in American hospitals.1,2 The Agency for Healthcare Research and Quality (AHRQ) in the United States noted that pressure ulcer-related hospitalizations increased by 80% from 1993 to 2006. Specifically, the prevalence figures are highest among vulnerable populations, such as frail and disabled residents in long-term care facilities, individuals receiving palliative care, and medically complex patients in intensive care units.3
The impact of pressure ulcers is significant to individuals and the healthcare system. Individuals with pressure ulcers have increased awareness about their pain, reduced quality of life, and limited abilities to participate in activities and rehabilitation. The amount of healthcare resources to manage the care of individuals with pressure ulcers in addition to frequent hospital stays is staggering. The pressure ulcer cost-of-illness has been calculated to be at least 1% of the total Dutch healthcare budget and 4% of the United Kingdom healthcare budget. In the United States, the Centers for Medicare & Medicaid Services (CMS) reported that the cost of treating a pressure ulcer in acute care, as a secondary diagnosis, in 2008 was $43,180.00 per hospital stay. In the United States, the cost of litigation adds to the burden of healthcare costs, especially in long-term care, where 87% of settlements against facilities are awarded to the plaintiffs. Therefore, addressing the overall management of pressure ulcers is now a prominent national healthcare issue in many western countries. Despite advances in healthcare, pressure ulcers remain a major cause of morbidity and mortality.

Both poor nutritional intake and poor nutritional status have been identified as the key risk factors for pressure ulcer development and prolonged wound healing. Notwithstanding methodological shortcomings, cross-sectional and prospective studies suggest a fairly strong correlation between malnutrition and pressure ulcer development. Malnutrition is a status of nutrition in which a deficiency, excess, or imbalance of energy, protein, and other nutrients causes measurable adverse effects on tissue, body structure, body function, and clinical outcome. The studies related to pressure ulcers have mostly focused on the relationship between pressure ulcers and undernutrition. Multivariate analysis of epidemiological data indicates that poor nutritional status and related factors, such as low body weight and poor oral food intake, are independent risk factors for pressure ulcer development. Moreover, it appears that many acute and chronically ill as well as elderly individuals at risk for pressure ulcer development or with established pressure ulcers suffer from undesired weight loss. A recent study from Shahin et al on the relationship between malnutrition parameters and pressure ulcers in German hospitals and nursing homes clearly established a significant relationship between the presence of pressure ulcers and undesired weight loss (5%-10%). Inadequate and poor nutritional intake was strongly related to the presence of pressure ulcers in both healthcare settings as well.

These findings confirm the importance of adequate nutritional care in individuals prone to pressure ulcer development, especially since malnutrition is a reversible risk factor for wounds (including pressure ulcers), unless the individual has a terminal illness.

Pathophysiology

In the NPUAP and EPUAP clinical practice guideline on pressure ulcer prevention and treatment, a pressure ulcer is defined as a localized injury to the skin and/or underlying tissue, usually over a bony prominence, as a result of pressure or pressure in combination with shear. The external mechanical loading of the skin can be a force perpendicular to the skin surface (direct pressure), a force parallel to the skin surface (shear), or a combination of both. Depending on the magnitude, time duration, and type of the mechanical load, the mechanical and geometrical properties of the tissues, as well as the susceptibility of the individual, ischemia as a result of the deformation of the tissues will lead to hypoxia. In addition, blocking of the nutrient supply and blocking of waste product removal combined with a subsequent change in pH will eventually lead to tissue damage. Finally, reperfusion after a period of ischemia may increase the ultimate cell death damage. The resultant tissue necrosis may cause local injured tissue alterations and even further exacerbate the damage.

The development of pressure ulcers depends on extrinsic and intrinsic risk factors. The most important extrinsic risk factors are pressure, shear, and friction, which lead to mechanical loading and secondary damage to the skin and soft tissue. Intrinsic factors have an effect on tissue viability and consequently influence the pathophysiological response to mechanical loading. Studies have found significant associations with age, sex, limited activity, care dependency, incontinence (bowel and bladder), acute disease (eg, infection), and nutritional status. The relative influence of each of these intrinsic risk factors is still unclear.
Pressure Ulcer Risk Assessment, Prevention, and Treatment

Pressure ulcer risk assessment. Based on targeted parameters, risk assessment aimed at identifying susceptible individuals is of utmost importance in daily clinical practice. Next to the overall clinical assessment of general health status and, related to this, the possible diseases affecting tissue perfusion and sensory perception (e.g., cardiovascular diseases, diabetes, and neurological diseases), pressure ulcer risk assessment should be performed in a structured, interprofessional way and should include activity, mobility, the skin’s viability and moisture, and nutritional status.

