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Spinal Cord Injury

SCI: Major Recommendations (2009)

Spinal Cord Injury (SCI) Evidence-Based Nutrition Practice Guideline

Recommendations are categorized in terms of either conditional or imperative statements. While conditional statements clearly define a specific situation, imperative statements are broadly applicable to the target population and do not impose restraints on their application.

Conditional recommendations are presented in an *if/then* format, such that:

If CONDITION then ACTION(S) because REASON(S)

Fulfillment of the condition triggers one or more guideline-specified actions. In contrast, imperative recommendations include terms such as "require," "must," and "should," and do not contain conditional text that would limit their applicability to specified circumstances.

Resources Available with Each Recommendation

In addition to the recommendation statement and strength rating, you will find on each recommendation page:

- A brief narrative summary of the evidence analyzed to reach the recommendation
- A statement of justification, or reason for the strength of the recommendation
- Detailed information on the evidence supporting the recommendations and background narrative (available in the Supporting Evidence section toward the bottom of each recommendation page)
- A reference list at the end of each recommendation page that includes all the sources used in the evidence analysis for the particular recommendation (each reference is hyperlinked to a summary of the article analyzed in the evidence analysis).

Below, you will find a list of *Spinal Cord Injury* recommendations, organized by topic. Also view the [Executive Summary of Recommendations](#) or print the guideline material in [PDF](#) format.

[SCI: Role of the Registered Dietitian](#)

[SCI: Nutrition Screening for Persons with SCI Living in the Community](#)

- Nutrition screening for lipid abnormalities.

Assessment

[SCI: Nutrition Assessment in Acute Care, Rehabilitation and Community Settings](#)

- Nutrition assessment in the acute care setting
- Nutrition assessment in the rehabilitation setting
- Nutrition assessment in the community setting.

[SCI: Nutrition Assessment of Lipid Abnormalities](#)

[SCI: Assessment of Physical Activity and Energy Needs](#)

[SCI: Assessment for Prevention of Pressure Ulcers](#)

- Pressure Ulcers: Prevention
- Assessment of Biochemical Parameters Associated with Prevention of Pressure Ulcers
- Assessment of Anthropometric, Nutrition and Lifestyle Factors associated with Prevention of Pressure Ulcers

[SCI: Nutrition Assessment of Body Composition](#)

- Assessment of body composition: Estimation of ideal body weight
- Assessment of body composition: BMI and skinfold measurements
- Assessment of body composition: BIA and DEXA.

[SCI: Nutrition Assessment for Prevention and Treatment of Overweight and Obesity](#)

[SCI: Assessment of Energy Needs in Acute and Rehabilitation Phases](#)

- Assessment of energy needs in the acute phase
- Assessment of energy needs in the acute phase using predictive equations
- Assessment of energy needs in the rehabilitation phase.

[SCI: Assessment of Protein Needs](#)

- Assessment of protein needs in the acute phase
- Assessment of protein needs in the rehabilitation and community-living phases.

[SCI: Assessment of Nutrition Needs for Pressure Ulcers in SCI](#)

- Assessment: Energy needs for persons with spinal cord injury with pressure ulcers
- Assessment: Protein needs for persons with spinal cord injury with pressure ulcers
- Assessment: Fluid needs for persons with spinal cord injury with pressure ulcers
- Assessment: Micronutrient needs for persons with SCI with pressure ulcers.

Intervention

[SCI: Fluid and Neurogenic Bowel](#)

[SCI: Fiber and Neurogenic Bowel](#)

[SCI: Nutrition Intervention for Prevention and Treatment of Overweight and Obesity](#)

[SCI: Nutrition Intervention to Prevent Development of Pressure Ulcers](#)

[SCI: Nutrition Prescription for SCI Persons with Pressure Ulcers](#)

[SCI: Cranberry Juice](#)

[SCI: Cranberry Supplements](#)

[SCI: Nutrition Intervention for Lipid Abnormalities](#)

- Nutrition education and counseling for lipid abnormalities.

[SCI: Coordination of Care in Spinal Cord Injury](#)

[SCI: Physical Activity and Persons with Spinal Cord Injuries](#)

- SCI: Nutrition education regarding physical activity
- SCI: Nutrition education regarding physical activity in overweight and obese persons with SCI.

Monitoring and Evaluation

[SCI: Monitoring and Evaluation in the Acute Care Setting](#)

[SCI: Monitoring and Evaluation of Protein Intake in Acute Care Setting - Overfeeding](#)

[SCI: Monitoring Energy Needs in the Rehabilitation Phase](#)

[SCI: Nutrition Monitoring: Fiber and Neurogenic Bowel](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Recommendations Summary

SCI: Role of the Registered Dietitian 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Role of the Registered Dietitian

A registered dietitian should be an active participant of the interdisciplinary team providing care for patients with spinal cord injuries in the acute phase, rehabilitation setting and community setting. Evidence suggests that medical nutrition therapy provided to patients with spinal cord injuries by a registered dietitian results in improved nutrition-related patient outcomes, such as adequate nutrient intake and management of serum lipids, weight, dysphagia, bowel function and pressure ulcers.

Rating: Fair

Imperative

- [Risks/Harms of Implementing This Recommendation](#)

Provision of nutrition support, including enteral or parenteral nutrition, to nutritionally compromised patients with spinal cord injuries may be associated with patient complications including, but not limited to:

- Aspiration
- Infections, including catheter-related infections
- Metabolic complications resulting from under- or overfeeding
- Gastrointestinal complications, including diarrhea.

- [Conditions of Application](#)

This recommendation applies to all persons with spinal cord injury.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with the staffing, training, equipment, supplies and facilities required to provide adequate nutrition care to persons with spinal cord injury.

Individualized nutrition care provided by a registered dietitian to persons with spinal cord injury may result in significant cost savings to organizations by reducing length of stay in acute care and rehabilitation settings, occurrence of pressure ulcers and other nutrition-related complications.

- [Recommendation Narrative](#)

SCI: Nutrition Assessment in the Acute Care Setting

- One cohort study found that 24.6% of patients with spinal cord injuries require dietary modifications during the acute phase of injury and that 8.2% of patients were discharged from acute care with feeding tubes (Abel et al, 2004)
- One narrative review concluded that baseline nutrition assessment performed by a registered dietitian is essential and should occur within the first 48 hours of the acute phase of spinal cord injury (Mitcho et al, 1998)
- One non-randomized trial concluded that early nutrition intervention by registered dietitians should be part of the clinical pathway for treatment during the acute phase of spinal cord injury (Vitaz et al, 2001).

SCI : Nutrition Assessment in the Rehabilitation Setting

- One narrative review concluded that the registered dietitian should be part of the interdisciplinary team managing the rehabilitation phase of spinal cord injury and that optimal rehabilitation requires a multidisciplinary approach to all aspects of care, including nutrition care (Croes-Barone et al, 1998)
- One narrative review found that, during the rehabilitation phase of spinal cord injury, nutrition needs should be assessed by a registered dietitian. The paper also recommended that nutrition education be provided to the patient and patient's family by a registered dietitian (Murphy et al, 1999).

SCI : Nutrition Assessment in the Community Setting

- Two studies (one non-comparative study, one single-group uncontrolled trial) found that health promotion and weight management interventions may improve health parameters and quality of life in patients with spinal cord injuries living in the community. The weight management intervention was led by a registered dietitian (Block et al, 2005; Chen et al, 2006).
- One non-comparative case study found that a bowel protocol including a standardized fiber intake and fluid guidelines may result in improved bowel function and quality of life in patients with spinal cord injuries living in the community (Badiali et al, 1997)
- One expert commentary concluded that evaluation by a registered dietitian should be part of every patient with spinal cord injuries' annual medical exam (Barber, Foster and Rogers, 2003)
- One cohort study found that registered dietitians were able to use a tele-rehabilitation approach to provide nutrition care to community-dwelling patients with spinal cord injuries and that tele-rehabilitation interventions conducted by an interdisciplinary team resulted in a reduced number of hospitalizations and decreased length of stay for patients (Galea et al, 2005)
- One cross-sectional study found that nutrition interventions and nutrition education are needed to reduce dietary fat intakes and serum lipids, especially in men with spinal cord injury (Moussavi et al, 2001)
- One non-randomized prospective trial found that dietary intervention should be included in the treatment of individuals with **SCI** whose total cholesterol levels are more than 200mg per dL (5.2mmol per L), with the expectation that about 20% will favorably respond to dietary intervention. The researchers also recommended that a registered dietitian should provide dietary intervention, since an individualized diet plan may enhance patients' compliance with dietary treatment (Szlachic, 2001).
- One non-randomized controlled trial found that comprehensive wellness programs for spinal cord-injured patients result in improvements in health behaviors in several important areas and thus may improve long-term outcomes and quality of life (Zemper et al, 2003)
- One cross-sectional study found that spinal cord-injured patients' intake of key nutrients often did not meet guidelines and that clinicians should screen, counsel and treat patients in order to prevent chronic disease (Tomey et al, 2005).

- [Recommendation Strength Rationale](#)

SCI: Nutrition Assessment in the Acute Care Setting

- Small number of studies
- Studies were of weak design for answering the question, however studies were in substantial agreement
- Strong rating (Grade I conclusion statement) for starting enteral nutrition within 48 hours following injury or admission to reduce the incidence of infectious complications; conclusion statement is supported by several [RCTs](#) and three meta-analyses studies.

Nutrition Assessment in the Rehabilitation Setting

- Small number of studies
- Studies were of weak design for answering the question.

Nutrition Assessment in the Community Setting

Several studies of strong design for answering the question.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

- [References](#)

[Abel R, Ruf S, Spahn B. Cervical spinal cord injury and deglutition disorders. *Dysphagia*. 2004; 19 \(2\): 87-94.](#)

[Badiali D, Bracci F, Castellano V, Corazzari E, Fuoco U, Habib FI, Scivoletto G. Sequential treatment of chronic constipation in paraplegic subjects. *Spinal Cord*. 1997 Feb;35 \(2\): 116-20.](#)

[Barber D, Foster D, and Rogers S. The importance of nutrition in the care of persons with spinal cord injury. *The Journal of Spinal Cord Medicine*, 26:2; Summer 2003. Commentary.](#)

[Block P, Skeels SE, Keys CB, Rimmer JH. Shake-It-Up: Health promotion and capacity building for people with spinal cord injuries and related neurological disabilities. *Disabil Rehabil*. 2005 Feb 18; 27\(4\): 185-190.](#)

[Chen Y, Henson S, Jackson AB, Richards JS. Obesity intervention in persons with spinal cord injury. *Spinal Cord*. 2006;44:82-91.](#)

[Croes-Barone SJ, Rolnick RH, Durante D, Zaunbrecher MM, Hackell V, Farias Y. Medical nutrition therapy is recognized as an important element in complete rehabilitation. *Rehab Manag*. 1998;56: 59-60. 63.](#)

[Galea M, Tumminia J, Garback LM. Telerehabilitation in spinal cord injury persons: a novel approach. *Telemedicine and e-Health*. 2006;12:160-162.](#)

[Mitcho K, Yanko JR. Acute care management of spinal cord injuries. *Critical Care Nursing Quarterly*. 1999; 22\(2\). 60-79.](#)

[Moussavi RM, Ribas-Cardus F, Rintala DH, Rodriguez GP. Dietary and serum lipids in individuals with spinal cord injury living in the community. *J Rehabil Res Dev*. 2001;38\(2\):225-233.](#)

[Murphy M. Traumatic spinal cord injury: an acute care rehabilitation perspective. *Crit Care Nurs Q*. 1999 Aug;22\(2\):51-9. Review.](#)

[Szlachic Y, Adkins R, Adal T, Yee F, Bauman W, Waters RL. The effects of dietary intervention on lipid profiles in individuals with spinal cord injury. *The Journal of Spinal Cord Injury*. 2001; 24 \(1\): 26-29. \[#82\]](#)

[Tomey KM, Chen DM, Wang X, Braunschweig CL. Dietary intake and nutritional status of urban community-dwelling men with paraplegia. *Arch Phys Med Rehabil*. 2005 Apr; 86\(4\): 664-71.](#)

[Vitaz TW, McIlvoy L, Raque GH, Spain DA, Shields CB. Development and implementation of a clinical pathway for spinal cord injuries. *J Spinal Disord*. 2001 Jun;14\(3\):271-6.](#)

[Zemper ED, Tate DG, Roller S, Forchmeimer M, Chiodo A, Nelson VS, Scelza W. Assessment of a holistic wellness program for persons with spinal cord injury. *Am J Phys Med Rehabil*. 2003 Dec; 82\(12\): 957-68.](#)

- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

- Commission on Accreditation of Rehabilitation Facilities. *Medical Rehabilitation Standards Manual*, Section 3.1, Spinal Cord System of Care. 2008
- Escott-Stump. Nutrition and Diagnosis-Related Care, 6th edition. 2008; 918.

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Screening for Persons with Spinal Cord Injury Living in the Community 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Screening for Lipid Abnormalities

Screening for lipid abnormalities is recommended for all persons with spinal cord injury living in the community setting in order to reduce morbidity and mortality. Studies show that spinal cord injury is associated with increased risk for cardiovascular disease due to inactivity and immobilization.

Rating: Fair

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

No potential risks or harms are associated with the implementation of this recommendation.

- [Conditions of Application](#)

- This recommendation applies to all persons with spinal cord injury living in the community setting
- If a lipid profile is not available, the registered dietitian should request the necessary blood work from the person's primary care provider.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with the development of comprehensive screening programs for persons with spinal cord injury.

- [Recommendation Narrative](#)

There were 21 studies evaluated. Of these studies, two were specific to screening for lipids in persons with spinal cord injury living in the community:

- One narrative review (Bauman et al, 2001) stated that periodic screening for carbohydrate and lipid abnormalities is recommended for all persons with spinal cord injuries to reduce mortality associated with increased risk factors
- One cross-sectional case-control study (Jannssen et al, 1998) found that age, activity level, smoking behavior, alcohol consumption and amount of adipose tissue are modifiable risk factors that determine cardiovascular disease risk in patients with spinal cord injuries.

