Prevention and Treatment of Pressure Ulcers: 

*Nutrition* – an extract from the Clinical Practice Guideline
INTRODUCTION

Foreword

This document presents an extract of the full Clinical Practice Guideline. The methodology used to appraise research and develop the recommendations is presented in the Clinical Practice Guideline, the abridged Quick Reference Guide, and in the methodology report, all available on the International Pressure Ulcer Guideline website (www.internationalguideline.com).

The full Clinical Practice Guideline presents recommendations and summarizes the supporting evidence for pressure ulcer prevention and treatment. The first edition was developed as a four year collaboration between the National Pressure Ulcer Advisory Panel (NPUAP) and the European Pressure Ulcer Advisory Panel (EPUAP). In the second edition of the guideline, the Pan Pacific Pressure Injury Alliance (PPPIA) has joined the NPUAP and EPUAP.

The goal of this international collaboration was to develop evidence-based recommendations for the prevention and treatment of pressure ulcers that could be used by health professionals throughout the world. An explicit scientific methodology was used to identify and critically appraise all available research. In the absence of definitive evidence, expert opinion (often supported by indirect evidence and other guidelines) was used to make recommendations. Drafts of the recommendations and supporting evidence were made available to 986 invited stakeholders (individuals and organizations) around the world. The final guideline is based on available research and the accumulated wisdom of the NPUAP, EPUAP, PPPIA and international stakeholders. In this edition of the guideline, a consensus voting process (GRADE) was used to assign a strength to each recommendation. The strength of recommendation identifies the importance of the recommendation statement based on potential to improve patient outcomes. It provides an indication to the health professional of the confidence one can have that the recommendation will do more good than harm, and can be used to assist in prioritizing pressure ulcer related interventions. Printed copies of the English version of the full Clinical Practice Guideline are available through links provided on the following websites:

NPUAP website: www.npuap.org
EPUAP website: www.epuap.org
Wounds Australia (previously Australian Wound Management Association) website: www.woundsaustralia.com.au
New Zealand Wound Care Society (NZWCS) website: www.nzwcs.org.nz
International Pressure Ulcer Guideline website: www.internationalguideline.com

Suggested Citation

The NPUAP, EPUAP and PPPIA welcome the use and adaptation of this guideline at an international, national and local level. We request citation as the source, using the following format for this extract:

Limitations and Appropriate Use of This Guideline

- Guidelines are systematically developed statements to assist health professional and patient consumer decisions about appropriate health care for specific clinical conditions. The recommendations may not be appropriate for use in all circumstances.
- The decision to adopt any particular recommendation must be made by the health professional with consideration to available resources and circumstances of the individual patient. Nothing contained in this guideline is to be considered medical advice for specific cases.
- Because of the rigorous methodology used to develop this guideline, the Guideline Development Group members believe that the research supporting these recommendations is reliable and accurate. Every effort has been made to critically appraise the research contained within this document. However, we do not guarantee the reliability and accuracy of individual studies referenced in this document.
- This guideline is intended for education and information purposes only.
- This guideline contains information that was accurate at the time of publication. Research and technology change rapidly and the recommendations contained in this guideline may be inconsistent with future advances. The health professional is responsible for maintaining a working knowledge of research and technology advances that may affect his or her clinical decision making.
- Generic names of products have been used. Nothing in this guideline is intended as endorsement of a specific product.
- Nothing in this guideline is intended as advice regarding coding standards or reimbursement regulations.
- The guideline does not seek to provide full safety and usage information for products and devices; however commonly available safety and usage tips have been included. Adverse events reported in the included research have been reported in the evidence summaries and caution statements. All products should be used according to manufacturer’s directions.

Abstract

The guideline is the result of a collaborative effort among the National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA). A comprehensive literature review was conducted on pressure ulcer prevention and treatment. A rigorous scientific methodology was used to appraise available research and make evidence-based recommendations for the prevention and treatment of pressure ulcers. Draft guidelines were made available to 986 invited stakeholder individuals and organizations/societies and stakeholder feedback was considered by the guideline developers. In the final development process, the guideline development team used a consensus voting process (GRADE) to assign strengths of recommendation. Strength of recommendations indicate the extent to which one can be confident that adherence to a recommendation will do more good than harm, and are intended to assist the health professional to prioritize interventions.

The full Clinical Practice Guideline includes 575 explicit recommendations and/or research summaries.

This extract focuses on the evidence presented on nutrition for prevention and treatment of pressure injuries.
Strengths of Evidence and Strengths of Recommendations

Full explanation of the methodology is available in Appendix 1: Guideline Methodology in the Full Clinical Practice Guideline. Individual studies were assigned a ‘level of evidence’ based on study design and quality. The body of evidence supporting each recommendation was given a ‘strength of evidence’. A consensus voting process (GRADE) involving all the experts formally engaged in the guideline development was used to assign a ‘strength of recommendation’ that indicates the confidence the health professional can have that the recommended practice will improve patient outcomes (i.e., do more good than harm). The overall aim of the ‘strength of recommendation’ is to help health professionals to prioritize interventions.

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Guideline Website

http://www.internationalguideline.com

The guideline website will remain accessible during the interim period until the next guideline revision. The Quick Reference Guideline, sponsor acknowledgement, and supportive documents (e.g., data extraction tables) to the guideline are available from the website.
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Stakeholders

Special thanks to the many stakeholders who reviewed the guideline processes and drafts. All stakeholder comments were reviewed by the Guideline Development Group and revisions were made based on the comments received. We appreciate the investment of health professionals, researchers, educators and manufacturers from all over the world who took time to share their expertise and thoughtful critique.
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INTerventions for Prevention & Treatment of Pressure Ulcers

Nutrition in Pressure Ulcer Prevention and Treatment

Introduction

The recommendations in this section of the guideline are predominantly for adult individuals and have been derived from evidence conducted in adult populations. Recommendations for nutritional assessment and treatment in pediatric populations are presented in the Special Populations: Pediatric Individuals section in the full Clinical Practice Guideline.