Pressure ulcer risk assessment scales can be used to support risk assessment. Several widely used risk assessment scales include the Waterlow pressure sore risk scale and the Braden scale, which consists of 6 items referring to sensory perception, skin moisture, activity, mobility, nutritional status, and the extent of friction and shear forces. In scientific research, risk assessment scales in general appear to have a poor predictive value, yet the advice is to incorporate them in the daily care process because they can be regarded as a means of alerting healthcare professionals to the possibility of pressure ulcers. Their use indeed may lead to structural systematic assessment and a stimulus for treatment of pressure ulcer risk within the healthcare organization.

Pressure ulcer prevention. After establishing pressure ulcer risk or pressure ulcer diagnosis, preventive measures should be initiated. Relevant preventive measures include:

- Regular inspection of the skin for signs of redness in individuals identified as being at risk of pressure ulceration together with the use of skin emollients to hydrate dry skin
- Reduction of the duration and magnitude of pressure on vulnerable areas of the body by repositioning at-risk individuals in combination with using pressure redistribution surfaces, such as mattresses, beds, seats, and cushions
- Optimization of the individual’s general health condition, including improvement of mobility and nutritional status.

Pressure ulcer treatment. In the case of a confirmed pressure ulcer, therapeutic measures must be taken directly and in agreement with an additional comprehensive assessment of the individual involved. During the course of the treatment, the aforementioned preventive measures remain in force.

Curative intervention consists primarily of appropriate wound care to encourage tissue repair as much as possible. This process includes cleaning the wound (removal of any necrosis, disinfection, and cleansing of the wound) and application of appropriate wound dressings. Sometimes surgical interventions may be indicated.

In addition, attention must be paid to the individual’s general health status, the management of secondary infection, pain, and psychosocial suffering, and, last but not least, adequate nutritional care.

Basic Aspects of Wound Healing

Healing wounds is a complex process directly influenced by the status of the local wound environment and also by the overall physical condition of the individual. The wound healing process involves the overlapping sequential stages of blood coagulation, inflammation, migration, proliferation of defense and repair cells (e.g., neutrophils, macrophages, lymphocytes, endothelial cells, fibroblasts, and keratinocytes), remodelling of tissue structure, scar formation, and maturation. To promote wound healing, several endogenous factors are crucial. One such factor is the body’s ability to generate an adequate inflammatory and defense response to manage the bacterial burden of the wound and to create the required enzymatic environment needed for the various wound repair tasks. These tasks include prevention of ischemia-reperfusion damage and counteracting of oxidative damage; removal of devitalized tissue; prevention of cell migration; epidermal-mesenchymal interactions during keratinocyte migration; angiogenesis; remodelling of newly synthesized connective tissue during maturation; and regulation of growth factor activities. In the total process of wound repair, nutrients also play an important role.

Role of Nutrients in Wound Healing

Carbohydrates, fats, and proteins supply the energy source (kilocalories) for the body. Consumption of adequate kilocalories supports collagen and nitrogen synthesis for healing. External
consumption also promotes anabolism by sparing
the body’s endogenous protein from being used
as an energy source.\textsuperscript{25} When the energy from
carbohydrates and fats fails to meet the body’s
requirements, glucose is synthesized by the liver
and kidney from non-carbohydrate sources, such
as protein or amino acids. Gluconeogenesis oc-
curs when the nitrogen is removed from the
amino acid that is part of the protein structure
leaving the carbon skeleton that can be used as an
energy source by the body. When visceral protein
stores in the muscle are converted to glucose, the
caloric requirement needed to promote anabo-
lism and reverse catabolism (a breakdown of pro-
tein and other body energy sources) is increased.
The decline in lean body mass can lead to muscle
wasting, loss of subcutaneous tissue, and poor
wound healing.