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade II
- Although most included studies are of weak design for answering the question, all but two of 21 studies are in substantial agreement
- Included studies provided multi-ethnic representation, male and female gender representation and consistency across study designs.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How should lipid abnormalities be managed in Spinal Cord Injury patients?](#)

- [References](#)

[Apstein MD, George BC. Serum lipids during the first year following acute spinal cord injury. *Metabolism*. 1998;47:367-370.](#)

[Bauman WA, Spungen AM. Carbohydrate and lipid metabolism in chronic spinal cord injury. *J Spinal Cord Med*. 2001;24\(4\):266-277.](#)

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[Dallmeijer AJ, van der Woude LH, van Kamp GJ, Hollander AP. Changes in lipid, lipoprotein and apolipoprotein profiles in persons with spinal cord injuries during the first 2 years post-injury. *Spinal Cord*. 1999;37\(2\):96-102.](#)

[Dallmeijer AJ, Hopman MT, van der Woude LH. Lipid, lipoprotein, and apolipoprotein profiles in active and sedentary men with tetraplegia. *Arch Phys Med Rehabil*. 1997;78\(11\):1173-1176.](#)

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[Janssen TW, van Oers CA, van Kamp GJ, TenVoorde BJ, van der Woude LH, Hollander AP. Coronary heart disease risk indicators, aerobic power, and physical activity in men with spinal cord injuries. *Arch Phys Med Rehabil*. 1997;78\(7\):697-705.](#)

[Kjaer M, Dela F, Sorensen FB, Secher NH, Bangsbo J, Mohr T, Galbo H. Fatty acid kinetics and carbohydrate metabolism during electrical exercise in spinal cord-injured humans. *Am J Physiol Regul Integr Comp Physiol*. 2001;281\(5\):R1492-1498.](#)

[Lee MY, Myers J, Hayes A, Madan S, Froelicher VF, Perkashl, Kiratli BJ. C-reactive protein, metabolic syndrome, and insulin resistance in individuals with spinal cord injury. *J Spinal Cord Med*. 2005;28\(1\):20-25.](#)

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[Moussavi RM, Ribas-Cardus F, Rintala DH, Rodriguez GP. Dietary and serum lipids in individuals with spinal cord injury living in the community. *J Rehabil Res Dev*. 2001;38\(2\):225-233.](#)

[Ozqurtas T, Alaca R, Gulec M, Kutluay T. Do spinal cord injuries adversely affect serum lipoprotein profiles?. *Mil Med*. 2003;168\(7\):545-547.](#)

[Schmid A, Halle M, Stutzle C, Konig D, Baumstark MW, Storch MJ, Schmidt-Trucksass A, Lehmann M, Berg A, Keul J. Lipoproteins and free plasma catecholamines in spinal cord-injured men with different injury levels. *Clin Physiol*. 2000; 20\(4\): 304-310.](#)

[Sorg RJ. HDL-cholesterol: exercise formula. Results of long-term \(6-year\) strenuous swimming exercise in a middle-aged male with paraplegia. *J Orthopaedic Sports/Physical Therapy*. 1993;17:195-199.](#)

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[Storch MJ, Konig D, Bultermann D, Blum A, Vogt S, Baumstark M, Berg A, Schmid A. Lipid profile in spinal cord-injured women with different injury levels. *Prev Med*. 2005;40\(3\):321-325.](#)

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[Zlotolow SP, Levy E, Bauman WA. The serum lipoprotein in veterans with paraplegia: The relationship to nutritional factors and body mass index. *J Am Paraplegia Society*. 1992;](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Assessment in Acute Care, Rehabilitation, and Community Setting 2009

[Click here](#) to see the explanation of recommendation ratings (*Strong, Fair, Weak, Consensus, Insufficient Evidence*) and labels (*Imperative or Conditional*). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Assessment in the Acute Care Setting

If a patient is in the acute phase of spinal cord injury, the registered dietitian should conduct a nutrition assessment within the first 48 hours post-injury, in order to determine nutrient needs, provide nutrition support recommendations and identify conditions that may predispose the patient to nutrition-related complications. Evidence suggests that early nutrition support is associated with improved patient outcomes.

The nutrition assessment should include but is not limited to:

- *Food- and nutrition-related history:* Energy intake, diet order, food or beverage intake
- *Anthropometrics:* Weight change
- *Biochemical and medical tests and procedures:* Swallow study, inflammatory profile, metabolic profile, albumin, prealbumin
- *Nutrition-focused physical findings:* Digestive system, cardiovascular and pulmonary systems
- *Client history:* Treatment and therapy
- *Comparative standards:* Energy needs, protein needs, ideal and reference body weight, fluid needs.

Rating: Strong

Conditional

SCI: Nutrition Assessment in the Rehabilitation Setting

If a patient is in the rehabilitation phase of spinal cord injury, the registered dietitian should conduct a nutrition assessment to develop and implement an individualized therapeutic nutrition plan for the patient. Evidence suggests that medical nutrition therapy by a registered dietitian may result in improved ability to participate in therapies and in an improved transition into the community setting.

The nutrition assessment should include but is not limited to:

- *Food- and nutrition-related history:* Energy intake, diet order, food beverage intake, fiber intake, medication and herbal supplement use, mealtime behavior, nutrition-related ADLs and IADLs, physical activity, weight change
- *Anthropometrics:* Weight change
- *Biochemical and medical tests and procedures:* Swallow study, inflammatory profile, metabolic profile, albumin
- *Nutrition-focused physical findings:* Digestive system; cardiovascular-pulmonary system, skin
- *Client history:* Social history
- *Comparative standards:* Energy needs, protein needs, ideal or reference body weight, fluid needs, fiber needs.

Rating: Fair

Conditional

SCI: Nutrition Assessment in the Community Setting

If a person with spinal cord injury is living in the community setting, the registered dietitian should conduct a nutrition assessment as part of the annual medical exam to develop and implement an individualized therapeutic nutrition plan.

The nutrition assessment should include but is not limited to:

- Food- and nutrition-related history (specifically knowledge deficits, beliefs and attitudes, body image, mealtime behaviors, physical ability to self-feed, access to food- and nutrition-related supplies, meal preparation and food avoidances)
- Anthropometric measurements (specifically body composition, weight)
- Biochemical data, medical tests and procedures (specifically serum lipid and glucose levels)
- Social history (specifically isolation)
- Nutrition-focused physical findings (specifically bowel and bladder function). Evidence suggests that annual nutrition assessment by a registered dietitian is necessary to identify nutrition-related concerns that may affect the health and quality of life of persons with spinal cord injury.

Rating: Fair

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

No potential harm or risks are associated with the implementation of this recommendation.

- [Conditions of Application](#)

Nutrition care provided to spinal cord injured patients by a registered dietitian in the acute, rehabilitation and community settings should occur within the context of an interdisciplinary care team in order to ensure a comprehensive approach to care.

- [Potential Costs Associated with Application](#)

- There are staffing and organizational costs associated with providing individualized nutrition care by a registered dietitian to spinal cord-injured patients in the acute care, rehabilitation and community settings
- Individualized nutrition care provided by a registered dietitian to spinal cord-injured patients may result in significant cost savings to organizations by reducing length of stay in acute care and rehabilitation settings, occurrence of pressure ulcers and other nutrition-related complications.

- [Recommendation Narrative](#)

SCI: Nutrition Assessment in the Acute Care Setting

- One cohort study found that 24.6% of patients with spinal cord injuries require dietary modifications during the acute phase of injury, and that 8.2% of patients were discharged from acute care with feeding tubes (Abel et al, 2004)
- One narrative review concluded that baseline nutrition assessment performed by a registered dietitian is essential, and should occur within the first 48 hours of the acute phase of spinal cord injury (Mitcho et al, 1998)
- One non-randomized trial concluded that early nutrition intervention by registered dietitians should be part of the clinical pathway for treatment during the acute phase of

spinal cord injury (Vitaz et al, 2001).

SCI: Nutrition Assessment in the Rehabilitation Setting

- One narrative review concluded that the registered dietitian should be part of the interdisciplinary team managing the rehabilitation phase of spinal cord injury and that optimal rehabilitation requires a multidisciplinary approach to all aspects of care, including nutrition care (Croes-Barone et al, 1998)
- One narrative review found that during the rehabilitation phase of spinal cord injury, nutrition needs should be assessed by a registered dietitian. The paper also recommended that nutrition education be provided to the patient and patient's family by a registered dietitian (Murphy et al, 1999).

SCI: Nutrition Assessment in the Community Setting

- Two studies (one non-comparative study, one single-group uncontrolled trial) found that health promotion and weight management interventions may improve health parameters and quality of life in patients with spinal cord injuries living in the community. The weight management intervention was led by a registered dietitian (Block et al, 2005; Chen et al, 2006).
- One non-comparative case study found that a bowel protocol including a standardized fiber intake and fluid guidelines may result in improved bowel function and quality of life in spinal cord injured patients living in the community (Badiali et al, 1997)
- One expert commentary concluded that evaluation by a registered dietitian should be part of every spinal cord-injured patient's annual medical exam (Barber, Foster, Rogers, 2003)
- One cohort study found that registered dietitians were able to use a tele-rehabilitation approach to provide nutrition care to community-dwelling spinal cord-injured patients and that tele-rehabilitation interventions conducted by an interdisciplinary team resulted in a reduced number of hospitalizations and decreased length of stay for patients (Galea et al, 2005)
- One cross-sectional study found that nutrition interventions and nutrition education are needed to reduce dietary fat intakes and serum lipids, especially in men, with spinal cord injury (Moussavi et al, 2001)
- One non-randomized prospective trial found that dietary intervention should be included in the treatment of individuals with SCI whose total cholesterol levels are more than 200mg per dL (5.2mmol per L), with the expectation that about 20% will favorably respond to dietary intervention. The researchers also recommended that a registered dietitian should provide dietary intervention, since an individualized diet plan may enhance patients' compliance with dietary treatment (Szlachic, 2001).
- One non-randomized controlled trial found that comprehensive wellness programs for spinal cord-injured patients result in improvements in health behaviors in several important areas, and thus may improve long-term outcomes and quality of life (Zemper et al, 2003)
- One cross-sectional study found that spinal cord-injured patients' intake of key nutrients often did not meet guidelines and that clinicians should screen, counsel and treat patients in order to prevent chronic disease (Tomey et al, 2005).

• [Recommendation Strength Rationale](#)

- SCI: Nutrition Assessment in the Acute Care Setting:
 - Small number of studies
 - Studies were of weak design for answering the question; however, studies were in substantial agreement
 - Strong rating (Grade I conclusion statement) for starting enteral nutrition within 48 hours following injury or admission to reduce the incidence of infectious complications; conclusion statement is supported by several RCTs and three meta-analyses studies.
- Nutrition Assessment in the Rehabilitation Setting:
 - Small number of studies
 - Studies were of weak design for answering the question.
- Nutrition Assessment in the Community Setting: Several studies of strong design for answering the question.

• [Minority Opinions](#)

Consensus reached.

• [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the benefit of nutrition care provided by a Registered Dietitian for Spinal Cord Injury patients in the acute care, rehabilitation, and community settings?](#)

[Does the timing of enteral feeding impact the mortality of critically ill patients?](#)

[Does the timing of enteral feeding impact infectious complications in critically ill patients?](#)

[Does the timing of enteral feeding impact the length of hospital stay in critically ill patients?](#)

• [References](#)

[Abel R, Ruf S, Spahn B. Cervical spinal cord injury and deglutition disorders. *Dysphagia*. 2004; 19 \(2\): 87-94.](#)

[Barber D, Foster D, and Rogers S. The importance of nutrition in the care of persons with spinal cord injury. *The Journal of Spinal Cord Medicine*, 26:2; Summer 2003. \[Commentary\]\(#\).](#)

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[Block P, Skeels SE, Keys CB, Rimmer JH. Shake-It-Up: Health promotion and capacity building for people with spinal cord injuries and related neurological disabilities. *Disabil Rehabil*. 2005 Feb 18; 27\(4\): 185-190.](#)

[Chen Y, Henson S, Jackson AB, Richards JS. Obesity intervention in persons with spinal cord injury. *Spinal Cord*. 2006;44:82-91.](#)

[Croes-Barone SJ, Rolnick RH, Durante D, Zaunbrecher MM, Hackell V, Farias Y. Medical nutrition therapy is recognized as an important element in complete rehabilitation. *Rehab Manag*. 1998;56, 59-60, 63.](#)

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 - [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Assessment of Lipid Abnormalities 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Assessment of Lipid Abnormalities

If persons with spinal cord injury living in the community setting have lipid abnormalities, the registered dietitian should include age, ethnicity, gender, time since injury, level of injury, activity level, dietary habits, smoking behavior, alcohol intake and overweight or obese status in the food and nutrition-related history. Studies show that these factors are associated with abnormal blood lipids, particularly decreased HDL cholesterol, in persons with spinal cord injury.

Rating: Strong

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

No potential risks or harms are associated with implementation of this recommendation.

- [Conditions of Application](#)

This recommendation applies to persons with spinal cord injury with lipid abnormalities living in the community setting.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with the development of comprehensive screening, nutrition assessment and dietary counseling programs for persons with spinal cord injury.

- [Recommendation Narrative](#)

Three cross-sectional studies (Jannssen et al, 1998; Demirel et al, 2001; Lee et al, 2005) and one narrative review (Bauman et al, 2001) were in substantial agreement regarding the risk factors listed in the recommendation.

- [Recommendation Strength Rationale](#)

- Conclusion statement in Grade II
- Although most included studies are of weak design for answering the question, all but two of 21 studies are in substantial agreement
- Included studies provided multi-ethnic representation, male and female gender representation and consistency across study designs.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How should lipid abnormalities be managed in Spinal Cord Injury patients?](#)

- [References](#)

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- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

None.

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Assessment of Body Composition 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Assessment of Body Composition: Estimation of Ideal Body Weight

The registered dietitian should estimate ideal body weight for persons with spinal cord injury by adjusting the Metropolitan Life Insurance tables for individuals of equivalent height and weight. There are two reported methods for adjusting the tables:

- Quadraplegia, reduction of 10% to 15% lower than table weight; paraplegia, reduction of 5% to 10% lower than table weight
- Quadriplegia, 15 lbs to 20 lbs lower than table weight; paraplegia, 10 lbs to 15 lbs lower than table weight.

Rating: Consensus

Imperative

SCI: Assessment of Body Composition: BMI and skinfold measurements

The registered dietitian should not use body mass index (BMI) or skinfold measurements to measure body composition in persons with spinal cord injury. These methods may not provide reliable results since they were developed based on able-bodied persons.

Rating: Fair

Imperative

SCI: Assessment of Body Composition: BIA and DEXA

For persons with spinal cord injury who are medically stable, the registered dietitian should consider using bioelectric impedance analysis (BIA) or dual-energy X-ray absorptiometry (DEXA) to assess body composition. Evidence suggests that BIA and DEXA correlate with measures of total body water (TBW) when labeled water is used to provide a reference value for TBW. Persons with spinal cord injury have significantly higher fat mass and lower lean mass than persons without spinal cord injury.

Rating: Fair

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

[DEXA](#) screening requires exposure to radiation.

- [Conditions of Application](#)

- [DEXA](#) scanning may be inappropriate for some persons with spinal cord injury due to spasms, contracture or tall stature
 - [DEXA](#) scanning requires the subject to lie flat and still on the scanning table
 - If the subject is taller than the scanning table, the full body will not be scanned
 - [DEXA](#) scanning requires exposure to radiation, although the exposure is low
 - Cost and availability issues may preclude some persons with spinal cord injury from obtaining [DEXA](#) screening.
- Weight of external fixation devices such as halos and orthotics should be considered when determining body weight
- Aim for consistency in method and equipment used in measuring weight.

- [Potential Costs Associated with Application](#)

- Organizational costs are associated with the provision and maintenance of equipment required for the measurement of body composition using [DEXA](#) or [BIA](#)
- Organizational costs are associated with the provision of staff required to assess the body composition of persons with spinal cord injuries.

- [Recommendation Narrative](#)

SCI: Assessment of Body Composition: Estimation of Ideal Body Weight

A neutral-quality case-series study recommended that ideal body weights for persons with spinal cord injuries be below those recommended by the NY Metropolitan Life Insurance table: Individuals with paraplegia, 10 lbs to 15 lbs lower; with quadriplegia, 15 lbs to 20 lbs lower (Peiffer et al, 1981).