Nutrition is the process of ingesting carbohydrates, protein, fat, vitamins, minerals, and fluids in sufficient amounts to meet nutritional requirements. Malnutrition is simply defined as any nutritional imbalance. It is a condition in which a nutritional deficiency or an excess or imbalance of energy, protein, and other nutrients causes measurable adverse effects on tissue, body structure, body function, and clinical outcomes. In this guideline, malnutrition primarily refers to a status of undernutrition.

Thomas (2008) noted that recent weight loss in older adults was a key factor in mortality risk. Murden et al. (1994) indicated that a 10% decline in weight over a six month period was a strong predictor of mortality in this population. A retrospective study by Fry et al. (2010) noted malnutrition and/or weight loss correlated with a fourfold higher risk of developing a pressure ulcer. Two studies support the theory that individuals in long-term care with a body weight that has declined by 5% in 30 days were at increased risk of death. Thomas (2007) described the “anorexia of aging” as including appetite decline, weight loss and decreased metabolic rate, all of which can place the older adult at risk for malnutrition. Unintended weight loss is a well-validated risk factor for malnutrition; however, bariatric adults may also be poorly nourished.

Identifying individuals who exhibit these characteristics is important because malnutrition is associated with many adverse outcomes, including the risk of pressure ulcers and impaired wound healing. In 2012 the Academy of Nutrition and Dietetics (the Academy) and the American Society for Parenteral and Enteral Nutrition (ASPEN) recommended that a standardized set of diagnostic characteristics be used to identify and document adult malnutrition in routine clinical practice. Adult malnutrition usually occurs along a continuum of inadequate intake and/or increased requirement, impaired absorption, altered transport, and compromised nutrient utilization. Individuals may also have hypermetabolic and/or hypercatabolic and inflammatory conditions. The consensus statement by the Academy and ASPEN defines malnutrition as the presence of two or more of the following characteristics:

- insufficient energy intake,
- unintended weight loss,
- loss of muscle mass,
- loss of subcutaneous fat,
- localized or generalized fluid accumulation, and/or
- decreased functional status.

Serum albumin and prealbumin are generally not considered reliable indicators of nutritional status. The Academy’s Evidence Analysis Library analyzed change in serum albumin and prealbumin with weight loss, anorexia nervosa, non-malabsorptive gastric partitioning, calorie restricted diets and nitrogen balance. The analysis concluded that changes in acute phase proteins do not consistently or predictably change with weight loss, calorie restriction or nitrogen balance. They appear to reflect severity of inflammatory response rather than nutritional status. Inflammation can increase the risk of malnutrition by increasing metabolism. Thus the relevance of laboratory values as indicators of malnutrition is limited. It should be noted that people with a daily energy intake of less than 6.3 MJ (1,500 kcal) often have an insufficient intake of vitamins and minerals.
Malnutrition impacts pressure ulcer healing. Both inadequate nutritional intake and poor nutritional status (malnutrition) have been shown to correlate to the development of pressure ulcers, pressure ulcer severity, and protracted healing of wounds.\textsuperscript{11-13} Yamamoto et al. (2009)\textsuperscript{14} reported a correlation between energy intake and pressure ulcer healing. In addition to malnutrition, dehydration is a common yet under recognized problem in individuals with, or at risk of, a pressure ulcer. Dehydration contributes to skin fragility, increasing its susceptibility to breakdown.\textsuperscript{15}

As discussed in detail in the \textit{Risk Factors and Risk Assessment} section in the full \textit{Clinical Practice Guideline}, multivariable analysis of epidemiological data indicates that a poor nutritional status (malnutrition) and variables that indicate potential malnutrition (e.g., low body weight and poor oral food intake) are independent risk factors for the development of pressure ulcers.\textsuperscript{16-18} Moreover, it appears that many acute and chronically ill individuals who are at risk of developing pressure ulcers or have an established pressure ulcer suffer from unintended weight loss.\textsuperscript{11, 17-20}

Numerous studies conducted in a number of countries and clinical settings have demonstrated a relationship between malnutrition and pressure ulcers. A study in the US evaluating the care process for hospitalized Medicare individuals (n = 2,425) aged 65 years and older and assessed as being at risk for pressure ulcers noted that 76% of the study population was malnourished.\textsuperscript{21} In an Australian study conducted in public acute and aged care facilities, Banks et al. (2010)\textsuperscript{22} concluded that the odds ratio (OR) of having a pressure ulcer was 2.6 (95% confidence interval [CI] 1.8 to 3.5) for adults with malnutrition in acute care and 2.0 (95% CI 1.5 to 2.7) for adults with malnutrition in aged care. In a prognostic case-control study investigating the relationship between nutritional status and pressure ulcer development in individuals aged over 65 years who were receiving home care in Japan, Iizaka et al. (2010)\textsuperscript{13} found the rate of malnutrition was significantly higher in those with a pressure ulcer (58.7% versus 32.6%, \( p < 0.001 \)). Malnutrition was also significantly associated with more severe pressure ulcers; the OR of having a full thickness pressure ulcer with malnutrition was 1.88 (95% CI 1.03 to 3.45). Verbrugghe et al. (2013)\textsuperscript{23} conducted an analytical cross sectional study investigating prognostic factors for malnutrition in 23 nursing homes in Belgium (n = 1,188 older adults). Multivariate logistic regression in which the dependent variable was a score of less than 17 (malnourished) on the Mini Nutritional Assessment full version (MNA) showed that the presence of pressure ulcers was a potential predictor of malnutrition (OR = 5.02, 95% CI 1.69 to 14.92, \( p < 0.01 \)). The researchers concluded that the presence of pressure ulcers is one of the major factors independently associated with malnutrition in older nursing home residents. In a small (n = 31) observational study, Wojcik et al. (2011)\textsuperscript{24} showed that adults with pressure ulcers receiving home living support in the US may be at risk for nutritional deficits due to an unsatisfactory dietary intake that may delay wound healing.