Fat. Fat, the most concentrated source of kilo-
calories, transports the fat-soluble vitamins (A, D,
E, and K) and provides insulation under the skin
and padding to bony prominences. Meats, eggs,
dairy products, and vegetable oils contain fat.

Protein and amino acids. Protein is the only
nutrient containing nitrogen and is composed
of amino acids that form the building blocks of
protein. Protein is important for tissue perfusion,
preservation of immune function, repair and syn-
thesis of enzymes involved in wound healing, cell
multiplication, and collagen and connective tis-
sue synthesis. Protein is required to compensate
for the nitrogen lost through pressure ulcer skin
breakdown and exudate.\textsuperscript{26}

Foods that provide all 9 essential amino acids,
such as meat, poultry, fish, eggs, milk products,
and soybeans, are considered complete proteins.
Essential or indispensable amino acids must be
obtained from the diet. The body requires an ad-
quate supply of the essential amino acids plus
enough nitrogen and energy to synthesize the 11
other amino acids. Legumes, grains, and vegeta-
bles contain incomplete proteins, meaning they
are lacking or low in one or more of the essential
amino acids.

During periods of stress or trauma, such as
injury, wound healing, or sepsis, certain amino
acids, such as arginine and glutamine, become
conditionally essential. \textbf{L-arginine}, which is 32%
nitrogen, has been shown in some studies to in-
crease concentrations of hydroxyproline, which is
an amino acid that is a constituent of collagen and
an indicator of collagen deposition and protein
in the wound site.\textsuperscript{27,28} Desneves et al conducted
a randomized controlled trial to measure pressure
ulcer healing for 3 groups of subjects using the
Pressure Ulcer Scale for Healing (PUSH) scores.
One group received a standard hospital diet. A
second group received the standard hospital diet
plus 2 high-calorie supplements totalling 500
Kcalories, 18 g of protein, 72 mg of vitamin C,
and 7.5 mg of zinc. The third group received the
standard diet plus 2 high-calorie supplements to-
talling 500 Kcalories, 21 g of protein, 9 g of added
arginine, 500 mg of vitamin C, and 50 mg of zinc.
The third group noted a reduction in the PUSH
score (indicating clinical improvement) when
they consumed the oral nutritional supplement
containing arginine.\textsuperscript{29} This was a small study of
16 people. In a randomized controlled trial, van
Anholt et al discovered significantly reduced
PUSH scores and significantly faster wound heal-
ing in non-malnourished individuals aged 18 to
90 years with normal body mass indices (BMIs),
no undesired weight loss, and stage III or stage IV
pressure ulcers who received an oral nutritional
supplement with arginine, protein, zinc, ascor-
bic acid, and vitamin E.\textsuperscript{30} Additional research is
needed to determine the impact of using arginine
alone or combined with other nutrients.\textsuperscript{31}

While it has been shown that inflammatory
cells within the wound use \textbf{glutamine} for prolif-
eration and as a source of energy, studies on the
effectiveness of consuming supplements contain-
ing glutamine are inconclusive.\textsuperscript{32}

Water. Water is distributed throughout the
body in our intracellular, interstitial, and intravas-
cular compartments and serves as the transport
medium for moving nutrients to the cells and
removing waste products. Fluids are the solvent
for minerals, vitamins, amino acids, glucose, and
other small molecules, thus enabling them to dif-
fuse into and out of cells.

Individuals with draining wounds, emesis, di-
arrhea, increased insensible loss due to elevated
temperature, or increased perspiration require ad-
ditional fluids to replace lost fluid.\textsuperscript{33} Water consi-
tutes 60% of an adult’s body. The elderly individu-
al generally has increased body fat and decreased
lean body mass, resulting in a decreased percent-
age of water stored. The decrease in water stored
coupled with a declined sense of thirst places the elderly at risk for dehydration. Schols et al noted that illness and warm weather are contributing factors to dehydration in the elderly.34 Hydration needs are met with liquids plus the water content of food, which accounts for 19% to 27% of the total fluid intake of healthy adults.35 Adequate intake of fluids for healthy adults is 2.7 L/day for women and 3.7 L/day for men. This includes all beverages as well as the moisture content of food.