SCI: Assessment of Body Composition: BMI and Skinfold Measurements

- One neutral-quality case-control study found that, although BMI was not significantly different between subjects with SCI and able-bodied controls, when body composition was assessed using [DEXA](#), [SCI](#) subjects had significantly greater fat mass and significantly less lean mass than controls (Jones et al, 2003)
- One neutral-quality case-control study found that, although fat mass did not differ significantly between subjects with [SCI](#) and able-bodied controls when measured by

skinfold, when body composition was assessed using [DEXA](#). [SCI](#) subjects had significantly greater fat mass than controls (Maggioni et al, 2003).

SCI: Assessment of Body Composition: [BIA](#) and [DEXA](#)

- One positive-quality case-control study found that able-bodied control subjects had significantly greater lean body mass than [SCI](#) subjects (Monroe et al, 1998)
- One neutral-quality case-control study found that, using [DEXA](#), total body and regional lean mass were significantly less and fat mass was significantly greater in subjects with [SCI](#) than able-bodied controls (Spungen et al, 2003)
- One neutral-quality case-control study using labeled water as a reference standard found that [TBW](#) and therefore fat-free mass and fat mass, can be reasonably well-predicted in patients with [SCI](#) using [BIA](#) and two equations (Buchholz et al, 2003)
- One neutral-quality cross-sectional study found that [BIA](#) using 100kHz energy correlated acceptably with labeled water in predicting [TBW](#) in patients with spinal cord injuries (Desport et al, 2000)
- One neutral-quality cross-sectional study found that fat percentage as measured by total body electrical conductivity (TBEC) correlated significantly with fat percentage as estimated by summing seven skinfold measurements (Olle et al, 1993)
- One neutral-quality cross-sectional study found no significant differences among [BIA](#), [DEXA](#), [TBW](#) and the Steinkamp methods when measuring total body fat in spinal cord-injured persons (Spungen et al, 1995).

◦ [Recommendation Strength Rationale](#)

- Results are consistent across eight studies with minor exceptions at most
- Conclusion statement is Grade II.

◦ [Minority Opinions](#)

Consensus reached.

• [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How should body composition be measured in spinal cord injured people?](#)

[What are the indications for nutrition care to prevent or treat overweight and obesity in the community living phase of persons with Spinal Cord Injury?](#)

◦ [References](#)

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• [Spinal Cord Injury](#)

• [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Assessment: Energy Needs in Acute and Rehabilitation Phases 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Assessment: Energy Needs in the Acute Phase

If the patient with spinal cord injury is in the acute phase of spinal cord injury, the registered dietitian (RD) should assess energy needs by measuring energy expenditure. Patients with spinal cord injury have reduced metabolic activity due to denervated muscle. Actual energy needs are at least 10% below predicted needs. Indirect calorimetry is more accurate than estimation of energy needs in critically ill patients.

Rating: Strong
Conditional

SCI: Assessment: Energy Needs in the Acute Phase using Predictive Equations

If the patient with spinal cord injury is in the acute phase of spinal cord injury, and indirect calorimetry is not available, the registered dietitian may consider estimating energy needs with the Harris-Benedict formula, using admission weight, an injury factor of 1.2 and an activity factor of 1.1. No research was available to compare Harris-Benedict with other predictive equations in this population.

Rating: Weak
Conditional

SCI: Assessment: Energy Needs in the Rehabilitation Phase

If the patient with spinal cord injury is in the rehabilitation phase, the registered dietitian may estimate energy needs using 22.7kcal per kg body weight for patients with quadriplegia and 27.9kcal per kg for those with paraplegia. Patients with spinal cord injury have reduced metabolic activity due to denervated muscle.

Rating: Weak
Conditional

- [Risks/Harms of Implementing This Recommendation](#)

- Use of predictive equations rather than measured energy expenditure may result in under- or overfeeding persons with SCI and may lead to metabolic complications with subsequent poor outcomes such as obesity, pressure ulcer development, decreased ability to perform ADLs and transfers, heart disease and diabetes
- The weight of stabilization devices such as braces and halos should be considered when determining the body weight of persons with spinal cord injury to avoid overfeeding.

- [Conditions of Application](#)

Certain predictive equations were designed for application in mechanically ventilated patients.

The AARC Clinical Practice Guidelines (1994) recommend that measurements may be indicated in patients with the following conditions:

- Neuro trauma
- Paralysis
- COPD
- Acute pancreatitis
- Cancer with residual tumor
- Multiple trauma
- Amputations
- Patients with no accurate height or weight
- Long-term acute care (ventilator units)
- Severe sepsis
- Extreme obesity
- Severely hypermetabolic or hypometabolic patients
- Failure to wean.

The AARC Clinical Practice Guidelines (1994) also provide recommendations for hazards and complications, limitations of the procedures and infection control.

Hazards and Complications

- Short-term disconnection of a patient from the ventilator for connection to an indirect calorimetry machine may result in hypoxemia, bradycardia and patient discomfort
- Inappropriate calibration or system setup may result in erroneous results, causing incorrect patient management
- Isolation valves in calorimeters may increase circuit resistance and cause increased work of breathing or dynamic hyperinflation
- Inspiratory reservoirs may cause reduction in alveolar ventilation due to increased compressible volume of the breathing circuit
- Manipulation of the vent circuit may cause leaks that may lower alveolar ventilation.

Limitations of the Procedure

- Leaks in the ventilator circuit, endotracheal tube cuffs or uncuffed tubes, through chest tubes or bronchopleural fistula
- Peritoneal and hemo-dialysis procedures remove CO₂ during the treatment and require a few hours after the treatment for acid-base to stabilize. Patients should not be measured during dialysis or for four hours after these dialysis treatments.
- Inaccurate measures may be caused by:
 - Unstable O₂ delivery, due to vent blender or mixing characteristics
 - FIO₂ above 60%
 - Inability to separate inspired from expired gases, due to bias flow with intermittent mandatory ventilation systems
 - Anesthetic gases other than O₂, CO₂ and nitrogen in the system
 - Water vapor presence
 - Inappropriate calibration
 - Total circuit flow exceeding internal gas flow of calorimeter
 - Leaks within the calorimeter
 - Inadequate measurement length.

Measures should be done by personnel trained in and with demonstrated and documented ability to calibrate, operate and maintain the calorimeter, having a general understanding of how mechanical ventilation works and recognizing calorimeter values within the normal physiologic range.

More frequent measures may be needed in patients with rapidly changing clinical course, as recognized by hemodynamic instability, spiking fevers, immediate post-operative status and ventilator weaning.

Infection Control

- Use standard precautions for contamination of blood and bodily fluids
- Appropriate use of barriers and hand washing
- Tubing to connect expired air from ventilator to indirect calorimetry should be disposed of or cleaned between patients
- Connections in the inspiratory limb of the circuit should be wiped clean between patients and equipment distal to the humidifier should be disposed of
- Bacteria filters may be used to protect equipment in inspire and expired lines.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with equipment, maintenance of equipment, time required, staff and staff training required for measurement of energy expenditure in patients with spinal cord injury.

- [Recommendation Narrative](#)

Caloric Needs During the Acute Phase

- One neutral-quality narrative review found that indirect calorimetry is more accurate than predicting energy expenditure in acute-phase SCI patients (Houda, 1993)
- One neutral-quality longitudinal study (Barco et al, 2002) found that energy needs predicted by the Harris-Benedict equation, with an activity factor of 1.1 and an injury factor of 1.2, correlated closely with measured energy expenditure
- One neutral-quality longitudinal study (Rodríguez et al, 1997) found that predicting energy needs with the Harris-Benedict equation, with an activity factor of 1.2 and an injury factor of 1.6, resulted in excessive overfeeding.
- One neutral-quality case-control study concluded that a caloric intake of 1, 500kcal per day may be sufficient to prevent nutrition-related complications (Laven et al, 1989).

Caloric Needs During the Rehabilitation Phase

- Two case-control studies (one positive quality and one neutral quality) found that resting energy expenditure is significantly lower in SCI patients than in able-bodied subjects (Monroe et al, 1998; Buchholz et al, 2003)
- One positive-quality cross-sectional study found that caloric requirements generally represented 45% to 90% of caloric needs as predicted by equations. The reduction in energy needs was proportional to the amount of denervated muscle. Using current body weight, stable patients were found to require 23.4kcal per kg per day; quadriplegics required 22.7kcal per kg per day and paraplegics required 27.9kcal per kg per day (Cox et al, 1985).

- [Recommendation Strength Rationale](#)

- Lack of generalizability across study designs
- Further research is needed to define calorie and protein needs of SCI patients
- Conclusion statements are Grade I and III.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What are the caloric needs for patients during the acute and rehabilitation phases following spinal cord injury?](#)

[What is the most accurate method for determination of resting metabolic rate \(RMR\) in critically ill patients?](#)

- [References](#)

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- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

None.

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Assessment of Physical Activity and Energy Needs 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Physical Activity and Energy Needs

The registered dietitian should consider the body weight, co-morbid conditions including abnormal blood lipids and obesity, level of physical activity, rate of propulsion and type of wheelchair used by the person with spinal cord injury when assessing energy needs. Evidence suggests that the use of a manual standard wheelchair increases energy needs, heart rate, oxygen consumption and ventilation, especially as speed and resistance levels increase, compared to ultralight wheelchairs and pushrim-activated, power-assisted wheelchairs.

Rating: Fair

Imperative

- [Risks/Harms of Implementing This Recommendation](#)

null

- [Conditions of Application](#)

This recommendation applies to all persons with spinal cord injury.

The registered dietitian should coordinate care with a physician, physiatrist, exercise physiologist or physical therapist to properly classify the types of physical activity in which the person with spinal cord injury may participate, including assisted exercise.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with the provision of staff, staff training, equipment and facilities to provide assessment of energy needs and opportunities to participate in physical activity for persons with spinal cord injury.

- [Recommendation Narrative](#)

null

- [Recommendation Strength Rationale](#)

null

- [Minority Opinions](#)

null

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How does physical activity affect energy needs in spinal cord-injured individuals?](#)

[How should body composition be measured in spinal cord injured people?](#)

[What are the indications for nutrition care to prevent or treat overweight and obesity in the community living phase of persons with Spinal Cord Injury?](#)

- [References](#)

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- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

null

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Assessment of Protein Needs 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Assessment of Protein Needs in the Acute Phase

If the patient with spinal cord injury is in the acute phase, the registered dietitian should calculate protein needs at 2.0g per kg of ideal body weight per day to lessen the obligatory negative nitrogen balance that occurs during the acute phase.

Rating: Weak
Conditional

SCI: Assessment of Protein Needs in the Rehabilitation and Community Living Phases

If the person with spinal cord injury is in the rehabilitation phase or community living phase, then the registered dietitian should calculate protein needs at 0.8g to 1.0g per kg of body weight per day for maintenance of protein status in the absence of pressure ulcers or infection.

Rating: Weak
Conditional

- [Risks/Harms of Implementing This Recommendation](#)

These recommendations may be contraindicated in persons with spinal cord injury who have concurrent hepatic or renal dysfunction.

- [Conditions of Application](#)

Assessment of Protein Needs in the Acute Phase

Decreased albumin and transthyretin (prealbumin) are often interpreted as indicators of malnutrition. However, albumin and prealbumin are also inversely influenced by inflammatory and stress responses. These visceral proteins should be interpreted with keeping in mind the patient's total clinical status. Use of C-reactive protein, a protein that increases with stress, is useful in interpreting whether albumin and prealbumin are being affected or decreased by inflammation and stress. The role of albumin as a nutrition indicator in persons with spinal cord injuries will be addressed systematically in scheduled updates to this guideline. This recommendation applies to patients in the acute phase of spinal cord injury.

Assessment of Protein Needs in the Rehabilitation phase and Community Living Phase

This recommendation applies to patients in the rehabilitation phase and community living phase of spinal cord injury.

- [Potential Costs Associated with Application](#)

- Staffing and organizational costs are associated with assessment and monitoring of protein status
- Organizational costs are associated with provision of protein by oral, enteral or parenteral feeding routes.

- [Recommendation Narrative](#)

SCI: Protein Needs in Acute Phase (Nutrition Prescription, Monitoring)

- One positive-quality case-control study found that patients with spinal cord injuries did not achieve positive nitrogen balance within seven weeks following injury when 2.4g per kg of IBW per day was provided (Rodriguez et al, 1991)
- One neutral-quality longitudinal study found that nutrition support of 2.0g per kg IBW and basal energy expenditure multiplied by an activity factor of 1.2 and an injury factor of 1.6 resulted in overfeeding and did not alter the persisting negative nitrogen balance in patients with spinal cord injury (Rodriguez et al, 1997)
- One positive-quality case series study found that nutrient parameters, including serum albumin, were positively correlated with improvements in energy and protein intake during the first eight weeks post-injury (Laven et al, 1989)
- One neutral-quality narrative review stated that hypoalbuminemia is associated with spinal cord injury, usually appearing within days of the injury, and that a rising serum albumin level within three weeks of injury generally indicates adequate nutritional intake (Chin and Kearns, 1991).

SCI: Protein Needs in the Rehabilitation Phase

- One positive-quality case series study found that patients in the rehabilitation phase of spinal cord injury who received 0.8g to 1.0g per kg of body weight per day experienced improving serum albumin levels throughout the four-week study. Negative nitrogen balance peaked at baseline and remained negative throughout the study, but fell significantly by week three (Kearns et al, 1992).
- One negative-quality narrative review stated that 0.8g per kg of body weight per day may be required for maintenance; however, 1.0g to 1.5g per kg of body weight per day may be required if infection or pressure ulcers are present (Blisset, 1990).

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade III
- Small number of studies
- Lack of generalizability across study designs
- Most studies of weak design for answering question.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated

consensus will not have supporting evidence linked).

[What are the protein needs for patients during the acute and rehabilitation phases following spinal cord injury?](#)

- [References](#)

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- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Assessment for Prevention of Pressure Ulcers 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Pressure Ulcers: Prevention

The Registered Dietitian (RD) should assess persons with spinal cord injury for risk factors associated with the development of pressure ulcers. The RD should determine the frequency of nutrition reassessment based on changes in nutritional or medical parameters and institutional protocols. Research suggests that maintenance of nutrition-related parameters, including anthropometrics, skin integrity, dietary intake, lifestyle factors and biochemical indices, may be associated with reduced risk of pressure ulcers.

Rating: Fair
Imperative

SCI: Assessment of Biochemical Parameters Associated with Prevention of Pressure Ulcers

The Registered Dietitian should assess laboratory indices associated with the risk of pressure ulcers such as albumin, prealbumin, zinc, vitamin A and vitamin C as part of the nutrition assessment of persons with spinal cord injury. Biochemical parameters as close to normal as possible or within the normal range are associated with reduced risk of pressure ulcers.