\textbf{Nutrition Screening}

1. \textit{Screen nutritional status for each individual at risk of or with a pressure ulcer:}
   - at admission to a health care setting;
   - with each significant change of clinical condition; and/or
   - when progress toward pressure ulcer closure is not observed. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

   Poor outcomes, including the risk of morbidity and mortality, are associated with malnutrition; hence the need to quickly identify and treat malnutrition when pressure ulcers are present. Nutrition screening is the process used to identify individuals who require a comprehensive nutrition assessment due to characteristics that put them at potential nutritional risk. Any qualified member of the health care team may complete nutrition screening, and it should be conducted on admission to the health care facility, or at first visit in community settings.
A cross-sectional study investigating the role of clinical guidelines in the assessment and management of patients with pressure ulcers found that adopting a formalized, facility-wide nutritional guideline contributes to the continuing practice of regular nutritional screening in daily practice. Introduction of a nutritional guideline was also shown to reduce barriers to providing nutritional support.\(^2^5\)

2. **Use a valid and reliable nutrition screening tool to determine nutritional risk. (Strength of Evidence = C; Strength of Recommendation = \(\ddagger\))**

   It is important that the screening tool is validated, reliable, and relevant to the patient group being assessed. The screening tool should consider current weight status (e.g., underweight or obesity), as well as past and likely future change in weight, both of which are linked to food intake/appetite and disease severity. It is important that the screening tool is capable of establishing nutritional risk in all types of individuals, including those with fluid disturbances and those in whom weight and height cannot be easily measured.\(^2^6\), \(^2^7\) There are numerous valid and reliable nutrition screening tools available for use in specific clinical settings and populations. The most commonly used tools for screening adults are reported below.

   The MNA\(^\text{®}\) is a validated nutrition screening and assessment tool (n.b., the MNA\(^\text{®}\) refers to the MNA short form version that is recommended for clinical use). Langkamp-Henken et al. (2005)\(^2^8\) conducted a cross-sectional study (n = 23) in older males with pressure ulcers in residential aged care investigating correlation of the tool with MNA\(^\text{®}\) scores and clinical indicators. There was a significant positive correlation between MNA\(^\text{®}\) scores and nutritional indicators including body mass index (BMI; \(r = 0.66, p = 0.0006\)), calf circumference (\(r = 0.46, p = 0.0286\)), hemoglobin (\(r = 0.43, p = 0.0409\)), hematocrit (\(r = 0.44, p = 0.0358\)) and fat mass index (\(r = 0.50, p = 0.0275\)). In a German study comparing the nutritional status of individuals with and without pressure ulcers, the researcher concluded that the MNA\(^\text{®}\) is easy to use for assessing older adults with pressure ulcers and multiple comorbidities.\(^2^9\)

   The MNA\(^\text{®}\) is the only nutrition screening tool that has specifically been validated in individuals with pressure ulcers.\(^3^0\) The MNA\(^\text{®}\) is also validated for identifying older adults at nutritional risk in both community and long term care settings.\(^3^0\), \(^3^1\) In a comparative study of six different nutrition screening tools used in a sample of 248 older adults, Poulia et al. (2012)\(^3^2\) established the MNA\(^\text{®}\) had a sensitivity of 98.1% and a specificity of 75% for identifying nutritional risk.

   The Malnutrition Universal Screening Tool (MUST) has been validated in acute care, long term care and community settings. Poulia et al. (2012)\(^3^2\) concluded that the MUST was the most appropriate tool for evaluating the risk of malnutrition in older adults admitted to hospital, with a high sensitivity (87.3%) and a high negative predictive value (75%) for identifying nutritional risk.

   The Nutrition Risk Screening 2002 (NRS) is validated for screening nutritional risk in adults in hospital. In terms of predictive validity, clinical outcomes improve when individuals identified by the NRS to be at nutrition risk are treated. Reliability between observers has been established (\(\kappa = 0.67\)).\(^2^6\) The tool has high sensitivity (99.4%) and high negative predictive value (83.3%) for identifying nutritional risk in older adults.\(^3^2\)

   The Short Nutrition Assessment Questionnaire (SNAQ) has been validated in both hospital and residential care adult populations. Weight change, appetite, supplements and tube feeding are the parameters of the SNAQ. Neelemant et al. (2008)\(^1^3\) demonstrated validity of the tool in a population of pre-operative adults with a mean age of 49 years, of which 12% were screened as moderately or severely malnourished. Using a cut-off score of 2 points or more, the SNAQ had a sensitivity of 67% (95% CI 52% to 79%) and a specificity of 98% (95% CI 97% to 99%). In the same study, the sensitivity of the tool was lower in an outpatient population (59%, 95% CI 42 to 72%).\(^3^3\)

3. **Refer individuals screened to be at risk of malnutrition and individuals with an existing pressure ulcer to a registered dietitian or an interprofessional nutrition team for a comprehensive nutrition assessment. (Strength of Evidence = C; Strength of Recommendation = \(\ddagger\))**
Nutrition Assessment

1. Assess the weight status of each individual to determine weight history and identify significant weight loss (≥ 5% in 30 days or ≥ 10% in 180 days). (Strength of Evidence = C; Strength of Recommendation = )

2. Assess the individual’s ability to eat independently. (Strength of Evidence = C; Strength of Recommendation = )

3. Assess the adequacy of total nutrient intake (i.e., food, fluid, oral supplements and enteral/parenteral feeds). (Strength of Evidence = C; Strength of Recommendation = )

These statements are based on expert opinion and indirect evidence. All adults at risk for malnutrition based on the results of nutrition screening should be referred to a registered dietitian or an interprofessional nutrition team for a comprehensive nutritional assessment. A comprehensive nutrition assessment involves a systematic process of collecting, verifying, and interpreting data related to nutritional status, and forms the basis for all nutrition interventions. The assessment process is continuous, and early intervention is critical.

A comprehensive nutrition assessment should be conducted by a registered dietitian in consultation with the interprofessional team (including, but not limited to, a physician, nurse, speech pathologist, occupational therapist, physical therapist and dentist). The focus of nutrition assessment should be on evaluating energy intake, unintended weight change and the effect of psychological stress or neuropsychological problems. Additionally, assessment should include a determination of the individual’s caloric, protein and fluid requirements.