Vitamins and minerals. The role of micro-nutrients that are assumed to promote wound healing is debatable. Ascorbic acid (vitamin C), a water-soluble vitamin, is a cofactor with iron during the oxidation of proline and lysine in the production of collagen. Hence, a deficiency of vitamin C prolongs the healing time and contributes to reduced resistance to infection.36 The Dietary Reference Intake (DRI) of 70–90 mg/day of vitamin C is achieved with the consumption of fruits and vegetables, such as citrus fruits, tomatoes, potatoes, and broccoli. Most oral nutritional supplements provide ascorbic acid along with calories, protein, and other vitamins and minerals. Mega doses of ascorbic acid have not resulted in accelerated pressure ulcer healing.37

Vitamin A and vitamin E are fat-soluble vitamins, and the dietary intake of these vitamins comes from a variety of foods. Vitamin A acts as a stimulant during the wound healing process to increase collagen formation and promote epithelization. Mega doses of vitamin A above 3,000 ug of the DRI’s Tolerable Upper Limit (UL), the maximum level of daily nutrient intake that is likely not to pose concern, should not be recommended without consultation with the physician. Vitamin E acts as an antioxidant, and the DRI can easily be met with food and/or a multivitamin, unless a deficiency is confirmed.

Zinc, a cofactor for collagen formation, also metabolizes protein, liberates vitamin A from storage in the liver, and assists in immune function. Individuals who have large draining wounds, poor dietary intake over an extended time, or excessive gastrointestinal losses may trigger a zinc deficiency. Unless a deficiency is confirmed, elemental zinc supplementation, above the UL of 40 mg/day, is not recommended for individuals with pressure ulcers.38,39 Copper is an essential mineral for collagen cross-linking. Zinc and copper compete for the same binding site on the albumin molecule, thus high serum zinc levels interfere with copper metabolism, inducing a copper deficiency.40,41 If deficiencies are suspected, a multivitamin with minerals may be appropriate. Check the nutrient analysis of oral nutritional supplements or enteral formulas recommended to individuals with pressure ulcers, since they usually contain additional micronutrients.

Nutritional Screening and Assessment

Screening and assessment of nutritional status should be part of the prevention and treatment plan for individuals at risk for pressure ulcer development and those with pressure ulcers.

Nutritional screening. Unless the individual has a terminal illness, under-nutrition is a reversible risk factor for pressure ulcer development, making early identification and management critical. Individuals at risk for pressure ulcer development may also be in danger of under-nutrition, so nutritional screening should be completed.17–20,26,42 Healthcare organizations should have a policy on nutritional screening and its frequency. Screening should be completed upon admission to a healthcare setting and with each condition change. Since individuals frequently move from one healthcare setting to another, the screening results must be documented and communicated from one care setting to another.26,43 Screening tools should be quick and easy to use, validated, and reliable for the patient population served.44 Any qualified healthcare professional may complete a screening. Validated screening tools are more widely used in Europe than in the United States. In a cross-sectional study, Langkamp-Henken et al noted an advantage to using the Mini-Nutritional Assessment (MNA) and the MNA short form (MNA-SF) over using visceral protein when screening and assessing nutritional status.45,46 The MNA-SF was revised to 6 questions and revalidated for adults age 65 and older and has an 80% sensitivity and specificity and a 97% positive predictive value according to clinical status.47 The Malnutrition Universal Screening Tool (MUST) was validated in acute care, long-term care, and the community and identifies those individuals who are underweight or at risk for under-nutrition.48 The MUST tool uses
5 steps to establish nutritional risk and determine a plan of care. First, the height and weight are recorded to determine BMI. In step 2, percentage of unplanned weight loss is recorded. In step 3, established acute disease effect is scored. In step 4, the previous 3 scores are added to obtain the overall risk of malnutrition, and step 5 uses either the management guide or local policy to develop a plan of care.