Rating: Fair
Imperative

SCI: Assessment of Anthropometric, Nutrition and Lifestyle Factors Associated with Prevention of Pressure Ulcers

The Registered Dietitian should assess anthropometric, nutrition and lifestyle factors, including weight, food and nutrition-related history (food intake, alcohol intake, physical activity and function) and smoking history for persons with spinal cord injury. Evidence suggests that the risk of developing pressure ulcers is reduced in individuals who maintain a normal weight, consume adequate amounts of nutrients and do not have a history of smoking or alcohol abuse.

Rating: Fair
Imperative

- [Risks/Harms of Implementing This Recommendation](#)

No harm or risks are associated with implementation of this recommendation.

- [Conditions of Application](#)

- Because of immobility, all persons with spinal cord injury should be considered at increased risk of developing pressure ulcers
- Decreased albumin and transthyretin (prealbumin) are often interpreted as indicators of malnutrition. However, albumin and prealbumin are also inversely influenced by inflammatory and stress responses. These visceral proteins should be interpreted by keeping in mind the patient's total clinical status. Use of C-Reactive Protein, a protein that increases with stress, is useful in interpreting whether albumin and prealbumin are being affected or decreased by inflammation and stress. The role of albumin as a nutrition indicator in spinal cord-injured persons will be addressed systematically in scheduled updates to this Guideline. This recommendation applies to patients in the acute phase of spinal cord injury.
- Due to the metabolic response to illness, levels of vitamin A, vitamin C and zinc may be affected by the stress response and not be indicative of nutritional status.

- [Potential Costs Associated with Application](#)

- Organizational expenses incurred as a result of providing adequate nutrition care to reduce the risk of development of pressure ulcers may be cost-effective, as it is likely that costs associated with treating a pressure ulcer will be higher than preventive care
- Organizations will incur costs in providing nutritional supplementation for prevention of pressure ulcers, including vitamins, minerals, medical food supplements and enteral and parenteral nutrition when appropriate
- Organizations will incur costs in providing laboratory monitoring of biochemical indices.

- [Recommendation Narrative](#)

SCI: Pressure Ulcer Prevention

- One negative-quality time-series study of spinal cord-injured patients found that all [SCI](#) patients had significantly lower serum albumin than a control group, and that [SCI](#)

patients with pressure ulcers had significantly lower prealbumin and zinc levels than the control group (Cruse et al, 1999)

- One positive-quality cross-sectional study of spinal cord-injured patients found that the more severe the SCI injury, the lower the vitamin A level, and that those SCI patients without a pressure ulcer in the past 12 months had higher vitamin A levels (Moussavi et al, 2003)
- One positive-quality cross-sectional study of spinal cord-injured patients found that lifestyle, exercise and diet were significant protective behaviors for prevention of recurrent ulcers (Krause et al, 2004)
- One neutral-quality cross-sectional study found that pressure ulcers were least likely to occur among spinal cord-injured individuals who maintained a normal weight, were employed and maintained a family role, and did not have a history of tobacco use, suicidal behaviors, self-reported incarcerations or alcohol or drug abuse (Krause et al, 2001)
- One positive-quality systematic review provided clinical practice guidelines for spinal cord injury, including recommendations for assessment, dietary intake and correction of malnutrition (Consortium of Spinal Cord Medicine, 2001).

SCI: Assessment of Biochemical Parameters Associated with Pressure Ulcers

- One negative-quality time-series study of spinal cord-injured patients found that all SCI patients had significantly lower serum albumin than a control group, and that SCI patients with pressure ulcers had significantly lower prealbumin and zinc levels than the control group (Cruse et al, 1999)
- One positive-quality cross-sectional study of spinal cord-injured patients found that the more severe the SCI injury, the lower the vitamin A level, and that those SCI patients without a pressure ulcer in the past 12 months had higher vitamin A levels (Moussavi et al, 2003).

SCI: Assessment of Anthropometric and Lifestyle Factors Associated with Prevention of Pressure Ulcers

- One positive-quality cross-sectional study of spinal cord-injured patients found that lifestyle, exercise and diet were significant protective behaviors for prevention of recurrent ulcers (Krause et al, 2004)
- One neutral-quality cross-sectional study found that pressure ulcers were least likely to occur among spinal cord-injured individuals who maintained a normal weight, were employed and maintained a family role and did not have a history of tobacco use, suicidal behaviors, self-reported incarcerations or alcohol or drug abuse (Krause et al, 2001).

SCI: Intervention to Prevent Development of Pressure Ulcers

One positive-quality systematic review provided clinical practice guidelines for spinal cord injury, including recommendations for assessment, dietary intake and correction of malnutrition (Consortium of Spinal Cord Medicine, 2001).

• [Recommendation Strength Rationale](#)

- Several studies of strong design for answering the question
- Substantial agreement among studies.

• [Minority Opinions](#)

Consensus reached.

• [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the role of nutritional status and nutrition care in the prevention of pressure ulcers in Spinal Cord Injury patients?](#)

• [References](#)

[Consortium for Spinal Cord Medicine Clinical Practice Guidelines. Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals. J Spinal Cord Med 2001;24 Suppl 1:S40 - S101.](#)

[Cruse JM, Lewis RE, Roe DL, Dilioglou S, Blaine MC, Wallace WF, Chen RS. Facilitation of immune function, healing of pressure ulcers, and nutritional status in spinal cord injury patients. Experimental and Molecular Pathology 1999;68:38-54.](#)

[Krause JS, Broderick L. Patterns of recurrent pressure ulcers after spinal cord injury: identification of risk and protective factors 5 or more years after onset. Arch Phys Med Rehabil. 2004;85:1257-1264.](#)

[Krause JS, Vines CL, Farley TL, Sniezek J, Coker J. An exploratory study of pressure ulcers after spinal cord injury: relationship to protective behaviors and risk factors. Arch Phys Med Rehabil 2001;82:107-113.](#)

[Moussavi RM, Garza HM, Eisele SG, Rodriguez G, Rintala DH. Serum levels of vitamins A, C, and E in persons with chronic spinal cord injury living in the community. Arch Phys Med Rehabil 2003;84:1061-1067.](#)

• [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

None.

• [Spinal Cord Injury](#)

• [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Recommendations Summary

SCI: Assessment of Nutritional Needs for Pressure Ulcers 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

• [Recommendation\(s\)](#)

SCI: Assessment: Energy Needs For Persons with Spinal Cord Injury with Pressure Ulcers

If a person with spinal cord injury has a pressure ulcer, the registered dietitian should measure energy needs by indirect calorimetry (IC). If indirect calorimetry is not available, any of the following predictive equations may be used to calculate energy needs :

- 30kcal to 40kcal per kg of body weight per day
- Harris-Benedict times stress factor (1.2 for stage II ulcer, 1.5 for stage III and IV ulcers).

No evidence currently exists to suggest that any one of the above predictive equations is superior to the others.

Persons with spinal cord injury with pressure ulcers have higher energy needs than persons with spinal cord injury who have similar levels of injury and no pressure ulcers. Evidence suggests that additional energy is needed for optimal healing of pressure ulcers.

Rating: Consensus

Conditional

SCI: Assessment: Protein Needs For Persons with Spinal Cord Injury with Pressure Ulcers

If a person with spinal cord injury has a pressure ulcer, the registered dietitian should calculate protein needs as follows:

- 1.2g to 1.5g of protein per kg body weight per day (Stage II pressure ulcers)
- 1.5g to 2.0g of protein per kg body weight per day (Stage III and IV pressure ulcers).

Persons with spinal cord injury with pressure ulcers have higher protein needs than persons with spinal cord injury who have similar levels of injury and no pressure ulcers. Evidence suggests that additional protein is needed for optimal healing of pressure ulcers.

- Arginine and its relationship to wound healing has been researched for over 30 years, primarily in animal models. Clear and definitive guidelines for its safe and effective use have yet to be established.
- Glutamine should not be routinely provided to all patients with wounds due to insufficient data.

Rating: Consensus

Conditional

SCI: Assessment: Fluid Needs for Persons with Spinal Cord Injury with Pressure Ulcers

If a person with spinal cord injury has a pressure ulcer, the registered dietitian should assess hydration status to determine fluid needs. Assessment of hydration status includes evaluation of parameters such as input and output, urine color, skin turgor, BUN and serum sodium. Increased fluid losses may result from the evaporation of fluids from a severe pressure ulcer, draining or open wounds, fever or the use of an air-fluidized bed. Current fluid recommendations are based on guidelines for the non-SCI population.

- Normal requirement: 30ml to 40ml per kg
- Minimum of 1.0ml per kcal per day
- 10ml to 15ml per kg additional fluids may be required with the use of air fluidized beds set at a high temperature (more than 31° to 34°C or more than 88° to 93°F)
 - Fluid loss includes evaporation from open wounds, wound drainage and fever
 - These guidelines are only a general indication of insensible water loss; the registered dietitian will need to monitor other parameters of hydration status.

Rating: Consensus

Conditional

SCI: Assessment: Micronutrient Needs for Persons with SCI with Pressure Ulcers

If a person with spinal cord injury has a pressure ulcer, the registered dietitian should recommend a daily vitamin and mineral supplement that meets no more than 100% of the RDA.

Certain micronutrients play a role in the process of wound healing; however, the optimal nutrient intake is not known at this time. Few rigorous scientific studies exist in this area, even for the non-SCI population. Therefore, comprehensive evidence-based practice guidelines are not developed for micronutrient needs.

If a person with spinal cord injury has a pressure ulcer and has a suspected or documented micronutrient deficiency, the registered dietitian should provide additional supplementation. Caution should be used when supplementing greater than the Tolerable Upper Intake Level (UL). The dietitian should re-evaluate the need for micronutrient supplementation every seven to 10 days.

Vitamin A

Vitamin A deficiency results in impaired wound healing and alteration in immune function that may increase the likelihood of wound infections. Documented recommendations for amount of Vitamin A for enhanced wound healing in injured patients is 10, 000 IU to 50, 000 IU per day and 10, 000 IU IV for moderate-severely injured patients or malnourished patients for a limit of 10 days. For patients receiving steroids, 10, 000 IU to 15, 000 IU for one week has been recommended to counteract the anti-inflammatory effects of steroids. Vitamin A supplementation should be implemented cautiously and judiciously because of potential toxicity.

Additional research is needed to confirm optimal dosage.

Vitamin C

Vitamin C deficiency has been associated with delayed wound healing. In patients with Vitamin C deficiency, supplementation has been shown to enhance wound healing. High doses of Vitamin C for healing chronic wounds is widely recommended in the literature. The Agency for Health Care Research and Quality recommends 100mg to 200mg per day of Vitamin C for Stage I and II pressure ulcers and 1, 000mg to 2, 000mg per day of Vitamin C for Stage III and IV pressure ulcers.

Additional research is needed to confirm optimal dosage.

Vitamin E

The effect of Vitamin E in healing acute and chronic wounds is controversial. Further research is needed in humans with controlled randomized trials to determine risks and benefits of various doses of Vitamin E and the effect on healing.

Zinc

Zinc deficiency is associated with delayed wound healing due to a decrease in collagen and protein synthesis and impaired immune competence. Replacement therapy guidelines have not been well defined in the literature. ZnSo4 220mg (50mg elemental Zinc) twice per day is recommended as a standard adult oral replacement. High-dose supplementation of zinc should be limited to two to three weeks. Dosage should be individualized according to zinc status and metabolic demands.

Iron

Anemia assessed by hemoglobin and hematocrit levels reduces oxygen supply to tissues, thus impairing healing of pressure ulcers. If low hemoglobin concentration is due to iron deficiency anemia, it may be a factor in tissue hypoxia and impaired wound healing. Supplementation should be provided as indicated to correct iron deficiency anemia.

Rating: Consensus

Conditional

- Risks/Harms of Implementing This Recommendation
 - Provision of nutrition support, including enteral or parenteral nutrition, to nutritionally compromised patients with spinal cord injuries may be associated with patient complications including, but not limited to:
 - Aspiration
 - Infections, including catheter-related infections
 - Metabolic complications resulting from under- or overfeeding
 - Gastrointestinal complications, including diarrhea.
 - Use of predictive equations rather than measured energy expenditure may result in under- or overfeeding persons with SCI and may lead to metabolic complications with subsequent poor outcomes such as obesity, pressure ulcer development, decreased ability to perform ADLs and transfers, heart disease and diabetes
 - Additional consideration should be given to fluid intake in patients with conditions in which fluid should be restricted such as renal disease, heart failure and bladder management programs
 - The protein needs recommendation may be contraindicated in persons with spinal cord injury who have concurrent hepatic or renal dysfunction
 - *Vitamin A*: Caution that supplementation of Vitamin A, even at the lower range of the recommendations, is not strongly justified. Systematic Vitamin A could potentially reactivate the inflammatory reaction against which the steroid use was aimed. The benefits of high doses should be weighed against the potential risk of toxicity. Use of a water soluble form of Vitamin A should be considered in cases of fat malabsorption.
 - *Vitamin C*: Use caution with higher doses of vitamin C in those with renal failure due to the possibility of renal oxalate stone formation. Adverse effects such as nausea, abdominal cramping and diarrhea may occur with increased doses.
 - *Vitamin E*: Use caution when supplementing with Vitamin E, as there is evidence from animal studies that vitamin E may delay wound healing by impairing collagen synthesis
 - *Zinc*: High-dose supplementation can adversely affect copper status, immune response and lipid profiles and may cause GI side effects. Some authors have suggested that high-dose supplementation should be limited to two to three weeks to minimize the risk of adverse effects unless justified by ongoing losses. Parenteral dose of zinc is less than oral and enteral recommendations due to differences in bioavailability.