Biochemical laboratory data may not be available or cost effective in every clinical setting. Current research indicates that serum protein levels may be affected by inflammation, renal function, hydration, and other factors. Serum albumin, prealbumin and other laboratory values may be useful in establishing the individual’s overall prognosis; however, they may not correlate well with clinical observation of nutritional status. Fuhrman et al. (2004) reported evidence suggesting that serum hepatic proteins correlate with mortality and morbidity; are useful indicators of illness severity; and help identify individuals at risk for developing malnutrition. Hepatic protein levels do not accurately measure nutritional repletion. Thus, serum concentrations may not be markers of malnutrition or caloric repletion, but instead may be indicators of morbidity severity and risk of mortality. As of 2012, the Academy and ASPEN do not recommended using inflammatory biomarkers for diagnosis of malnutrition.

Care Planning

1. Develop an individualized nutrition care plan for individuals with or at risk of a pressure ulcer. (Strength of Evidence = C; Strength of Recommendation = )

A registered dietitian, in consultation with the interprofessional team (including, but not limited to, a physician, nurse, speech pathologist, occupational therapist, physical therapist and dentist) should develop and document an individualized nutrition intervention plan based on the individual’s nutritional needs, feeding route and goals of care, as determined by the nutrition assessment. Monitoring and evaluation of nutritional status is an ongoing process and the management plan should be adjusted with each change in the individual’s clinical condition.

Allen (2013) conducted a quasi-experimental study examining the effect of a comprehensive, interprofessional nutritional protocol that included consultation with an occupational therapist, registered dietitian and speech therapist; regular (pre-) albumin assessments; and protein and vitamin/mineral supplementation on pressure ulcer healing in individuals aged over 60 years. Participants were recruited from an acute long term care hospital in the US and compared with a
The study concluded that, for older adults, an interprofessional nutritional intervention that includes protein and vitamin/mineral supplementation may contribute to increased pressure ulcer healing assessed as percent tissue regeneration (Level 4 study).

2. Follow relevant and evidence-based guidelines on nutrition and hydration for individuals who exhibit nutritional risk and who are at risk of pressure ulcers or have an existing pressure ulcer. (Strength of Evidence=C; Strength of Recommendation = \( \bigcirc \))

Energy Intake

1. Provide individualized energy intake based on underlying medical condition and level of activity. (Strength of Evidence = B; Strength of Recommendation = \( \bigcirc \))

2. Provide 30 to 35 kcalories/kg body weight for adults at risk of a pressure ulcer who are assessed as being at risk of malnutrition. (Strength of Evidence = C; Strength of Recommendation = \( \bigcirc \))

3. Provide 30 to 35 kcalories/kg body weight for adults with a pressure ulcer who are assessed as being at risk of malnutrition. (Strength of Evidence = B; Strength of Recommendation = \( \bigcirc \))

4. Adjust energy intake based on weight change or level of obesity. Adults who are underweight or who have had significant unintended weight loss may need additional energy intake. (Strength of Evidence = C; Strength of Recommendation = \( \bigcirc \))

The National Academy of Sciences, Institute of Medicine, and Food and Nutrition Board, in partnership with Health Canada, defined estimated energy requirements needed to maintain energy balance in a healthy individual. The requirements are defined by age, gender, weight, height, and activity. These requirements form the basis for determining baseline caloric needs. The Trans Tasman Dietetic Wound Care guidelines for adults with pressure injuries also recommend 30 to 35 kcalories/kg body weight for individuals with moderate to high risk of delayed healing due to nutritional concerns. Guidelines by the European Society for Clinical Nutrition and Metabolism also recommend 30 to 35 kcalories/kg body weight nutritional support for most chronic conditions in individuals at risk of malnutrition.

Energy needs are currently assessed using several methods. The methods used for predictive formulas or energy needs measurement should be defined for the relevant individual population (e.g., critically ill or obese). Research indicates that the original Harris-Benedict equation is inaccurate for calculating energy requirements. Cereda et al. (2011) noted the estimation of energy needs for adults with pressure ulcers using Harris-Benedict formula should consider a correction factor based on the underestimation of 10% of energy needs. This review supported the goal of 30 kcalories/kg/day but noted limitations of the meta-analysis, including a small number of included studies, small sample sizes and heterogeneity of the groups. The Miffin-St. Jeor equation may be more accurate and have a smaller margin of error when used to calculate resting metabolic rate for obese but otherwise healthy individuals. Measured energy requirements (i.e., indirect calorimetry), if available, are a more accurate measure of energy expenditure; however, may be cost prohibitive in many settings.

A randomized, controlled trial (RCT) investigating the effectiveness of a nutritional intervention that uses calorie calculation according to basal energy expenditure (BEE) in promoting pressure ulcer healing was conducted by Ohura et al. (2011). Mean daily calories administered during the intervention period were 1,092.1 ± 161.8 kcalories (29.1 ± 4.9 kcalories/kg/day) in the control group and 1,383.7 ± 156.5 kcalories (37.9 ± 6.5 kcalories/kg/day) in the intervention group, with both groups receiving enteral rather than oral feeding. It should be noted that individuals receiving enteral feeding generally have low energy needs when compared with mobile individuals receiving oral nutrition. Statistically significant increases were noted for the intervention group over the control group for weight (p < 0.001), waist circumference (p < 0.001), supra iliac skinfold thickness (p < 0.005) and thigh circumference (p < 0.005). Pressure ulcers healed within 12 weeks for four subjects in the control
group and seven subjects in the intervention group. Pressure ulcer depth decreased steadily in the intervention group (p < 0.05). The researchers concluded that a nutritional intervention calculated using BEE x activity factor 1.1 x stress factor 1.3 to 1.5 may be associated with increased pressure ulcer healing in older adults receiving tube feeding. This was a small study (n = 60) and inclusion was limited to participants receiving enteral feeding who were not mobile. Additionally, the high calorie group also received higher levels of protein (Level 2 study).

In a retrospective study, Yamamoto et al. (2009)²⁴ investigated the total nutritional intake of individuals with pressure ulcers to determine the level of energy intake needed to heal pressure ulcers. In individuals showing an improvement or healing of pressure ulcers the daily energy intake over 12 weeks was greater than 30 kcalories/kg body weight. Individuals who experienced worsening or no improvement in the pressure ulcer had an energy intake of no greater than 20 kcalories/kg body weight (Level 3 study).