When the screening tool triggers a nutrition assessment, timely referral to the appropriate professionals is critical. Conditions requiring immediate assessment and intervention include unplanned weight loss, dysphagia, poor appetite or the inability to consume adequate food or fluid, and pressure ulcers or other wounds. The

Figure 1. Nutrition for pressure ulcer prevention and treatment is interprofessional care.
registered dietitian (RD) completes the nutrition assessment and communicates with the other healthcare team members. In addition to the RD, the members of the nutritional team include the speech therapist who is responsible for screening, evaluating, and treating swallowing problems; the occupational therapist who works to strengthen the individual’s ability to feed him or herself; and the nursing staff whose responsibilities include monitoring factors, such as mood, pain, and dentition, which can affect oral intake. The physician is responsible for the overall care of the individual and ordering any treatments recommended by the team (Figure 1).

**Nutrition assessment.** Nutrition assessment is a methodical process of obtaining, verifying, and interpreting data in order to make decisions about the basis of nutrition-related problems. The American Dietetic Association (ADA) Nutrition Care Process includes 4 steps:

- Nutrition assessment
- Nutrition diagnosis
- Nutrition intervention
- Nutrition monitoring and evaluation.

The assessment includes obtaining anthropometric measurements; evaluating visual signs of poor nutrition, oral status, chewing/swallowing ability, and/or diminished ability to eat independently; and interpreting and analyzing medical, nutritional, and biochemical data along with food-medication interactions.

**Anthropometrics.** Anthropometric measurements include height, weight, and BMI. Obtaining accurate height and weight is important, since these values are the basis for calculating BMI and caloric requirements. Individuals should be weighed on a calibrated scale at the same time of the day and wearing the same amount of clothing. Specialty beds often are equipped with a device to weigh an immobile individual. The RD evaluates the severity of the weight loss, considering the effect of recent surgery, diuretic therapy, and other traumatic events. Significant weight loss places an individual at increased nutritional risk and has a negative effect on wound healing. Several studies support the theory that **unintentional weight loss of 5% in 30 days or 10% in 180 days is a predictor of mortality in the elderly.**

During the interview with the individual or caregiver, the RD/clinician asks what the usual body weight has been over the past few months. Usual body weight is used to calculate the percentage of weight lost or gained over time thus determining the significance of any weight change.

**BMI, an index of an individual’s weight in relationship to his or her height,** is calculated as weight (kg)/height (m²), or weight (lb)/height (m²) x 705. BMI is highly correlated with body fat, but increased lean body mass or a large body frame can also increase the BMI. It is generally agreed that a normally hydrated individual with a BMI ≥ 30 is obese and an individual with a BMI less than 20 is considered underweight. The National Pressure Ulcer Long Term Care Study (NPULS) of residents in nursing homes who were at risk for developing a pressure ulcer reported that more than 50% of the residents had a 5% weight loss during a 12-week study, and 45.6% were considered underweight (defined by a BMI of 22 or less). Residents with the highest percentage of weight loss more often had a recent pressure ulcer. Under-nutrition has been defined in the literature as protein and energy deficiency often associated with coexisting deficiencies of micronutrients, which is reversed solely by nutrients. Unintentional weight loss, poor food intake, and the inability to eat independently impact the healing process.

The obese individual is also at risk for pressure ulcer development, and healing may be delayed when the diet consumed is inadequate in nutrients, including protein. When pressure ulcer healing is the goal, the interprofessional team should evaluate the risks versus the benefits of recommending a low-calorie diet.

**Nutrition-focused clinical examination.** The interprofessional team, including the RD, should examine the individual for physical signs of under-nutrition and protein depletion as evidenced by changes in the hair, skin, or nails, such as thin, dry hair; brittle nails; or cracked lips. Individuals with missing or decayed teeth or ill-fitting dentures often reduce their intake of difficult-to-chew protein foods, thus restricting their caloric intake and increasing the chance for weight loss. If untreated, individuals with swallowing problems or dysphagia may become dehydrated, lose weight, and develop pressure ulcers. Loss of dexterity and/or the ability to self-feed is a risk factor...
often resulting in poor oral intake. All of these conditions are roadblocks to wound healing.