- [Conditions of Application](#)
 - This recommendation applies to persons with spinal cord injury with pressure ulcers
 - Actual weight should be used in calculating energy and protein needs; however, the patient should be closely monitored for signs and symptoms of overfeeding or underfeeding or of substrate overload
 - Decreased albumin and transthyretin (prealbumin) are often interpreted as indicators of malnutrition. However, albumin and prealbumin are also inversely influenced by inflammatory and stress response. These visceral proteins should be interpreted, keeping in mind the patient's total clinical status. Use of C-reactive protein, a protein that increases with stress, is useful in interpreting whether albumin and prealbumin are being affected or decreased by inflammation and stress. The role of albumin as a nutrition indicator in persons with spinal cord injury will be addressed systematically in scheduled updates to this guideline. This recommendation applies to patients in the acute phase of spinal cord injury.
 - Due to the metabolic response to illness, levels of vitamin A, vitamin C and zinc may be affected by the stress response and not be indicative of nutritional status.
- [Potential Costs Associated with Application](#)
 - Significant organizational costs are associated with the treatment of pressure ulcers in persons with spinal cord injury, including the provision of staff, equipment, supplies, blood work, facilities, nutritional supplements and nutrition support required for appropriate care.
 - Organizational expenses incurred as a result of treating pressure ulcers may be reduced by the provision of adequate nutrition care, as appropriate nutrition care may reduce healing time and thus reduce organizational costs.
- [Recommendation Narrative](#)
 - One clinical practice guideline provided evidence-based expert recommendations regarding nutrition care for pressure ulcers, including recommendations for assessment of energy, protein and micronutrient needs and monitoring of nutrition and hydration status (Consortium for Spinal Cord Medicine, 2000)
 - Two nutrition support textbooks provided general recommendations for nutrition care in wound healing, including recommendations for micronutrient intake (ASPEN Nutrition Support Manual, 2005; ASPEN Nutrition Support Core Curriculum, 2007; ADA Nutrition Care Manual, Baranski and Ayello, 2008)
 - See 'Citations Not Used in Evidence Analysis' for other works consulted.
- [Recommendation Strength Rationale](#)
 - Rating is based on expert consensus, clinical guidelines and textbooks
 - Few to no high-quality studies of strong design are available at this time.
- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

- [References](#)
- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)
 - Pressure ulcer prevention and treatment following spinal cord injury: A clinical practice guideline for health care professionals. Consortium for Spinal Cord Medicine, Paralyzed Veterans of America. 2000.
 - ASPEN 2005 Nutrition Support Manual. American Society for Parenteral and Enteral Nutrition. 2005.
 - ASPEN 2007 Nutrition Support Core Curriculum. American Society for Parenteral and Enteral Nutrition. 2007.
 - Nutrients and wound healing: Still searching for the magic bullet. *Nutrition in Clinical Practice*. 2005 June; 20: 331-347.
 - *ADA Nutrition Care Manual*. Chicago, IL: ADA; 2008.
 - 5 Million Lives Campaign. Available at: <http://www.ihl.org/IHI/Programs/Campaign/>.
 - Baranski S, Ayello EA. *Wound care essentials: Practice principles*. Philadelphia: Lippincott Williams and Wilkins; 2008.
- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Assessment for Prevention and Treatment of Overweight and Obesity 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Assessment for Prevention and Treatment of Overweight and Obesity

The Registered Dietitian should assess the weight and body composition of persons with spinal cord injury ([SCI](#)), and adjust energy level or implement weight management strategies as appropriate. The [SCI](#) population is at a higher risk of associated comorbidities such as diabetes, metabolic syndrome and cardiovascular disease. Lower levels of spontaneous physical activity and a lower thermic effect of food result in decreased energy expenditure and energy needs. See Nutrition Assessment recommendations for methods to determine [weight](#) and [energy needs](#), and [ADA Adult Weight Management Evidence-based Nutrition Practice Guideline](#) for methods to manage overweight and obesity.

Rating: Strong
Imperative

- [Risks/Harms of Implementing This Recommendation](#)

No potential harm or risks are associated with implementation of this recommendation.

- [Conditions of Application](#)

- This recommendation applies to all persons with spinal cord injury
- Aim for consistency in method and equipment used in measuring weight.

- [Potential Costs Associated with Application](#)

There are staffing and equipment costs associated with weight management for persons with spinal cord injury.

- [Recommendation Narrative](#)

SCI: Nutrition Care for Prevention and Treatment of Obesity

- One positive-quality case-control study found that 24-hour total and resting energy expenditure were significantly lower in [SCI](#) than in control subjects, that this difference was independent of body composition and that the difference may have been related to a lower thermic effect of food and lower levels of spontaneous physical activity

(Monroe et al, 1998)

- One positive-quality cross-sectional study found that patients with SCI in the early rehabilitation phase had measured caloric needs that were 45% to 90% of caloric needs as predicted by equations, and the reduction in energy needs was proportional to the amount of denervated muscle (Cox et al, 1985)
- A neutral-quality case-series study recommended that ideal body weights for persons with SCI be below those recommended by the NY Metropolitan Life Insurance table: Individuals with paraplegia, 10 lb to 15 lb lower; with quadriplegia, 15 lb to 20 lb lower (Peiffer et al, 1981)
- A neutral quality systematic review concluded that patients with SCI in the chronic phase should consume a low-calorie diet, since atrophied muscle cells are eventually partially replaced with connective tissue and filled with lipid and water (Claus-Walker et al, 1981)
- A neutral quality narrative review found that the metabolic rates of patients with spinal cord injury tend to be below predicted levels due to decreased metabolic activity of denervated muscle; the higher the lesion, the lower the energy expenditure (Chin and Keams, 1991)
- One neutral quality descriptive study found that glucose intolerance and dyslipidemias were common among paraplegic and tetraplegic individuals (Tharion et al, 1998)
- One neutral quality narrative review found that risk for obesity, CVD, type 2 diabetes and osteoporosis is higher in persons with SCI than able-bodied persons (Kocina, 1997)
- One neutral quality cross-sectional study found that fat-free mass composition changes following SCI include a bone mineral content decrease of 25% to 50%; total body protein reduction of 30% and total body water relative to body weight decrease of 15%, with body fatness related to level of SCI (Olle et al, 1993).

- [Recommendation Strength Rationale](#)

- Eight studies in substantial agreement
- Two studies of strong design for answering the question
- Conclusion statements are Grade II and III.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What are the indications for nutrition care to prevent or treat overweight and obesity in the community living phase of persons with Spinal Cord Injury?](#)

[What are the caloric needs for patients during the acute and rehabilitation phases following spinal cord injury?](#)

- [References](#)

[Chin DE, Keams P. Nutrition in the Spinal-Injured Patient. *NCP*. 1991; 6\(6\):213-222.](#)

[Claus-Walker J, Halstead LS. Metabolic and Endocrine Changes in Spinal Cord Injury: I. The Nervous System Before and After Transection of the Spinal Cord. *Arch Phys Med Rehabil*. 1981;62:595-601.](#)

[Cox SAR, Weiss SM, Posuniak EA, Worthington P, Prioleau M, Heffley G. Energy Expenditure after Spinal Cord Injury: Evaluation of Stable Rehabilitating Patients. *J Trauma* 1985; 25: 419-423.](#)

[Kocina P. Body Composition of Spinal Cord Injured Adults. *Sports Med*. 1997;23\(1\): 48-60.](#)

[Monroe MB, Tataranni PA, Pratley R, Manore MM, Skinner JS, Ravussin E. Lower Daily Energy Expenditure as Measured by a Respiratory Chamber in Subjects with Spinal Cord Injury Compared with Control Subjects. *Am J Clin Nutr*, 1998; 68: 1223-1227.](#)

[Olle MM, Pivarnik JM, Klish WJ, Morrow JR. Body Composition of Sedentary and Physically Active Spinal Cord Injured Individuals Estimated from Total Body Electrical Conductivity. *Arch Phys Med Rehabil*. 1993; 74: 706-710.](#)

[Peiffer SC, Blust P, Leyson JF. Nutritional Assessment of the Spinal Cord Injured Patient. *J Am Diet Assoc*. 1981; 78: 501-505.](#)

[Tharion G, Prasad KR, Gopalan L, Bhattacharji S. Glucose Intolerance and Dyslipidaemias in Persons with Paraplegia and Tetraplegia in South India. *Spinal Cord*, 1998; 36: 228-230.](#)

[Chin DE, Keams P. Nutrition in the Spinal-Injured Patient. *NCP*. 1991; 6\(6\):213-222.](#)

[Claus-Walker J, Halstead LS. Metabolic and Endocrine Changes in Spinal Cord Injury: I. The Nervous System Before and After Transection of the Spinal Cord. *Arch Phys Med Rehabil*. 1981;62:595-601.](#)

[Cox SAR, Weiss SM, Posuniak EA, Worthington P, Prioleau M, Heffley G. Energy Expenditure after Spinal Cord Injury: Evaluation of Stable Rehabilitating Patients. *J Trauma* 1985; 25: 419-423.](#)

[Kocina P. Body Composition of Spinal Cord Injured Adults. *Sports Med*. 1997;23\(1\): 48-60.](#)

[Monroe MB, Tataranni PA, Pratley R, Manore MM, Skinner JS, Ravussin E. Lower Daily Energy Expenditure as Measured by a Respiratory Chamber in Subjects with Spinal Cord Injury Compared with Control Subjects. *Am J Clin Nutr*, 1998; 68: 1223-1227.](#)

[Olle MM, Pivarnik JM, Klish WJ, Morrow JR. Body Composition of Sedentary and Physically Active Spinal Cord Injured Individuals Estimated from Total Body Electrical Conductivity. *Arch Phys Med Rehabil*. 1993; 74: 706-710.](#)

[Peiffer SC, Blust P, Leyson JF. Nutritional Assessment of the Spinal Cord Injured Patient. *J Am Diet Assoc*. 1981; 78: 501-505.](#)

[Tharion G, Prasad KR, Gopalan L, Bhattacharji S. Glucose Intolerance and Dyslipidaemias in Persons with Paraplegia and Tetraplegia in South India. *Spinal Cord*, 1998; 36: 228-230.](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Intervention for Lipid Abnormalities 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Education and Counseling for Lipid Abnormalities

If persons with spinal cord injury living in the community setting have total cholesterol levels more than 200mg per dL (5.2mmol per L), then a Registered Dietitian (RD) should provide comprehensive nutrition education and counseling regarding a cardioprotective diet. Persons with spinal cord injury can achieve improvements in lipid values similar to those of other individuals with disorders of lipid metabolism, and persons with spinal cord injury are at higher risk of cardiovascular conditions.

Rating: Fair

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

No potential harm or risks are associated with this recommendation.

- [Conditions of Application](#)

This recommendation applies to persons with spinal cord injury living in the community setting whose total cholesterol levels exceed 200mg per dL.

- [Potential Costs Associated with Application](#)

Staff and organizational costs are associated with the development of comprehensive nutrition screening, nutrition assessment and dietary counseling programs for persons with spinal cord injury.

- [Recommendation Narrative](#)

Lipid Abnormalities: Dietary Intervention

One positive quality nonrandomized prospective trial with concurrent controls (Szlachic et al, 2001) and one cross-sectional study (Moussavi et al, 2001) were in substantial agreement that dietary treatment should be provided to patients with SCI whose total cholesterol levels exceed standard guidelines. The positive quality study recommended that a Registered Dietitian should initiate dietary intervention for persons whose total cholesterol levels exceed more than 200mg per dL (5.2mmol per L).

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade II
- Although most included studies are of weak design for answering the question, all but two of twenty-one studies are in substantial agreement
- Included studies provided multi-ethnic representation, male and female gender representation and consistency across study designs.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How should lipid abnormalities be managed in Spinal Cord Injury patients?](#)

- [References](#)

[Apstein MD, George BC. Serum lipids during the first year following acute spinal cord injury. *Metabolism*. 1998;47:367-370.](#)

[Bauman WA, Spungen AM. Carbohydrate and lipid metabolism in chronic spinal cord injury. *J Spinal Cord Med*. 2001;24\(4\):266-277.](#)

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[Dallmeijer AJ, van der Woude LH, van Kamp GJ, Hollander AP. Changes in lipid, lipoprotein and apolipoprotein profiles in persons with spinal cord injuries during the first 2 years post-injury. *Spinal Cord*. 1999;37\(2\):96-102.](#)

[Dallmeijer AJ, Hopman MT, van der Woude LH. Lipid, lipoprotein, and apolipoprotein profiles in active and sedentary men with tetraplegia. *Arch Phys Med Rehabil*. 1997;78\(11\):1173-1176.](#)

[Demirel S, Demirel G, Tukek T, Erk O, Yilmaz H. Risk factors for coronary heart disease in patients with spinal cord injury in Turkey. *Spinal Cord*. 2001;39\(3\):134-138.](#)

[Janssen TW, van Oers CA, van Kamp GJ, TenVoorde BJ, van der Woude LH, Hollander AP. Coronary heart disease risk indicators, aerobic power, and physical activity in men with spinal cord injuries. *Arch Phys Med Rehabil*. 1997;78\(7\):697-705.](#)

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[Midha M, Schmitt JK, Sclater M. Exercise effect with the wheelchair aerobic fitness trainer on conditioning and metabolic function in disabled persons: a pilot study. *Arch Phys Med Rehabil*. 1999;80\(3\):258-61.](#)

[Moussavi RM, Ribas-Cardus F, Rintala DH, Rodriguez GP. Dietary and serum lipids in individuals with spinal cord injury living in the community. *J Rehabil Res Dev*. 2001;38\(2\):225-233.](#)

[Ozqurtas T, Alaca R, Gulec M, Kutluay T. Do spinal cord injuries adversely affect serum lipoprotein profiles?. *Mil Med*. 2003;168\(7\):545-547.](#)

[Schmid A, Halle M, Stutzle C, Konig D, Baumstark MW, Storch MJ, Schmidt-Trucksass A, Lehmann M, Berg A, Keul J. Lipoproteins and free plasma catecholamines in spinal cord-injured men with different injury levels. *Clin Physiol*. 2000; 20\(4\): 304-310.](#)

[Sorg RJ. HDL-cholesterol: exercise formula. Results of long-term \(6-year\) strenuous swimming exercise in a middle-aged male with paraplegia. *J Orthopaedic Sports/Physical Therapy*. 1993;17:195-199.](#)

[Stewart BG, Tamopolsky MA, Hicks AL, McCartney N, Mahoney DJ, Staron RS, Phillips SM. Treadmill training-induced adaptations in muscle phenotype in persons with incomplete spinal cord injury. *Muscle Nerve*. 2004; 30\(1\): 61-68.](#)

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[Vidal J, Javierre C, Curia FJ, Garrido E, Lizarraga M-A, Segura R: Long-term evolution of blood lipid profiles and glycemic levels in patients after spinal cord injury. Spinal Cord. 2003;41:178-181](#)

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- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Physical Activity in Spinal Cord Injured Persons 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Education Regarding Physical Activity

If a person with spinal cord injury has lipid abnormalities and weight management issues, then the registered dietitian should provide initial brief nutrition education regarding the relationship between physical activity and improving lipid levels. Evidence suggests that appropriate physical activity may result in improvements of blood lipid parameters and weight in persons with spinal cord injury.

Rating: Fair
Conditional

SCI: Nutrition Education Regarding Physical Activity in Overweight and Obese Persons with SCI

If a person with spinal cord injury is overweight or obese, the registered dietitian should encourage physical activity as part of a comprehensive weight management program. A carefully planned [weight management program](#) incorporating physical activity has been shown to reduce and maintain weight in overweight and obese persons with spinal cord injury. Evidence suggests that appropriate physical activity, such as wheelchair sports, swimming, electrical stimulation exercise and body weight supported treadmill training may result in improvements of blood lipid parameters and weight in persons with spinal cord injury.

Rating: Weak
Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Physical activity without medical clearance may contribute to further disability or death, thus physician, physiatrist and physiotherapy consultation for exercise recommendations based on level of spinal cord injury should be obtained before beginning an exercise program.

- [Conditions of Application](#)

- Exercise should be limited to those individuals who have received medical clearance for such activity
- If a person with spinal cord injury has lipid abnormalities and weight management issues, then the registered dietitian should coordinate care with other members of the interdisciplinary team including a physician, physiatrist, physical therapist or exercise physiologist.

- [Potential Costs Associated with Application](#)

- Staff and organizational costs are associated with the development of comprehensive dietary counseling programs for SCI patients
- Staff and organizational costs are associated with the development and implementation of exercise programs for SCI patients.