5. **Revise and modify/liberalize dietary restrictions when limitations result in decreased food and fluid intake.** These adjustments should be made in consultation with a medical professional and managed by a registered dietitian whenever possible. (Strength of Evidence = C; Strength of Recommendation = )

This statement is based on expert opinion. Caloric needs are ideally met by a healthy diet; however, some individuals are unable or unwilling to consume an adequate diet. Overly restricted diets may make food unpalatable and unappealing, and therefore reduce intake. The Academy’s 2010 position statement³⁸ emphasizes the enhancement of quality of life for older adults residing in health care facilities by reduction in dietary restriction through individualization of dietary intake. Thus, it is recommended that health professionals assess the risks versus benefits of overly restrictive and/or therapeutic diets, especially for older adults. For example, an individual may not consume adequate nutrients on a sodium restricted diet, thus leading to malnutrition and delayed pressure ulcer healing. In addition, macronutrient sources of calories should follow a healthy pattern. A healthy diet includes 45% to 65% of calories from carbohydrates. The synthesis of glucose (gluconeogenesis) by the liver and kidneys is more fuel efficient than breaking down protein and fat for energy; protein is needed for collagen synthesis.

6. **Offer fortified foods and/or high calorie, high protein oral nutritional supplements between meals if nutritional requirements cannot be achieved by dietary intake.** (Strength of Evidence = B; Strength of Recommendation = ²²)

The type and amount of food and fluid ingested daily should be reviewed periodically to ensure that the individual actually consumes the number of calories required to meet nutrient needs. Oral nutritional supplements (ONS), enhanced foods, and food fortifiers can be used to combat unintended weight loss and malnutrition. Oral nutritional supplements include products that supply nutrients including protein, carbohydrates, fat, vitamins, minerals, and/or amino acids.

Stratton et al. (2005)⁴⁹ pooled the results of four RCTs comparing ONS with routine care (i.e., following a normal diet and implementing routine pressure ulcer care) and one RCT comparing enteral tube feeding to routine care. The results of the meta-analysis showed that oral nutritional supplementation (mainly high protein, 400 to 500 kcal, duration of 4 to 72 weeks) was associated with a significant reduction in pressure ulcer development compared to routine care (OR = 0.75; 95% CI 0.62 to 0.89, n = 1,224). When the one additional study investigating enteral tube feeding was included in the meta-analysis the result remained similar (OR = 0.74; 95% CI 0.62 to 0.88, n = 1,325) (Level 1 study).

In a retrospective cohort study that included 1,524 residents in long-term care facilities, the prescription of any ONS was associated with a decreased likelihood of developing a Category/Stage I or greater pressure ulcer (OR = 0.57, 95% CI 0.36 to 0.90, p = 0.016). The relationship remained significant when analysis was limited to development of a Category/Stage II or greater pressure ulcer (OR = 0.43, 95% CI 0.25 to 0.72, p = 0.001)⁵⁰ (Level 5 study).
A study conducted by Wilson et al. (2002)\(^5\) indicated that healthy adults aged over 70 years who consumed high calorie, high protein oral liquid supplements between meals experienced better absorption of nutrients, with the least interference to meal intake (indirect evidence).

7. **Consider enteral or parenteral nutritional support when oral intake is inadequate. This must be consistent with the individual’s goals. (Strength of Evidence = C; Strength of Recommendation = \(\clubsuit\))**

   If oral intake is inadequate, enteral or parenteral nutrition may be recommended if consistent with the individual’s wishes. Enteral (tube) feeding is the preferred route if the gastrointestinal tract is functioning. The risks and benefits of nutrition support should be discussed with the individual and caregivers early on, and should reflect the individual’s preferences and goals for care. Routine assessment should confirm that individuals are actually receiving the amount of tube-feeding solution prescribed.

   One RCT \(^5\) evaluated the effect of additional tube feeding on the incidence of pressure ulcers in 129 hospital patients with a hip fracture. The experimental group (n = 62) was treated with a standard hospital diet and an additional nasogastric tube feeding (1,000 mL of 1,500 kcal/l; 60 g/l protein) that was administered with a feeding pump overnight. Participants in the control group (n = 67) received the standard hospital diet alone. The pressure ulcer incidence (Category/Stage II or greater) after two weeks was 52% in the experimental group and 57% in the control group. The difference between the two groups was not statistically significant (p = 0.12), indicating that enteral feeding had no influence on healing in this population. However, the duration of the trial was very short (Level 2 study).

   A cohort study by Teno et al. (2012)\(^5\) examined the effectiveness of tube feeding in preventing pressure ulcers or promoting their healing. Study participants included 461 subjects with both a pressure ulcer and a percutaneous endoscopic gastrostomy (PEG) tube. Results showed that the risk of new Category/Stage II or greater pressure ulcers was more than twice as high (OR = 2.27, 95% CI 1.95 to 2.65) when a PEG was present. The risk of a new Category/Stage IV pressure ulcer when a feeding tube was present was OR = 3.31 (95% CI 2.14 to 4.89). In participants who had a PEG inserted, 27.2% of pressure ulcers improved compared with 34.6% in participants with no PEG (OR = 0.66, 95% CI 0.45 to 0.97). The increased risk may be related to increased diarrhea, increased immobility or comorbidities, but this was not investigated. The investigators concluded that PEG feeding tubes are not beneficial and may be associated with increased risk of pressure ulcers (Level 4 study).

**Protein Intake**

1. **Provide adequate protein for positive nitrogen balance for adults assessed to be at risk of a pressure ulcer. (Strength of Evidence = C; Strength of Recommendation = \(\clubsuit\))**

2. **Offer 1.25 to 1.5 grams protein/kg body weight daily for adults at risk of a pressure ulcer who are assessed to be at risk of malnutrition when compatible with goals of care, and reassess as condition changes. (Strength of Evidence = C; Strength of Recommendation = \(\clubsuit\))**

3. **Provide adequate protein for positive nitrogen balance for adults with a pressure ulcer. (Strength of Evidence = B; Strength of Recommendation = \(\clubsuit\))**

4. **Offer 1.25 to 1.5 grams protein/kg body weight daily for adults with an existing pressure ulcer who are assessed to be at risk of malnutrition when compatible with goals of care, and reassess as condition changes. (Strength of Evidence = B; Strength of Recommendation = \(\clubsuit\))**

5. **Offer high calorie, high protein nutritional supplements in addition to the usual diet to adults with nutritional risk and pressure ulcer risk, if nutritional requirements cannot be achieved by dietary intake. (Strength of Evidence = A; Strength of Recommendation = \(\clubsuit\))**
6. Assess renal function to ensure that high levels of protein are appropriate for the individual. (Strength of Evidence = C; Strength of Recommendation = )

Protein is essential for promoting positive nitrogen balance. Increased protein levels have been linked to improved healing rates. Clinical judgment is required to determine the appropriate level of protein for each individual, based on the number of pressure ulcers present, overall nutritional status, co-morbidities, and tolerance to nutritional interventions. For example, adults with chronic kidney disease may be inappropriate candidates for high levels of protein. The health professional must assess renal function to ensure appropriate tolerance of higher protein levels.