**Biochemical data.** Analysis of current laboratory values is one component of the nutrition assessment. Biochemical assessment data must be used with caution because values can be altered by hydration, medication, and changes in metabolism. There is not one specific laboratory test that can expressly determine an individual’s nutritional status. Serum hepatic proteins including albumin, prealbumin (transthyretin), and transferrin may not correlate with the clinical observation of nutritional status. Serum albumin has a long half-life (12–21 days), and multiple factors, such as infection, acute stress, hydration, and excess cortisone, decrease the albumin level, making it a poor indicator of visceral protein status. Edema depresses albumin levels and dehydration falsely elevates both prealbumin and albumin levels. Low albumin levels may manifest the presence of inflammatory cytokine production or other comorbidities rather than poor nutritional status (eg, from the local wound bed or a systemic inflammatory process).

Table 1. Recommendations of the NPUAP/EPUAP Guideline


**Nutrition for Pressure Ulcer Prevention**

**General Recommendations**

1. Screen and assess the nutritional status of every individual at risk for pressure ulcer development in each healthcare setting.

   1.1. Use a valid, reliable, and practical tool for nutritional screening that is quick and easy to use and acceptable to both the individual and the healthcare worker.

   1.2. Establish and implement a nutritional screening policy in all healthcare settings, along with recommended frequency of screening.

2. Refer each individual with nutritional risk and pressure ulcer risk to a registered dietitian and also, if needed, to a multidisciplinary nutritional team that includes a registered dietitian, a nurse specializing in nutrition, a physician, a speech and language therapist, an occupational therapist, and, when necessary, a dentist.

   2.1. Provide nutritional support to each individual with nutritional risk and pressure ulcer risk, following the nutrition cycle. This support should include:

      • Nutritional assessment
      • Estimation of nutritional requirements
      • Comparison of nutrient intake with estimated requirements
      • Provision of appropriate nutritional intervention, based on appropriate feeding route
      • Monitoring and evaluation of nutritional outcome, with reassessment of nutritional status at frequent intervals while the individual is at risk.

   2.2. Follow relevant and evidence-based guidelines on enteral nutrition and hydration for individuals at risk for pressure ulcer development who show nutritional risk or nutritional problems.

   2.3. Offer each individual with nutritional risk and pressure ulcer risk a minimum of 30–35 kcal/kg/day, with 1.25–1.5 g/kg/day protein and 1 mL of liquid intake per kcal per day

**Specific Recommendations: Nutrition Prevention**

1. Offer high-protein mixed oral nutritional supplements and/or tube feeding, in addition to the usual diet, to individuals with nutritional risk and pressure ulcer risk because of acute or chronic diseases or following surgical intervention (strength of evidence = A).

   1.1. Administer oral nutritional supplements and/or tube feeding in between the regular meals to avoid reduction of normal food and fluid intake during regular mealtimes (strength of evidence = C).
Nutritional Strategies for Wound and Pressure Ulcer Management