- [Recommendation Narrative](#)

Lipid Abnormalities: Physical Activity

- One case-control study found that free fatty acid mobilization, delivery and uptake are lower and glycogen breakdown and glucose uptake are higher in individuals with spinal cord injury during electrical exercise than in controls performing voluntary exercise (Kjaer et al, 2001)
- One case-control study found that body weight-supported treadmill training significantly improved the total cholesterol, LDL cholesterol and total cholesterol-to-HDL cholesterol ratio in persons with spinal cord injury (Stewart et al, 2004)
- One case-control study found that tetraplegic men who participated in regular sports activities for six months showed significantly higher values for HDL cholesterol and ApoA1 or ApoB, compared with a sedentary group (Dallmeijer et al, 1997)
- One pre-post experimental study found that wheelchair aerobic exercise training over a ten-week period resulted in significant improvements to subjects' total cholesterol (Midha et al, 1999)
- One case study of one paraplegic subject found that long-term exercise in persons with paraplegia can result in significant improvements in HDL cholesterol (Sorg et al, 1993).

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade II
- Although most included studies are of weak design for answering the question, all the studies are in substantial agreement
- Included studies provided multi-ethnic representation, male and female gender representation and consistency across study designs.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[How should lipid abnormalities be managed in Spinal Cord Injury patients?](#)

[What are the indications for nutrition care to prevent or treat overweight and obesity in the community living phase of persons with Spinal Cord Injury?](#)

- [References](#)

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[Bauman WA, Adkins RH, Spungen AM, Kemp BJ, Walters RL. The effect of residual neurological deficit on serum lipoproteins in individuals with chronic spinal cord injury. *Spinal Cord*. 1998;36\(1\):13-17.](#)

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[Midha M, Schmitt JK, Sclater M. Exercise effect with the wheelchair aerobic fitness trainer on conditioning and metabolic function in disabled persons: a pilot study. *Arch Phys Med Rehabil*. 1999;80\(3\):258-61.](#)

[Moussavi RM, Ribas-Cardus F, Rintala DH, Rodriguez GP. Dietary and serum lipids in individuals with spinal cord injury living in the community. *J Rehabil Res Dev*. 2001;38\(2\):225-233.](#)

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[Sorg RJ. HDL-cholesterol: exercise formula. Results of long-term \(6-year\) strenuous swimming exercise in a middle-aged male with paraplegia. *J Orthopaedic Sports/Physical Therapy*. 1993;17:195-199.](#)

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- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Fluid and Neurogenic Bowel 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Fluid and Neurogenic Bowel: Estimating Fluid Needs to Promote Optimal Stool Consistency

The registered dietitian should estimate the fluid needs of persons with spinal cord injury with neurogenic bowel by using the guidelines of the Consortium on Spinal Cord Medicine, as follows:

- One ml fluid per kcal estimated energy needs plus 500ml or
- 40ml per kg body weight plus 500ml.

A minimum of 1.5L of fluid per day may promote optimal stool consistency in persons with spinal cord injury and neurogenic bowel. Persons with spinal cord injury and neurogenic bowel often have an increase in colonic transit time, resulting in excessive fluid reabsorption and the formation of hardened stools.

Further research is needed to establish fluid intake guidelines for this population.

Rating: Consensus

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

- Provision of inadequate or excessive fluid may result in poor clinical outcomes
- Provision of inadequate fluid per day (less than 1.5L fluid per day) or more than 40ml per kg of body weight fluid per day may result in poor clinical outcomes; adjustment should be made for individual needs such as medical conditions (including but not limited to congestive heart failure, renal disease) or bladder management programs.

- [Conditions of Application](#)

This recommendation applies to all patients with spinal cord injury with neurogenic bowel.

- [Potential Costs Associated with Application](#)

No organizational costs are associated with implementation of this recommendation.

- [Recommendation Narrative](#)

- One non-randomized clinical trial (Badiali et al, 1997) found that provision of 1.5L water and 15g fiber to spinal cord injured patients resulted in significant improvements in bowel function, evidenced by a reduction in transit time, more evacuations per week, greater predictability and an improved evacuation stimuli score
- One systematic review (Consortium on Spinal Cord Injury, 1998), based on expert consensus, recommended that initial fluid needs for spinal cord-injured patients be figured at 500ml fluid per day above National Research Council recommendations for the general population.

- [Recommendation Strength Rationale](#)

- Recommendation based on expert consensus only
- Very few studies answering the question.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the recommended fluid intake for bowel and bladder management in persons with Spinal Cord Injury?](#)

- [References](#)

[Badiali D, Bracci F, Castellano V, Corrazzari E, Fuoco U, Habib FI, Scivoletto G. Sequential treatment of chronic constipation in paraplegic subjects. *Spinal Cord* 1997; 35: 116-120.](#)

[Consortium for Spinal Cord Medicine. *Neurogenic Bowel Management in Adults with Spinal Cord Injury: Clinical Practice Guidelines for Health-Care Professionals*. Washington, DC: Paralyzed Veterans of America, 1998.](#)

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Fiber and Neurogenic Bowel 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Fiber and Neurogenic Bowel: Level of Fiber Intake

The Registered Dietitian should prescribe for persons with spinal cord injury with neurogenic bowel an initial fiber intake of 15g per day, with gradual increases up to 30g per day of fiber, as tolerated from a variety of sources. A fiber intake of 15g per day may be associated with significant improvements in bowel function. However, fiber intake greater than 20g per day may be associated with undesirable prolonged intestinal transit times in persons with spinal cord injury.

Rating: Weak

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Failure to monitor fiber intake closely may lead to provision of inadequate or excessive fiber with subsequent poor clinical outcomes such as constipation, bowel impaction, increased amount of stool, excessive flatulence or abdominal distention.

- [Conditions of Application](#)

All spinal cord-injured patients with neurogenic bowel should be closely monitored for fiber intake and tolerance and fiber should be increased or decreased as needed.

- [Potential Costs Associated with Application](#)

- Costs associated with the application may include:
 - Cost of high-fiber foods and fiber supplements
 - Cost of staff to monitor fiber intake.
- A reduction in the cost of medications needed for bowel management may be realized by application of this recommendation.

- [Recommendation Narrative](#)

Fiber and Neurogenic Bowel: Level of Fiber Intake

- One cross-sectional study found that, compared with patients with spinal cord injury with upper motor neuron bowel, patients with lower motor neuron bowel had increased frequency of defecation, increased incontinence, increased use of oral medications for bowel care, increased defecation time and increased dietary restrictions, indicating a need for an intensive bowel program for patients with lower motor neuron bowel (Yim et al, 2001)
- One non-randomized clinical trial found that significant improvements in bowel function, evidenced by a reduction in transit time, more evacuations per week, greater predictability and an improved evacuation stimuli score, resulted from a bowel program providing 15g fiber and 1.5L fluid daily (Badiali et al, 1997)
- One systematic review (Consortium on Spinal Cord Injury, 1998), based on expert consensus, recommended that initial fluid needs for spinal cord-injured patients be figured at 500 ml fluid per day above National Research Council recommendations for the general population.

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade III
- Small number of studies.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What level of fiber is recommended to manage neurogenic bowel in Spinal Cord Injury patients and how should it be introduced?](#)

- [References](#)

[Badiali D, Bracci F, Castellano V, Corraziari E, Fuoco U, Habib FI, Scivoletto G. Sequential treatment of chronic constipation in paraplegic subjects. *Spinal Cord* 1997; 35: 116-120.](#)

[Consortium for Spinal Cord Medicine. *Neurogenic Bowel Management in Adults with Spinal Cord Injury: Clinical Practice Guidelines for Health-Care Professionals*. Washington, DC: Paralyzed Veterans of America, 1998.](#)

[Yim SY, Yoon SH, Lee IY, Rah EW, Moon HW. A comparison of bowel care patterns in patients with spinal cord injury: upper motor neuron bowel vs lower motor neuron bowel. *Spinal Cord* 2001;39:204-207.](#)

- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

Han TR, Kim JH, Kwon BS. Chronic gastrointestinal problems and bowel dysfunction in patients with spinal cord injury. *Spinal Cord*. 1998; 36: 485-490.

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Cranberry Juice 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Cranberry Juice

If consistent with patient preference and other nutritional considerations, the Registered Dietitian may recommend that cranberry juice be included in the diet of persons with spinal cord injury to reduce urinary tract infections. Consumption of one cup (250ml) cranberry juice, three times per day, may be associated with a reduced urinary tract biofilm load.

Rating: Weak

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

- Consumption of one to three cups of cranberry juice per day may exceed the patient's caloric requirements, thus promoting obesity
- Consumption of one to three cups of cranberry juice per day may result in poor blood glucose control in persons with diabetes
- Consumption of one to three cups of cranberry juice per day may result in noncompliance with medically indicated fluid restriction.

- [Conditions of Application](#)

- [Potential Costs Associated with Application](#)

Use of cranberry juice may provide a potential cost savings by reducing the risk of urinary tract infections in persons with spinal cord injury.

- [Recommendation Narrative](#)

One nonrandomized crossover trial (quality rating neutral) found that adherence of bacteria to uroepithelial cells was significantly decreased in spinal cord injured patients who consumed 250ml cranberry juice three times per day (Reid et al, 2001). Cranberry juice intake resulted in a significant reduction in urinary tract biofilm load compared to baseline (P=0.013) and to water treatment (P=0.028).

- [Recommendation Strength Rationale](#)

- One small study (N=15)
- Further research is needed in the spinal cord-injured population.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[Does cranberry juice have a positive impact on urologic health \(prevention of urinary tract infections, stone formation, etc\) in persons with Spinal Cord Injury?](#)

- [References](#)

[Reid G, Hsieh J, Potter P, Mighton J, Lam D, Warren D, Stephenson J. Cranberry juice consumption may reduce biofilms on uroepithelial cells: pilot study in spinal cord injured patients. *Spinal Cord*. 2001;39:26-30.](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Cranberry Supplements 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Urologic Health: Cranberry Extract Supplements

The Registered Dietitian should not recommend cranberry extract supplements to promote urologic health (prevention of urinary tract infections, urologic stones, etc.) in spinal cord injured persons. Evidence suggests that cranberry extract supplements, ingested in tablet or capsule form, are not effective in prolonging the UTI-free period or decreasing bacteriuria or WBC count in persons with spinal cord injuries.

Rating: Fair

Imperative

- [Risks/Harms of Implementing This Recommendation](#)

- No risks or harms are associated with this recommendation.

- [Conditions of Application](#)

This recommendation applies to all persons with spinal cord injuries.

- [Potential Costs Associated with Application](#)

There are no costs associated with this recommendation.

- [Recommendation Narrative](#)

- One large, positive quality double-blinded randomized controlled trial found that cranberry extract supplements (1600 mg daily) were not effective in prolonging the UTI-free period in people with spinal cord injury (Lee et al 2007).
- Two smaller, neutral quality studies (one double-blinded randomized controlled trial, one double-blinded placebo-controlled crossover trial) found that cranberry extract supplements did not reduce bacteriuria, UTIs, or urinary leukocyte counts in spinal cord-injured people (Linsenmeyer et al 2004, Waites et al 2004).

- [Recommendation Strength Rationale](#)

- Substantial agreement between studies
- Generalizability across studies due to similar patient populations, similar dosage of cranberry supplement

- [Minority Opinions](#)

Consensus reached

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[Do cranberry extract supplements have a positive impact on urologic health \(prevention of urinary tract infections, stone formation, etc.\) in persons with spinal cord injury?](#)

- [References](#)

[Lee BB, Haran MJ, Hunt LM, Simpson JM, Marial O, Rutkowski SB, Middleton JW, Kotsiou G, Tudehope M, Cameron ID. Spinal-injured neuropathic bladder antiseptics \(SINBA\) trial. *Spinal Cord*. 2007;45:542-550.](#)

[Linsenmeyer TA, Harrison B, Oakley A, Kirshblum S, Stock JA, Millis SR. Evaluation of cranberry supplement for reduction of urinary tract infections in individuals with neurogenic bladders secondary to spinal cord injury. A prospective, double-blinded, placebo-controlled, crossover study. *J Spinal Cord Med*. 2004;27:29-34.](#)

[Waites KB, Canupp KC, Armstrong S, DeVivo MJ. Effect of cranberry extract on bacteriuria and pyuria in persons with neurogenic bladder secondary to spinal cord injury. *J Spinal Cord Med* 2004;27:35-40. PMID: 15156935](#)

- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

Biering-Sorenen F, Bagi P, Hoiby N. Urinary tract infections in patients with spinal cord lesions. *Drugs*. 2001;61:1275-1287.

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Intervention for Prevention and Treatment of Overweight and Obesity 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Intervention for Treatment of Overweight and Obesity

If a person with spinal cord injury is overweight or obese, the registered dietitian should implement weight management strategies as appropriate. The SCI population is at a higher risk of associated comorbidities such as diabetes, metabolic syndrome and cardiovascular disease. Lower levels of spontaneous physical activity and a lower thermic effect of food result in decreased energy expenditure and energy needs. See the Nutrition Assessment recommendations for methods to determine [weight](#) and [energy needs](#) and the [ADA Adult Weight Management Evidence-based Nutrition Practice Guideline](#) for methods to manage overweight and obesity.

Rating: Strong
Imperative

- [Risks/Harms of Implementing This Recommendation](#)

No potential risks or harms are associated with the implementation of this recommendation.

- [Conditions of Application](#)

This recommendation applies to persons with spinal cord injury who are overweight or obese.

- [Potential Costs Associated with Application](#)

There are staffing and equipment costs associated with weight management for persons with spinal cord injury.

- [Recommendation Narrative](#)

SCI: Nutrition Care for Prevention and Treatment of Obesity

- One positive-quality case-control study found that 24-hour total and resting energy expenditure were significantly lower in SCI than in control subjects, that this difference was independent of body composition and that the difference may have been related to a lower thermic effect of food and lower levels of spontaneous physical activity (Monroe et al, 1998)
- One positive-quality cross-sectional study found that patients with SCI in the early rehabilitation phase had measured caloric needs that were 45% to 90% of caloric needs as predicted by equations and the reduction in energy needs was proportional to the amount of denervated muscle (Cox et al, 1985)
- A neutral-quality case-series study recommended that ideal body weights for persons with SCI be below those recommended by the NY Metropolitan Life Insurance table: Individuals with paraplegia, 10 lbs to 15 lbs lower; with quadriplegia, 15 lbs to 20 lbs lower (Peiffer et al, 1981)
- A neutral-quality systematic review concluded that patients with SCI in the chronic phase should consume a low-calorie diet, since atrophied muscle cells are eventually partially replaced with connective tissue and filled with lipid and water (Claus-Walker et al, 1981)
- A neutral-quality narrative review found that the metabolic rates of patients with spinal cord injury tend to be below predicted levels, due to decreased metabolic activity of denervated muscle: The higher the lesion, the lower the energy expenditure (Chin and Keams, 1991)
- One neutral-quality descriptive study found that glucose intolerance and dyslipidemias were common among paraplegic and tetraplegic individuals (Tharion et al, 1998)
- One neutral-quality narrative review found that risk for obesity, CVD, type 2 diabetes and osteoporosis is higher in SCI persons than able-bodied persons (Kocina, 1997)
- One neutral-quality cross-sectional study found that fat-free mass composition changes following SCI include a bone mineral content decrease of 25% to 50%: Total body protein reduction of 30% and total body water relative to body weight decrease of 15%, with body fatness related to level of SCI (Olle et al, 1993).