Calculate the individual’s protein requirements and make determinations on any nutritional interventions. The Institute of Medicine recommendation for 0.8 g protein/kg body weight for a healthy adult is considered inadequate for pressure ulcer prevention and healing, especially for older adults. Based on metabolic changes and the loss of lean muscle (sarcopenia) that occurs with aging, other clinical guidelines recommend protein levels above the level recommended by the Institute of Medicine. The Trans Tasman evidence-based guideline for dietetic management of adults with pressure ulcers recommends 1.25 to 1.5 g protein/kg body weight daily for individuals at moderate to high risk for delayed healing of pressure ulcers due to nutritional concerns. Since aging is associated with decreased protein and energy intake and a decline in muscle mass, the 2010 Nutritional Recommendations for the Management of Sarcopenia published by the Society for Sarcopenia, Cachexia and Wasting Disease recommended total protein intake should be 1 to 1.5 g/kg body weight for older adults. The PROT-AGE Study Group evidence-based guideline recommends a protein intake of 1.2 to 1.5 g/kg body weight for older adults with acute or chronic disease, and suggests that those with severe illness or injury may need 2.0 g/kg body weight daily.

The previously reported RCT by Ohura et al. (2011) investigated the effectiveness of a nutritional intervention based on a calorie calculation according to BEE in promoting the healing of pressure ulcers. The intervention group, who received a high level of kcals, also received high mean levels of protein (1.62 g/kg/day) compared to the control group that received a mean daily protein intake of 1.24 g/kg/day. A statistically significant decrease in wound size was noted after week eight for the intervention group compared to the control group (Level 2 study).

In a RCT conducted by Cereda et al. (2009), which is described in more detail below, a high calorie (30 kcalories/kg/day) high protein (1.5 g/kg /day; n = 13) nutritional approach resulted in faster healing as assessed by reduction in wound area and Pressure Ulcer Scale for Healing (PUSH) score compared to a high calorie (30 kcalorie/kg body weight daily), normal protein (1.2 g/kg/day) nutritional regimen (n = 15) (Level 2 study). It should be noted that a normal protein (16% of total energy) intervention of 30 kcalories/kg/day provides at least 1.2 grams of protein/kg body weight daily. The amount of protein intake increases to 1.4 g/kg body weight with a 35 kcalorie/kg/day nutritional support intervention. In a high protein support (20% of total energy) the amount of protein provided to individuals would amount to 1.5 to 1.75 g/kg/day (Level 2 study).

The review by Stratton et al. (2005) showed that oral nutritional supplementation with high levels of protein and calories (16% to 32% energy as protein, 400 to 50 kcalories, duration of 4 to 72 weeks) was associated with a significant reduction in pressure ulcer development compared to routine care (4 RCTs, OR = 0.75; 95% CI 0.62 to 0.89, n = 1,224) (Level 1 study).

7. Supplement with high protein, arginine and micronutrients for adults with a pressure ulcer Category/Stage III or IV or multiple pressure ulcers when nutritional requirements cannot be met with traditional high calorie and protein supplements. (Strength of Evidence = B; Strength of Recommendation = )

Growing, but still moderate quality evidence supports a positive effect of nutritional supplementation with additional protein, arginine and micronutrients to promote pressure ulcer healing. Certain amino acids such as arginine become conditionally essential amino acids during periods of stress.
Cereda et al. (2009) conducted a single blinded RCT investigating a disease specific nutritional approach as a strategy to promote pressure ulcer healing. Participants with Category/Stage II or greater pressure ulcers residing in four long term care facilities in Italy received similar general pressure ulcer care. Participants (n = 15, but 2 deceased leaving n = 13) randomized to the intervention group received either a standard hospital diet with additional 400 mL of an oral supplement containing 500 kcalories, 34 g protein, 6 g arginine, 500 mg vitamin C, 18 mg zinc or, for those being tube fed, 1,000 mL high protein formula (20% energy from protein enriched with arginine, zinc and vitamin C) infused with isocaloric formula to reach energy requirements. The control group (n = 15) received a regular hospital diet consisting of 16% energy from protein or standard enteral formula. Both groups had significant improvement in pressure ulcer healing (p < 0.001 for both groups). Primary outcomes were pressure ulcer area and percent of wound healed assessed using the PUSH tool. Both groups showed significant improvement in pressure ulcer healing (p < 0.001 for both groups). The PUSH score became statistically significantly different between both groups at week 12 (favored treatment, p < 0.05) and the difference in ulcer area was significant by week eight (favored treatment, p < 0.05). The researchers concluded that the rate of pressure ulcer healing in older adults appears to accelerate when a nutrition formula enriched with protein, arginine, zinc and vitamin C is administered for at least eight weeks (Level 2 study).