Table 1. Recommendations of the NPUAP/EPUAP Guideline


Nutrition for Pressure Ulcer Healing

<table>
<thead>
<tr>
<th>Role of Nutrition in Pressure Ulcer Healing</th>
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<tbody>
<tr>
<td>1. Screen and assess nutritional status for each individual with a pressure ulcer at admission and with each condition change and/or when progress toward pressure ulcer closure is not observed (strength of evidence = C).</td>
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<tr>
<td>1.1. Refer all individuals with pressure ulcers to the dietitian for early assessment and intervention for nutritional problems (strength of evidence = C).</td>
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<tr>
<td>1.2. Assess weight status for each individual to determine weight history and significant weight loss from usual body weight (≥ 5% change in 30 days or ≥ 10% in 180 days) (strength of evidence = C).</td>
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<td>1.3. Assess the individual’s ability to eat independently (strength of evidence = C).</td>
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<tr>
<td>1.4. Assess the adequacy of total nutrient intake (food, fluid, oral supplements, enteral/parenteral feedings) (strength of evidence = C).</td>
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<tr>
<td>2. Provide sufficient calories (strength of evidence = B).</td>
</tr>
<tr>
<td>2.1. Provide 30–35 kcal/kg for individuals with a pressure ulcer under stress. Adjust formula based on weight loss, weight gain, or level of obesity. Individuals who are underweight or who have had significant unintentional weight loss may need additional kilocalories to cease weight loss and/or regain lost weight (strength of evidence = C).</td>
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<tr>
<td>2.2. Revise and modify (liberalize) dietary restrictions when limitations result in decreased food and fluid intake. These adjustments are to be managed by a dietitian or medical professional (strength of evidence = C).</td>
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<td>2.3. Provide enhanced foods and/or oral supplements between meals if needed (strength of evidence = B).</td>
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<tr>
<td>2.4. Consider nutritional support (enteral or parenteral nutrition) when oral intake is inadequate. This must be consistent with the individual’s goals (strength of evidence = C).</td>
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<td>3. Provide adequate protein for positive nitrogen balance for an individual with a pressure ulcer (strength of evidence = B).</td>
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<tr>
<td>3.1. Offer 1.25–1.5 g/kg/day protein for an individual with a pressure ulcer when compatible with the goals of care and reassess as condition changes (strength of evidence = C).</td>
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<tr>
<td>3.2. Assess renal function to ensure that high levels of protein are appropriate for the individual (strength of evidence = C).</td>
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<td>4. Provide and encourage adequate daily fluid intake for hydration (level of evidence = C).</td>
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<tr>
<td>4.1. Monitor individuals for signs and symptoms of dehydration: changes in weight, skin turgor, urine output, elevated serum sodium, or calculated serum osmolality (strength of evidence = C).</td>
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<tr>
<td>4.2. Provide additional fluid for individuals with dehydration, elevated temperature, vomiting, profuse sweating, diarrhea, or heavily draining wounds (strength of evidence = C).</td>
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<tr>
<td>5. Provide adequate vitamins and minerals (strength of evidence = B).</td>
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<tr>
<td>5.1. Encourage consumption of a balanced diet that includes good sources of vitamins and minerals (strength of evidence = B).</td>
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<tr>
<td>5.2. Offer vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected (strength of evidence = B).</td>
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with metabolic stress, inflammation, infection, and surgical trauma. Studies indicate that hepatic proteins may correlate with the severity of illness rather than with nutritional status.58-65

Since the blood carries oxygen to the wound bed, anemia may have an adverse effect on wound healing. Blood loss, poor dietary intake, malabsorption, and increased iron needs are causes of anemia. biochemical data used to diagnose iron-deficiency anemia include low hemoglobin and hematocrit, low mean corpuscular volume (MCV), low serum iron, low ferritin, and elevated total iron-binding capacity (TIBC). Treatment for iron-deficiency anemia is oral iron therapy.

Older adults often have pernicious anemia or vitamin B12 deficiency that is caused by inadequate intrinsic factor. The prevalence of anemia66 increases with each decade of life after age 70. Without adequate intrinsic factor, vitamin B12 cannot be properly absorbed. Laboratory results include low hemoglobin, hematocrit, and serum B12; normal or elevated MCV; and elevated serum iron, ferritin, folate, and homocysteine. There are several ways to supply vitamin B12, but the monthly injection is most effective. Some individuals with low B12 levels respond to daily intake of oral B12 with the suggested dose of 1000 IU or to the use of nasal sprays or patches.

Diet history. The diet history includes consultation with the individual and/or caregivers to determine the type, quantity, and frequency of food usually consumed by the individual. Questions about any vitamin, mineral, or herbal supplements taken by the individual should also be noted. The healthcare team should consider any factors that may influence the individual’s decision about nutrition, such as culture, tradition, religion, and belief systems of ethnic and minority groups. Often, culture or religion strongly influence food intake and may affect nutritional status. Since the individual is the center of the wound care model, recommendations for nutritional interventions should incorporate the values and beliefs of the individual.

Nutrition Intervention

Ultimately, the nutrition assessment will lead to a nutrition diagnosis and nutritional support. The cycle for both prevention and treatment should include:

- Nutrition assessment
- Estimation of nutritional requirements
- Comparisons of intake with estimated requirements
- Provision of appropriate nutrition intervention, based on appropriate feeding route
- Monitoring and evaluation of nutritional outcome, with reassessment of nutritional status at frequent intervals.