- [Recommendation Strength Rationale](#)

- Eight studies in substantial agreement
- Two studies of strong design for answering the question
- Conclusion statement is a Grade II.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What are the indications for nutrition care to prevent or treat overweight and obesity in the community living phase of persons with Spinal Cord Injury?](#)

- [References](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Intervention for Prevention of Pressure Ulcers 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Intervention to Prevent Development of Pressure Ulcers

If a patient with spinal cord injury is at risk of pressure ulcer development as indicated by biochemical, anthropometric and lifestyle factors, the registered dietitian should implement aggressive nutrition support measures. The range of options may include medical food supplements and enteral and parenteral nutrition. Research suggests that improved nutrition intake, body weight and biochemical parameters may be associated with reduced risk of pressure ulcer development.

Rating: Strong
Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Provision of nutrition support, including enteral or parenteral nutrition, to nutritionally compromised patients with spinal cord-injuries may be associated with patient complications including, but not limited to:

- Aspiration
- Infections, including catheter-related infections
- Metabolic complications resulting from under- or overfeeding
- Gastrointestinal complications, including diarrhea.

- [Conditions of Application](#)

This recommendation applies to persons with spinal cord injury who is at risk of pressure ulcer development as indicated by biochemical, anthropometric and lifestyle factors.

- [Potential Costs Associated with Application](#)

- Organizational expenses incurred as a result of providing adequate nutrition care to reduce the risk of development of pressure ulcers may be cost-effective, as it is likely that costs associated with treating a pressure ulcer will be higher than preventive care
- Organizations will incur costs in providing nutritional supplementation for prevention of pressure ulcers, including vitamins, minerals, medical food supplements and enteral and parenteral nutrition when appropriate
- Organizations will incur costs in providing laboratory monitoring of biochemical indices.

- [Recommendation Narrative](#)

- One negative-quality time-series study of patients with spinal cord injury found that all [SCI](#) patients had significantly lower serum albumin than a control group, and that [SCI](#) patients with pressure ulcers had significantly lower prealbumin and zinc levels than the control group (Cruse et al, 1999)
- One positive-quality cross-sectional study of patients with spinal cord injury found that the more severe the [SCI](#) injury, the lower the vitamin A level, and that those patients with [SCI](#) without a pressure ulcer in the past 12 months had higher vitamin A levels (Moussavi et al, 2003)
- One positive-quality cross-sectional study of patients with spinal cord-injury found that lifestyle, exercise and diet were significant protective behaviors for prevention of recurrent ulcers (Krause et al, 2004)
- One neutral-quality cross-sectional study found that pressure ulcers were least likely to occur among spinal cord-injured individuals who maintained a normal weight, were employed and maintained a family role and did not have a history of tobacco use, suicidal behaviors, self-reported incarcerations or alcohol or drug abuse (Krause et al, 2001)
- One positive-quality systematic review provided clinical practice guidelines for spinal cord injury, including recommendations for assessment, dietary intake and correction of malnutrition (Consortium of Spinal Cord Medicine, 2001).

- [Recommendation Strength Rationale](#)

- Several studies of strong design for answering the question
- Substantial agreement among studies.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the role of nutritional status and nutrition care in the prevention of pressure ulcers in Spinal Cord Injury patients?](#)

- [References](#)

[Consortium for Spinal Cord Medicine Clinical Practice Guidelines. Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals. J Spinal Cord Med 2001;24 Suppl 1:S40 - S101.](#)

[Cruse JM, Lewis RE, Roe DL, Dilioglou S, Blaine MC, Wallace WF, Chen RS. Facilitation of immune function, healing of pressure ulcers, and nutritional status in spinal cord injury patients. Experimental and Molecular Pathology 1999;68:38-54.](#)

[Goodman CM, Cohen V, Armenta A, Thomby J, Netscher DT. Evaluation of results and treatment variables for pressure ulcers in 48 veteran spinal cord-injured patients. Ann Plast Surg 1999;42:665-672.](#)

[Krause JS, Broderick L. Patterns of recurrent pressure ulcers after spinal cord injury: identification of risk and protective factors 5 or more years after onset. Arch Phys Med Rehabil 2004;85:1257-1264.](#)

[Krause JS, Vines CL, Farley TL, Sniezek J, Coker J. An exploratory study of pressure ulcers after spinal cord injury: relationship to protective behaviors and risk factors. Arch Phys Med Rehabil 2001;82:107-113.](#)

[Moussavi RM, Garza HM, Eisele SG, Rodriguez G, Rintala DH. Serum levels of vitamins A, C, and E in persons with chronic spinal cord injury living in the community. Arch Phys Med Rehabil 2003;84:1061-1067.](#)

- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

Goodman CM, Cohen V, Armenta A, Thomby J, Netscher DT. Evaluation of results and treatment variables for pressure ulcers in 48 veteran patients with spinal cord injury. *Ann Plast Surg.* 1999; 42: 665-672.

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Recommendations Summary

SCI: Nutrition Prescription for SCI Persons with Pressure Ulcers 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Prescription for SCI Persons with Pressure Ulcers

A nutrition prescription should be formulated as part of the nutrition intervention for persons with spinal cord injury ([SCI](#)) and pressure ulcers, which includes the energy, protein, fluid and micronutrient requirements. Evidence suggests that additional energy and protein is needed for optimal healing of pressure ulcers. Fluid and micronutrient needs will vary depending on the person's status. See the [Assessment of Nutritional Needs for Pressure Ulcers](#) for determining levels of each of these.

Rating: Consensus

Imperative

- [Risks/Harms of Implementing This Recommendation](#)

- Over- or underfeeding of persons with spinal cord injury may lead to metabolic and clinical complications and subsequent poor outcomes
- Provision of nutrition support, including enteral or parenteral nutrition, to nutritionally compromised spinal cord-injured patients may be associated with patient complications

including, but not limited to:

- Aspiration
- Infections, including catheter-related infections
- Metabolic complications resulting from under- or overfeeding
- Gastrointestinal complications, including diarrhea
- Provision of excessive or inadequate fluid may lead to inappropriate hydration status and subsequent poor outcomes.

○ [Conditions of Application](#)

- This recommendation applies to persons with spinal cord injury with pressure ulcers
- Actual weight should be used in calculating energy and protein needs; however, the patient should be closely monitored for signs and symptoms of overfeeding or underfeeding, or of substrate overload.

○ [Potential Costs Associated with Application](#)

- Significant organizational costs are associated with the treatment of pressure ulcers in persons with spinal cord injury, including the provision of staff, equipment, supplies, blood work, facilities, nutritional supplements and nutrition support required for appropriate care
- Organizational expenses incurred as a result of treating pressure ulcers may be reduced by the provision of adequate nutrition care, as appropriate nutrition care may reduce healing time and thus reduce organizational costs.

○ [Recommendation Narrative](#)

- One clinical practice guideline provided evidence-based expert recommendations regarding nutrition care for pressure ulcers, including recommendations for assessment of energy, protein and micronutrient needs, and monitoring of nutrition and hydration status (Consortium for Spinal Cord Medicine, 2000)
- Three nutrition support textbooks provided general recommendations for nutrition care in wound healing, including recommendations for micronutrient intake (ASPEN Nutrition Support Manual 2005, ASPEN Nutrition Support Core Curriculum 2007, ADA Nutrition Care Manual, Baranski and Ayello 2008)
- See 'Citations Not Used in Evidence Analysis' for other works consulted.

○ [Recommendation Strength Rationale](#)

- Rating is based on expert consensus, clinical guidelines and textbooks
- Few to no high-quality studies of strong design are available at this time.

○ [Minority Opinions](#)

Consensus reached.

● [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

○ [References](#)

○ [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

- *Pressure ulcer prevention and treatment following spinal cord injury: A clinical practice guideline for health care professionals.* Consortium for Spinal Cord Medicine, Paralyzed Veterans of America, 2000.
- *ASPEN 2005 Nutrition Support Manual.* American Society for Parenteral and Enteral Nutrition, 2005.
- *ASPEN 2007 Nutrition Support Core Curriculum.* American Society for Parenteral and Enteral Nutrition, 2007.
- Nutrients and wound healing: Still searching for the magic bullet. *Nutrition in Clinical Practice.* 2005 June; 20: 331-347.
- *ADA Nutrition Care Manual.* Chicago, IL: ADA, 2008.
- 5 Million Lives Campaign. Available at: <http://www.ihj.org/IHJ/Programs/Campaign/>.
- Baranski S and Ayello EA. *Wound care essentials: Practice principles,* Philadelphia: Lippincott Williams and Wilkins, 2008.

● [Spinal Cord Injury](#)

● [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Coordination of Care in Spinal Cord Injury 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

● [Recommendation\(s\)](#)

SCI: Coordination of Care in Spinal Cord Injury

The Registered Dietitian (RD) should implement [MNT](#) and coordinate care with the interdisciplinary team providing care for persons with spinal cord injury in the [acute phase, rehabilitation setting and community setting](#). The interdisciplinary team is composed of health professionals including but not limited to: Physicians, nurses, occupational therapists, physical therapists, speech therapists, [RDs](#), exercise physiologists and mental health professionals. Evidence suggests that optimal care of each patient requires a multidisciplinary approach in all aspects of patient care, including nutrition.

Rating: Weak

Imperative

○ [Risks/Harms of Implementing This Recommendation](#)

No harm or risks are associated with this recommendation.

○ [Conditions of Application](#)

This recommendation applies to all persons with spinal cord injury.

○ [Potential Costs Associated with Application](#)

Organizational costs are associated with staffing, training and equipping an interdisciplinary team to care for persons with spinal cord injury.

○ [Recommendation Narrative](#)

- Croes-Barone et al, 1998, in a narrative review (quality rating negative), discussed how medical nutrition therapy is valued as an important element of rehabilitation. Croes-Barone et al, concluded that the role of the dietitian on the interdisciplinary team is to work with other health care professionals (physicians, nurses, occupational therapists, speech therapists and physical therapists) to support the various therapy disciplines through development and implementation of a therapeutic nutrition plan.
- Galea et al, 2006, in a cohort study (quality rating negative), concluded that tele-rehabilitation interventions conducted by a multidisciplinary team including a [RD](#) result in

reduced hospitalizations and length of stay in spinal cord-injured patients. This study was limited by intervention and results not clearly described.

- Mitcho et al, 1998, in a narrative review (quality rating negative), developed a multidisciplinary acute care pathway that includes nutrition care, and concluded that a baseline nutrition assessment conducted by a registered dietitian is essential within the first 48 hours of spinal cord injury
- Murphy et al, 1999, in a narrative review (quality rating negative), concluded that a multidisciplinary team should enact a plan to promote rehabilitation and prevent complications in patients with spinal cord injury (SCI), and that the multidisciplinary team should include a RD
- Vitaz et al, 2001, in a nonrandomized trial with historic controls (quality rating positive), studied the effectiveness of a multidisciplinary clinical pathway to provide a high standard of care and to control costs for the treatment of patients with severe SCI, and included early intervention by dietitians as part of the pathway
- Chen et al, 2006, in a positive-quality nonrandomized group trial, concluded that a carefully planned coordinated weight management program including intervention by RDs and psychologists is effective to promote weight loss in overweight and obese individuals with spinal cord injury.

- [Recommendation Strength Rationale](#)

- Although the studies are in substantial agreement, they are of weak design for answering the question
- Conclusion statements are Grade III.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the benefit of nutrition care provided by a Registered Dietitian for Spinal Cord Injury patients in the acute care, rehabilitation, and community settings?](#)

[How does physical activity affect energy needs in spinal cord-injured individuals?](#)

- [References](#)

[Croes-Barone SJ, Rolnick RH, Durante D, Zaunbrecher MM, Hackell V, Farias Y. Medical nutrition therapy is recognized as an important element in complete rehabilitation. *Rehab Manag.* 1998;56: 59-60. 63.](#)

[Galea M, Tumminia J, Garback LM. Telerehabilitation in spinal cord injury persons: a novel approach. *Telemedicine and e-Health.* 2006;12:160-162.](#)

[Mitcho K, Yanko JR. Acute care management of spinal cord injuries. *Critical Care Nursing Quarterly.* 1999; 22\(2\): 60-79.](#)

[Murphy M. Traumatic spinal cord injury: an acute care rehabilitation perspective. *Crit Care Nurs Q.* 1999 Aug;22\(2\):51-9. Review.](#)

[Vitaz TW, McIlvoy L, Raque GH, Spain DA, Shields CB. Development and implementation of a clinical pathway for spinal cord injuries. *J Spinal Disord.* 2001 Jun;14\(3\):271-6.](#)

[Chen Y, Henson S, Jackson AB, Richards JS. Obesity intervention in persons with spinal cord injury. *Spinal Cord.* 2006;44:82-91.](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Monitoring and Evaluation in Acute Care Setting 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Monitoring and Evaluation in Acute Care Setting

If a patient is in the acute phase of spinal cord injury, a Registered Dietitian should provide ongoing monitoring of the patient's nutrition status. Evidence suggests that conditions such as hypoproteinemia, hypoalbuminemia, anemia, poor bowel function and dysphagia are better managed when patients receive adequate nutrition care from a Registered Dietitian.

Rating: Fair

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Provision of nutrition support, including enteral or parenteral nutrition, to nutritionally compromised with spinal cord injuries patients may be associated with patient complications including, but not limited to:

- Aspiration
- Infections, including catheter-related infections
- Metabolic complications resulting from under- or overfeeding
- Gastrointestinal complications, including diarrhea.

- [Conditions of Application](#)

Decreased albumin and transthyretin (prealbumin) are often interpreted as indicators of malnutrition. However, albumin and prealbumin are also inversely influenced by inflammatory and stress response. These visceral proteins should be interpreted keeping in mind the patient's total clinical status. Use of C-Reactive Protein, a protein that increases with stress, is useful in interpreting whether albumin and prealbumin are being affected or decreased by inflammation and stress. The role of albumin as a nutrition indicator in persons with spinal cord injuries will be addressed systematically in scheduled updates to this Guideline. This recommendation applies to persons with spinal cord injury in the acute phase of injury.

- [Potential Costs Associated with Application](#)

Organizational costs, including staffing, facility, equipment, and supply costs, are associated with the provision of adequate nutrition care by a Registered Dietitian to persons with spinal cord injury in the acute phase of injury.

- [Recommendation Narrative](#)

SCI: Monitoring and Evaluation in Acute Care Settings

- One cohort study (quality rating neutral) concluded that dysphagia is a serious problem for patients with spinal cord injuries who require prolonged ventilatory support, that 24.6% of patients with SCI require dietary restrictions and that a significant number of dysphagic patients with SCI will require permanent tube feedings (Abel et al, 2004).
- One narrative review (quality rating negative) of the needs of the patients with spinal cord injuries in the acute care setting recommended that dietary goals should be evaluated on a continuous basis, and should include monitoring of laboratory values, weight, intake and output, and vitamin and mineral deficiencies, and concluded that

a baseline nutrition assessment conducted by a Registered Dietitian is essential within the first 48 hours of spinal cord injury (Mitcho et al, 1998).