In one RCT, van Anholt et al. (2010) investigated a high protein, arginine and micronutrient rich supplement (the same formula as administered in the study of Cereda et al. (2009)) to improve healing in well-nourished adults with Category/Stage III and IV pressure ulcers. Participants (n = 43) were recruited from eight health care centers, hospitals, and long term care facilities in four European countries. Participants were randomly allocated to receive either a high energy ONS enriched with 20 g protein, 3 g arginine, antioxidants, 250 mg vitamin C, 38 mg vitamin E (α-tocopherol equivalents), 238 mg vitamin A, 9 mg zinc, 1.35 mg copper, 64 µg selenium and 200 µg folic acid in amounts of 200 mL three times daily between meals for eight weeks (n = 22) or 200 mL non-caloric placebo on the same regimen (n = 21). Supplementation with the specific ONS accelerated pressure ulcer healing, as indicated by a significantly different decrease in ulcer size compared with the control over the study period (p = 0.016). The decrease in PUSH severity score in the ONS group differed significantly (p = 0.033) from the control. Moreover, significantly fewer dressings were required per week in the ONS group compared with the control (p = 0.045) and less time was spent per week changing the dressings (p = 0.022). The researchers concluded that a nutritional supplement with high protein, arginine and micronutrients may be associated with improved pressure ulcer healing in older adults who do not have pre-existing malnutrition (Level 2 study). The positive results attained in this study would be stronger if they had been achieved in a study using an isonitrogenous and isocaloric placebo rather than a non-caloric placebo.

Brewer et al. (2010) conducted an historical control study investigating the effect of arginine supplementation in promoting healing of pressure ulcers in community-dwelling individuals with spinal cord injury (SCI). The intervention group that took a supplement equivalent to 9 g arginine daily showed superior healing compared to the control group (10.5 ± 1.3 weeks to complete healing versus 21.1 ± 3.7 weeks, p = 0.006). There was no statistically significant difference in healing rates between participants with and without diabetes in the intervention group (p = 0.894) or between participants with and without diabetes in the historical control group (p = 0.994). All participants in the intervention group consumed at least 85% of supplement doses until full healing was achieved. The authors concluded that arginine supplementation of 9 g daily may be associated with faster pressure ulcer healing in individuals with SCI (Level 5 study).

Chapman et al. (2011) conducted an observational study investigating pressure ulcer healing in individuals with SCI recruited from inpatient and outpatient services in Australia (n = 34) and receiving arginine supplements (9 g daily). Results showed that 41% of participants ceased the supplement prior to full healing. There was no statistically significant difference in time to healing of Category/Stage III pressure ulcers between those who ceased treatment (mean 14.3 ± 7.3 weeks) and those who completed the full course of treatment (11.4 ± 2.0 weeks, p = not significant [ns]). There was also no statistically significant difference in time to healing of Category/Stage IV pressure ulcers between...
those who ceased treatment (mean 31.3 ± 13.6 weeks) and those who completed (11.4 ± 2.0 weeks, p = ns). When healing of Category/Stage III and IV pressure ulcers was combined, a 2.5 fold greater rate of healing was observed in those who continued supplementation until full healing compared with those who ceased taking the supplement (8.5 ± 1.1 weeks versus 20.9 ± 7.0 weeks, p=0.04). The researchers concluded that an arginine supplement may be associated with improved healing rates of Category/Stage III and IV pressure ulcers in individuals with SCI (Level 5 study).

A RCT by Leigh et al. (2012) compared different doses of arginine for healing pressure ulcers in participants recruited from acute inpatient and rehabilitation wards of an Australian hospital (n = 23). All participants had standard pressure ulcer care throughout the study. Participants were randomized to receive either a standard hospital diet plus 4.5 g arginine daily for three weeks (n = 12) or standard hospital diet with the addition of 9 g arginine per day for three weeks (n = 11). There was a significant decrease over time (p < 0.001) in pressure ulcer severity assessed using the PUSH tool with no evidence of a statistically significant difference between the two arginine dosages (p = 0.991). Individuals categorized as malnourished showed clinically significant impaired healing rates compared with well-nourished participants (p = 0.057) although this was unaffected by arginine dosage (p = 0.727). There was no significant difference in healing rates based on arginine dosage (p = 0.393). The authors concluded that arginine was associated with increased healing compared with historical controls, with no difference noted between a 4.5 g daily and a 9 g daily dose of supplementation (Level 4 study).

Overall, based on the studies of arginine, there is moderate quality evidence supporting the positive effect of offering a high calorie, high protein nutritional supplement containing arginine and micronutrients to promote pressure ulcer healing.

Hydration

1. Provide and encourage adequate daily fluid intake for hydration for an individual assessed to be at risk of or with a pressure ulcer. This must be consistent with the individual’s comorbid conditions and goals. (Strength of Evidence = C; Strength of Recommendation = )

2. Monitor individuals for signs and symptoms of dehydration including change in weight, skin turgor, urine output, elevated serum sodium, and/or calculated serum osmolality. (Strength of Evidence = C; Strength of Recommendation = )

3. Provide additional fluid for individuals with dehydration, elevated temperature, vomiting, profuse sweating, diarrhea, or heavily exuding wounds. (Strength of Evidence = C; Strength of Recommendation = )

Fluid serves as the solvent for vitamins, minerals, glucose and other nutrients and transports nutrients and waste products through the body. In healthy individuals who are adequately hydrated, food accounts for 20% or more of total fluid intake. Total fluid needs include the water content of food. Oral nutritional supplements and enteral feedings are generally 75% water. For the specific amount of free fluids in each enteral formula, refer to each product’s nutrition labeling. Additional free water may be required.

Health professionals should monitor individuals’ hydration status, checking for signs and symptoms of dehydration such as: changes in weight, skin turgor, urine output, elevated serum sodium, or calculated serum osmolality.

Calculate individual fluid requirements. Various formulas have been used to calculate adequate daily fluid intake. Evidence-based guidelines recommend that fluid requirements be calculated as 1 mL/kcalorie consumed daily. Individuals with elevated temperature, vomiting, profuse sweating, diarrhea, and/or heavily exuding wounds often require additional fluid intake to replace fluid loss.
Individuals consuming high levels of protein may also require additional fluid. Conduct ongoing reassessment for tolerance and changes in clinical condition.