Early nutrition intervention and subsequent monitoring of the nutritional plan can reverse poor outcomes associated with under-nutrition and promote healing. Caloric, protein, and fluid requirements should be individualized and increased or decreased, depending on the assessed requirement of the individual. Hypermetabolic conditions, such as infection, stress, and trauma, require calories above the baseline requirements. Renal function should be assessed routinely to ensure that high levels of protein are appropriate.67 The interprofessional team should frequently review the type and amount of food and fluid consumed by the individual to determine when fortified foods and/or oral nutritional supplements should be incorporated into the treatment plan. Fortified foods include commercial products, such as cereal, soup, cookies, or dairy products enriched with additional calories and protein, or enriched menu items prepared by the staff of a care facility.

Research supports the theory of providing oral nutritional supplements to reverse under-nutrition, prevent pressure ulcer occurrence, and promote pressure ulcer healing.68-70 As previously noted, oral nutritional supplements provided in addition to the diet for non-malnourished individuals also decreased the healing time.30 One study noted that individuals who consume oral nutritional supplements between meals, in addition to the usual diet, experience better absorption of nutrients.71

Therapeutic or restricted diets often result in unappealing meals that are refused, thus delaying wound healing. The American Dietetic Association’s 2010 position statement noted that “the quality of life and nutritional status of older adults residing in healthcare communities can be enhanced by individualization to the least restrictive diet appropriate.”72
When normal oral intake is inadequate to promote healing, enteral or parenteral nutrition is considered if it is consistent with the individual’s goal of overall treatment. The interprofessional team should discuss the risks and benefits with the individual or his or her caregiver. When the gut is functioning, enteral feeding via oral nutritional supplements in addition to the diet or total tube feeding is the preferred route. Provision of an adequate nutrient supply can lower the incidence of metabolic abnormalities, reduce septic morbidity, and improve survival rates. However, research fails to show the benefit of initiating enteral tube feeding to improve pressure ulcer healing rates.

The NPUAP/EPUAP guideline on prevention and treatment of pressure ulcers is the most recently published international guideline on pressure ulcer care. The guideline was developed following a systematic, comprehensive review of peer-reviewed, published research on pressure ulcers from January 1998 to January 2008 and will be updated routinely as new research becomes available. This guideline also gives the most relevant recommendations regarding nutritional care for individuals prone to pressure ulcer development (Table 1).

**Conclusion**

Nutrition is a key element in pressure ulcer prevention and the treatment of individuals with pressure ulcers. The early identification of under-nutrition and the correction of nutritional deficits prevent pressure ulcer occurrence, promote pressure ulcer healing, and improve the individual’s quality of life. Nutritional care has to be incorporated into integrated and multidisciplinary pressure ulcer care, performed by a dedicated interprofessional team. In order to achieve optimal nutrition for each individual prone to pressure ulcer development, goals should be evaluated frequently and revised with each condition change or when progress toward healing is not occurring. The amount and type of nutritional support should be consistent with medical goals and the individual’s wishes. While each member of the interprofessional team has a distinct role in the care and treatment of the individual prone to pressure ulcer development, collaboration, communication, complementarity, and continuity are fundamental to benefit the individuals involved.

**Take-Home Messages for Practice**

- Screen and assess the nutritional status of individuals at risk for or with pressure ulcers and determine appropriate interventions.
- Encourage consumption of a balanced diet, which includes good sources of calories, protein, vitamins, and minerals.
- Provide enriched food and/or oral nutritional supplements between meals, if appropriate and consistent with the person’s overall plan of care.

**Self-Assessment Questions**

1. The appropriate daily kilocalories for an individual with a category/stage IV pressure ulcer weighing 120 pounds (54.5 kg) is:
   A. 1,100 kilocalories
   B. 1,650 kilocalories
   C. 1,909 kilocalories
   D. 1,275 kilocalories

2. The non-malnourished individual with a category/stage III pressure ulcer may benefit from:
   A. An oral nutritional supplement with calories, protein, vitamin A, and copper
   B. A balanced 2,200 kilocalorie diet plus a vitamin supplement
   C. A 1,200 kilocalorie diet plus 1,000 mg of ascorbic acid and 220 mg of zinc sulfate
   D. An oral nutritional supplement with added protein, arginine, zinc, vitamin C, and vitamin E

3. Mr. B has a wound infection, a draining pressure ulcer, and a fever. Wound healing can be facilitated by increasing:
   A. Fluid
   B. Vitamin C
   C. Iron
   D. Protein

   Answers: 1-C, 2-D, 3-A

**References**


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