- One nonrandomized trial with historic controls (quality rating positive) found that a multidisciplinary clinical pathway resulted in a significant decrease in complication rates, as measured by number of episodes of pneumonia per patient. Total hospital length of stay, intensive care unit length of stay and days on ventilator were significantly decreased for the clinical pathway group and decubitus ulcers were decreased but not significantly. Early intervention by dietitians was included as part of the clinical pathway (Vitaz et al, 2001).

- [Recommendation Strength Rationale](#)

- Lack of generalizability across study designs
- Conclusion statement is Grade III
- Small number of studies.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What is the benefit of nutrition care provided by a Registered Dietitian for Spinal Cord Injury patients in the acute care, rehabilitation, and community settings?](#)

- [References](#)

[Abel R, Ruf S, Spahn B. Cervical spinal cord injury and deglutition disorders. *Dysphagia*. 2004; 19 \(2\): 87-94.](#)

[Badiali D, Bracci F, Castellano V, Corazziari E, Fuoco U, Habib FI, Scivoletto G. Sequential treatment of chronic constipation in paraplegic subjects. *Spinal Cord*. 1997 Feb;35 \(2\): 116-20.](#)

[Barber D, Foster D, and Rogers S. The importance of nutrition in the care of persons with spinal cord injury. *The Journal of Spinal Cord Medicine*. 26:2; Summer 2003. Commentary.](#)

[Block P, Skeels SE, Keys CB, Rimmer JH. Shake-It-Up: Health promotion and capacity building for people with spinal cord injuries and related neurological disabilities. *Disabil Rehabil*. 2005 Feb 18; 27\(4\): 185-190.](#)

[Chen Y, Henson S, Jackson AB, Richards JS. Obesity intervention in persons with spinal cord injury. *Spinal Cord*. 2006;44:82-91.](#)

[Croes-Barone SJ, Rolnick RH, Durante D, Zaunbrecher MM, Hackell V, Farias Y. Medical nutrition therapy is recognized as an important element in complete rehabilitation. *Rehab Manag*. 1998;56: 59-60, 63.](#)

[Galea M, Tumminia J, Garback LM. Telerehabilitation in spinal cord injury persons: a novel approach. *Telemedicine and e-Health*. 2006;12:160-162.](#)

[Mitcho K, Yanko JR. Acute care management of spinal cord injuries. *Critical Care Nursing Quarterly*. 1999; 22\(2\), 60-79.](#)

[Moussavi RM, Ribas-Cardus F, Rintala DH, Rodriguez GP. Dietary and serum lipids in individuals with spinal cord injury living in the community. *J Rehabil Res Dev*. 2001;38\(2\):225-233.](#)

[Murphy M. Traumatic spinal cord injury: an acute care rehabilitation perspective. *Crit Care Nurs Q*. 1999 Aug;22\(2\):51-9. Review.](#)

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[Tomey KM, Chen DM, Wang X, Braunschweig CL. Dietary intake and nutritional status of urban community-dwelling men with paraplegia. *Arch Phys Med Rehabil*; 2005 Apr; 86\(4\): 664-71.](#)

[Vitaz TW, McIlvoy L, Raque GH, Spain DA, Shields CB. Development and implementation of a clinical pathway for spinal cord injuries. *J Spinal Disord*. 2001 Jun;14\(3\):271-6.](#)

[Zemper ED, Tate DG, Roller S, Forchmeimer M, Chiodo A, Nelson VS, Scelza W. Assessment of a holistic wellness program for persons with spinal cord injury. *Am J Phys Med Rehabil*. 2003 Dec; 82\(12\): 957-68.](#)

- [References not graded in Academy of Nutrition and Dietetics Evidence Analysis Process](#)

Commission on Accreditation of Rehabilitation Facilities. *Medical Rehabilitation Standards Manual*, Section 3.1, Spinal Cord System of Care. 2008.

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Monitoring and Evaluation of Protein Intake in Acute Care Setting: Overfeeding 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Monitoring and Evaluation of Protein Intake in Acute Care Setting: Overfeeding

If a patient with spinal cord injury is in the acute phase (zero to four weeks post-injury), the registered dietitian should monitor the patient's protein intake to ensure that the patient does not consume more than 2.0g per kg of body weight per day. Efforts to achieve positive nitrogen balance with excessive nutrition support are generally unsuccessful and may result in substrate overload and metabolic complications with subsequent poor outcomes.

Rating: Weak

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Protein intake of patients with renal and hepatic dysfunction should be individualized based on the patient's overall condition. The limit defined in the recommendation may exceed tolerance in these patients.

- [Conditions of Application](#)

Decreased albumin and transthyretin (prealbumin) are often interpreted as indicators of malnutrition. However, albumin and prealbumin are also inversely influenced by inflammatory and stress response. These visceral proteins should be interpreted keeping in mind the patient's total clinical status. Use of C-Reactive Protein, a protein that increases with stress, is useful in interpreting whether albumin and prealbumin are being affected or decreased by inflammation and stress. The role of albumin as a nutrition indicator in spinal cord-injured persons will be addressed systematically in scheduled updates to this guideline. This recommendation applies to persons with spinal cord injury in the acute phase of injury.

- [Potential Costs Associated with Application](#)

- Staffing and organizational costs are associated with monitoring of protein status
- Organizational costs are associated with provision of protein by oral, enteral or parenteral feeding routes.

- [Recommendation Narrative](#)

- One positive-quality case-control study found that patients with spinal cord injuries did not achieve positive nitrogen balance within seven weeks following injury when 2.4g protein per kg of body weight per day was provided (Rodríguez et al, 1991)
- One neutral-quality longitudinal study found that nutrition support of 2.0g protein per kg of IBW and basal energy expenditure multiplied by an activity factor of 1.2 and an injury factor of 1.6 resulted in overfeeding and did not alter the persisting negative nitrogen balance in patients with spinal cord injury (Rodríguez et al, 1997)
- One positive-quality case series study found that nutrient parameters, including serum albumin, were positively correlated with improvements in energy and protein intake during the first eight weeks post-injury (Laven et al, 1989)
- One neutral-quality narrative review stated that hypoalbuminemia is associated with spinal cord injury, usually appearing within days of the injury and that a rising serum albumin level within three weeks of injury generally indicates adequate nutritional intake (Chin and Kearns, 1991).

- [Recommendation Strength Rationale](#)

- Conclusion statement is Grade III
- Small number of studies
- Lack of generalizability across study designs
- Most studies of weak design for answering question.

- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What are the protein needs for patients during the acute and rehabilitation phases following spinal cord injury?](#)

- [References](#)

[Blissitt PA. Nutrition in Acute Spinal Cord Injury. *Critical Care Nursing Clinics of North America*. 1990;2\(3\):375-384.](#)

[Chin DE, Kearns P. Nutrition in the Spinal-Injured Patient. *NCP*. 1991; 6\(6\):213-222.](#)

[Kearns PJ, Thompson JD, Werner PC, Pipp TL, Wilmot CB. Nutritional and Metabolic Response to Acute Spinal Cord Injury. *J Parenter Enteral Nutr*. 1992; 16\(1\): 11-15.](#)

[Laven GT, Huang CT, DeVivo MJ, Stover SL, Kuhlemeier KV, Fine PR. Nutrition Status During the Acute Stage of Spinal Cord Injury. *Arch Phys Med Rehabil* 1989; 70: 277-282.](#)

[Rodríguez DJ, Benzel EC, Clevenger FW. The Metabolic Response to Spinal Cord Injury. *Spinal Cord*. 1997; 35: 599-604.](#)

[Rodríguez DJ, Clevenger FW, Osler TM, Demarest GB, Fry DE. Obligatory Negative Nitrogen Balance Following Spinal Cord Injury. *J Parenter Enteral Nutr* 1991; 15\(3\): 319-322.](#)

- [Spinal Cord Injury](#)

- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Monitoring and Evaluation of Energy Needs During the Rehabilitation Phase 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Monitoring and Evaluation of Energy Needs During the Rehabilitation Phase

The registered dietitian should monitor weight, functional capacity and physical activity and adjust energy needs as necessary. As patients with spinal cord injury progress through the rehabilitation phase and move into the community setting, changes in these factors may affect energy needs.

Rating: Weak

Conditional

- [Risks/Harms of Implementing This Recommendation](#)

- Use of predictive equations rather than measured energy expenditure may result in under- or overfeeding persons with SCI and may lead to metabolic complications with subsequent poor outcomes such as obesity, pressure ulcer development, decreased ability to perform ADLs and transfers, heart disease and diabetes
- The weight of stabilization devices such as braces and halos should be considered when determining the body weight of persons with spinal cord injury to avoid overfeeding.

- [Conditions of Application](#)

This recommendation applies to persons with spinal cord injury in the rehabilitation setting.

- [Potential Costs Associated with Application](#)

Organizational costs are associated with the staff, staff training and time required for monitoring and adjusting the energy needs of persons with spinal cord injury.

- [Recommendation Narrative](#)

- Two case-control studies (one positive-quality and one neutral-quality) found that resting energy expenditure is significantly lower in SCI patients than in able-bodied subjects (Monroe et al, 1998; Buchholz et al, 2003)
- One positive-quality cross-sectional study found that caloric requirements generally represented 45% to 90% of caloric needs as predicted by equations. The reduction in energy needs was proportional to the amount of denervated muscle. Using current body weight, stable patients were found to require 23.4kcal per kg per day;

quadriplegics required 22.7kcal per kg per day; paraplegics required 27.9kcal per kg per day (Cox et al, 1985).

- [Recommendation Strength Rationale](#)
 - Lack of generalizability across study designs
 - Further research is needed to define calorie and protein needs of [SCI](#) patients
 - Conclusion statement is Grade III.
- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What are the caloric needs for patients during the acute and rehabilitation phases following spinal cord injury?](#)

- [References](#)

- [Barco KT, Smith RA, Peerless JR, Plaisier BR, Chima CS. Energy expenditure assessment and validation after acute spinal cord injury. *Nutr Clin Prac.* 2002; 17: 309-313.](#)
- [Buchholz AC, McGillivray CF, Pencharz PB. Differences in resting metabolic rate between paraplegic and able-bodied subjects are explained by differences in body composition. *Am J Clin Nutr* 2003;77:371-378.](#)
- [Buchholz AC, McGillivray CF, Pencharz PB. Physical activity levels are low in free-living adults with chronic paraplegia. *Obes Res* 2003;11\(4\):563-570.](#)
- [Chin DE, Kearns P. Nutrition in the Spinal-Injured Patient. *NCP.* 1991; 6\(6\):213-222.](#)
- [Cox SAR, Weiss SM, Posuniak EA, Worthington P, Prisleau M, Heffley G. Energy Expenditure after Spinal Cord Injury: Evaluation of Stable Rehabilitating Patients. *J Trauma* 1985; 25: 419-423.](#)
- [Houda B. Evaluation of Nutritional Status in Persons with Spinal Cord Injury: A Prerequisite for Successful Rehabilitation. *SCI Nursing* 1993;10\(7\):4-7.](#)
- [Kearns PJ, Thompson JD, Werner PC, Pipp TL, Wilmot CB. Nutritional and Metabolic Response to Acute Spinal Cord Injury. *J Parenter Enteral Nutr.* 1992; 16\(1\): 11-15.](#)
- [Laven GT, Huang CT, DeVivo MJ, Stover SL, Kuhlemeier KV, Fine PR. Nutrition Status During the Acute Stage of Spinal Cord Injury. *Arch Phys Med Rehabil* 1989; 70: 277-282.](#)
- [Monroe MB, Tataranni PA, Pratley R, Manore MM, Skinner JS, Ravussin E. Lower Daily Energy Expenditure as Measured by a Respiratory Chamber in Subjects with Spinal Cord Injury Compared with Control Subjects. *Am J Clin Nutr.* 1998; 68: 1223-1227.](#)
- [Rodriguez DJ, Benzel EC, Clevenger FW. The Metabolic Response to Spinal Cord Injury. *Spinal Cord.* 1997; 35: 599-604.](#)

- [Spinal Cord Injury](#)
- [Spinal Cord Injury \(SCI\) Guideline \(2009\)](#)

Quick Links

Recommendations Summary

SCI: Nutrition Monitoring and Evaluation of Fiber and Neurogenic Bowel 2009

[Click here](#) to see the explanation of recommendation ratings (Strong, Fair, Weak, Consensus, Insufficient Evidence) and labels (Imperative or Conditional). To see more detail on the evidence from which the following recommendations were drawn, use the hyperlinks in the [Supporting Evidence Section](#) below.

- [Recommendation\(s\)](#)

SCI: Nutrition Monitoring and Evaluation for Fiber and Neurogenic Bowel

The Registered Dietitian ([RD](#)) should monitor at regular intervals the fiber intake of persons with spinal cord injury and neurogenic bowel, and the amount of dietary fiber provided should be adjusted as necessary. Provision of excessive fiber may result in unacceptable flatulence, significant increase in stool volume and painful abdominal distension, while provision of inadequate fiber may result in constipation or bowel impaction.

Rating: Weak
Conditional

- [Risks/Harms of Implementing This Recommendation](#)

Failure to monitor fiber intake closely may lead to provision of inadequate or excessive fiber with subsequent poor clinical outcomes such as constipation, bowel impaction, increased amount of stool, excessive flatulence or abdominal distention.

- [Conditions of Application](#)

All spinal cord-injured patients with neurogenic bowel should be closely monitored for fiber intake and tolerance, and fiber should be increased or decreased as needed.

- [Potential Costs Associated with Application](#)

Costs associated with the application may include:

- Cost of high fiber foods and fiber supplements
- Cost of staff to monitor fiber intake
- A reduction in the cost of medications needed for bowel management may be realized by application of this recommendation.

- [Recommendation Narrative](#)

- One positive-quality systematic review found that a diet containing no less than 15g fiber a day is needed initially, with increases provided gradually from a variety of sources. Symptoms of intolerance should be monitored, with a reduction in fiber intake if these symptoms occur. 20g to 30g of fiber a day may result in increased intestinal transit time in the spinal cord-injured population (Consortium of Spinal Cord Medicine, 1998)
- One cross-sectional study found that the incidence of chronic gastrointestinal problems in spinal cord-injured patients was 62.5%. In 80% of patients with chronic gastrointestinal problems, this caused dietary restrictions (Han et al, 1998).

- [Recommendation Strength Rationale](#)
 - Conclusion statement is grade III
 - Small number of studies.
- [Minority Opinions](#)

Consensus reached.

- [Supporting Evidence](#)

The recommendations were created from the evidence analysis on the following questions. To see detail of the evidence analysis, click the blue hyperlinks below (recommendations rated consensus will not have supporting evidence linked).

[What level of fiber is recommended to manage neurogenic bowel in Spinal Cord Injury patients and how should it be introduced?](#)

- [References](#)

[Badiali D, Bracci F, Castellano V, Corraziari E, Fuoco U, Habib FI, Scivoletto G. Sequential treatment of chronic constipation in paraplegic subjects. *Spinal Cord* 1997; 35: 116-120.](#)

[Consortium for Spinal Cord Medicine. *Neurogenic Bowel Management in Adults with Spinal Cord Injury: Clinical Practice Guidelines for Health-Care Professionals*. Washington, DC: Paralyzed Veterans of America, 1998.](#)

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