**Vitamins and Minerals**

1. Provide/encourage individuals assessed to be at risk of pressure ulcers to consume a balanced diet that includes good sources of vitamins and minerals. (Strength of Evidence = C; Strength of Recommendation = ★ ★)

2. Provide/encourage an individual assessed to be at risk of a pressure ulcer to take vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected. (Strength of Evidence = C; Strength of Recommendation = ★)

3. Provide/encourage an individual with a pressure ulcer to consume a balanced diet that includes good sources of vitamins and minerals. (Strength of Evidence = B; Strength of Recommendation = ★★★)

4. Provide/encourage an individual with a pressure ulcer to take vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected. (Strength of Evidence = B; Strength of Recommendation = ★★★)

The National Academy of Sciences, Institute of Medicine, and Food and Nutrition Board Dietary Reference Intakes indicate the level of each micronutrient needed at each stage of life for healthy individuals. Most nutrient needs can be met through a healthy diet. However, individuals who consume a diet low in nutrient rich foods, those who are food insecure (unable to purchase or prepare an adequate diet) or individuals with poor nutrient absorption or metabolism may not be consuming an adequate diet to meet established nutritional reference standards. Health professionals are advised to review the nutrition labeling on ONS, to determine micronutrient adequacy.

Micronutrients that are hypothesized to be related to pressure ulcer healing include Vitamin C (ascorbic acid), zinc, and copper. Vitamin C has a role in collagen formation and is an antioxidant; however, a double blinded RCT (n = 88) found no improvement in time to complete healing of pressure ulcers for adults supplemented with 1 g daily of Vitamin C compared to a control group receiving 10 mg Vitamin C daily for 12 weeks (Level 1 study). The inclusion of fruits (particularly citrus fruit) and vegetables in the diet can achieve the desired recommended daily amount. However, Vitamin C at physiological doses should be considered when dietary deficiency is diagnosed.

Zinc and copper have also been hypothesized to affect wound healing. No research has demonstrated an effect of zinc supplementation on improved pressure ulcer healing. When clinical signs of zinc deficiency are present, zinc should be supplemented at no more than 40 mg of elemental zinc per day. Some health professionals recommend that this supplementation be given for 2 to 3 weeks, but more research is needed to substantiate this recommendation. High dose zinc supplementation (above 40 mg per day) can adversely affect copper status, possibly resulting in anemia. Good dietary sources of zinc include high protein foods such as meat, liver, and shellfish.

A small, prospective RCT by Theilla et al. (2012) investigated the impact of a fish oil enriched formula on pressure ulcer healing. Adults requiring nutritional support for at least five days and who had a Category/Stage II or greater pressure ulcer were recruited from an intensive care unit in Israel (n = 40). The study participants received either enteral or parenteral nutrition containing fish oil and a micronutrient-enriched formula (enteral nutrition was enriched with vitamins A, C and E, zinc; manganese; copper and protein; study group, n = 20) or an isonitrogenous formula (control group, n = 20). Severity of pressure ulcers as assessed using PUSH scores significantly increased over time (p = 0.02) for the control group, while the study group had no significant change in PUSH scores. The study suggests that a micronutrient-enriched formula contributes to the prevention of worsening pressure ulcers.
References


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**Albumin:** Albumin makes up 60% of total protein in the blood. It decreases with stress, age, and impaired liver function. Albumin serves to maintain colloid osmotic pressure and as a transport protein for certain ions, hormones, medications, enzymes, fatty acids, amino acids, and bilirubin. It decreases with overhydration, stress, infection, impaired renal function, and liver disease, among other causes. Normal albumin blood level is 3.5 to 5.4 gm/dL. Normal values may vary depending upon the laboratory performing analysis.

**Body mass index (BMI):** Defined as an individual’s weight in kilograms divided by the square of his height in meters. The term bariatric, derived from the Greek word baros meaning heavy and iatric relating to the medical treatment of this condition, is used to refer to individuals with a BMI > 30 kg/m².

**Collagen:** The most abundant protein of the dermis, accounting for 70 to 80% of its dry weight; the main supportive protein of the skin and connective tissue.

**Enhanced food:** see Fortified food.

**Enteral nutrition:** Nutritional support given via a nasogastric, nasoenteral, or percutaneous tube. Enteral nutrition is used when the gastrointestinal tract is functioning.

**Fortified foods:** Normal food enriched with specific nutrients, in particular with energy and/or protein, minerals, vitamins, or trace elements.

**Malnutrition:** Malnutrition defined as any nutritional imbalance and is synonymous with the term undernutrition.

**Micronutrient:** A micronutrient is a chemical element or substance required in very small amounts for normal growth and development.

**Nutritional supplement:** A commercial or other prepared food or beverage that supplements energy, protein, carbohydrate, and/or fiber.

**Oral nutritional supplement:** A commercial or other prepared food or beverage that supplements nutrient and caloric intake.

**Parenteral nutrition:** The provision of macronutrients, vitamins, minerals, electrolytes, and fluids via a central or peripheral vein that is indicated when the gastrointestinal tract cannot be used for nutritional support. Total parenteral nutrition (TPN) provides all essential nutrients and is delivered through of central vein.

**Prealbumin:** A body protein whose function is to transport thyroxine and complexes with retinol-binding protein for Vitamin A transport. The normal level is 15 to 36 mg/dL, but it can vary with the laboratory determining the level.

**Pressure injury:** see Pressure ulcer.

**Pressure ulcer (pressure injury):** 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. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors has yet to be elucidated. (See the Etiology of Pressure Ulcers section of the guideline). Previously referred to as decubitus ulcer, bedsore and pressure sore.

**Protein-calorie malnutrition:** This occurs when both protein and energy intake are insufficient to meet an individual’s metabolic demands. The wasting and excessive loss of lean body mass resulting from too little energy being supplied to the body tissue can be reversed solely by the administration of nutrients.
**Standard (usual) care:** A term most often used in research studies to describe usual care delivered within a facility that is often the comparator intervention when pressure ulcer prevention interventions are being investigated. Standard care varies according to the setting and historical context. Within the context of this guideline, a description of the standard care is provided when available.

**Suspected deep tissue injury:** Purple or maroon localized area of discoloured, intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, or warmer or cooler than adjacent tissue. Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid exposing additional layers of tissue even with treatment.

**Undernutrition:** see Malnutrition.

**Unintentional weight loss:** Gradual, unintended weight loss over time.

**Unstageable pressure ulcer:** Full thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown, or black) in the wound bed. Until enough slough and/or eschar is removed to expose the base of the wound, the true depth cannot be determined, but it will be either a Category III or IV pressure ulcer. Stable (dry, adherent, intact, without erythema or fluctuance) eschar on the heels serves as a natural (biological) cover and should not be removed.

**References**
