Oncology Evidence-Based Nutrition Practice Guideline for Adults

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Editor's note: Figure 4 and Tables 1, 2, 3, and 4 that accompany this article are available online at www.andjrnl.org.

CANCER IS A TERM USED TO describe a group of more than 100 multifactorial diseases in which abnormal cells reproduce in an uncontrolled manner and are able to spread to other parts of the body and invade healthy tissues.[1] Numbers of cancer-related deaths have fallen steadily since the 1990s, and the number of cancer survivors has increased.[2] The National Cancer Institute has estimated that 1,685,210 new cases will be diagnosed and 595,690 deaths will occur in 2016.[2] Cancers develop from complex interactions between genes and the environment.[3] Although many of the specific pathways by which nutritional status can impact cancer remain poorly understood,[4] it is well recognized that nutrition plays important roles in cancer prevention and treatment.[4-8]

In 2007, the Academy of Nutrition and Dietetics (Academy) published guideline recommendations on the Evidence Analysis Library (EAL) related to nutrition interventions for specific types of cancer and cancer treatments. In 2010, a new evidence analysis workgroup was formed to supplement the original guideline, which was subsequently published on the EAL during November 2013. The current guideline focuses on comprehensive oncology nutrition practice for the care of adult patients with cancer. Although the recommendations are written for registered dietitian nutritionists (RDNs), others may find them helpful.

The guideline developed by the workgroup will be reviewed, beginning with the recommendations that are based on the related EAL systematic review, followed by a brief review of recommendations based on organization guidelines outside of the Academy.[9-11] The latter were included to further expand the scope of the evidence-based recommendations. Finally, a brief review of the consensus-based recommendations will be provided to further guide the RDN, where there is less nutrition research or the research is difficult to elucidate.

DEVELOPMENT OF CONCLUSION STATEMENTS AND RECOMMENDATIONS

The Academy's 5-step systematic review process[12] was followed throughout the project. The Oncology Workgroup chose to principally target four areas of oncology nutrition in adults where there was an adequate pool of evidence related to nutritional status and nutrition interventions:

- validity of malnutrition screening and nutrition assessment tools;
- the association among nutritional status and morbidity and mortality outcomes;
- the effect of medical nutrition therapy (MNT)[13] on patients undergoing chemotherapy (CT) and radiation treatment (RT); and
- cancer cachexia and the effect of dietary supplements and medical food supplements (MFS) containing fish oil (specifically eicosapentaenoic acid [EPA]), on body weight and lean body mass (LBM).

A comprehensive literature search was conducted using PubMed and Cumulative Index to Nursing and Allied Health Literature databases, with search inclusion dates 1993 to 2011. For the final questions on fish oil, search inclusion dates were 1990 to 2013 to adequately evaluate the body of literature on this topic. Additional articles were identified by hand searching reference lists from pertinent review articles. Figure 1 shows the criteria applied to the inclusion and exclusion of studies for each question. Figure 2 illustrates the search strategy and study selection process.[14] A total of 102 primary research articles were included in the final analysis.

Following the research analysis, conclusion statements were written and the strength of the evidence was graded by the workgroup based on quality, consistency, sample size, clinical impact, and generalizability of the studies. Full conclusion statements are found on the EAL (www.andeal.org). Conclusion statements were graded as I (Good/strong), II (Fair), III (Limited/weak), IV (Expert

*NC=Nutriólogo Certificado (the credential for licensed nutritionists in Mexico).

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Criteria	Inclusion	Exclusion
Age	≥18 y	<18 y
Setting	Ambulatory care, acute care	Intensive situations such as intensive care unit and critical care
Health status	Cancer patients undergoing treatment or not undergoing treatment	Cancer prevention; cancer survivorship
Study design preferences	Randomized controlled trials; controlled clinical studies; cohort studies; case-control studies; systematic reviews; meta-analyses	Review articles; hand search pertinent review articles
Size of study groups	≥10 subjects in each study group	<10 subjects in each group
Subject dropout rate	<20% <35% (advanced stage cancer patients)	>20% >35% (advanced stage cancer patients)
Year range	1990 through March 2013[a] 1993 through October 2011[b] 1993 through May 2011	Before 1990[a] Before 1993
Language	English	Not in English
Subjects	Human	Animal
Other	Article must be published in a peer-reviewed journal	Not peer-reviewed journal Studies by same author similar in content Abstracts or presentations
Subtopic-specific criteria applied in addition to the above criteria		
Anthropometric data[a]	Focus of study is on weight, lean body mass, or both; change from baseline must be reported	Focus of study is not on weight, lean body mass, or both; change from baseline not reported
Fish oil components[a]	At least 1 arm includes medical food supplement or dietary supplement containing EPA[c] and DHA[d] (with no confounding factors)	No medical food supplement or dietary supplement containing EPA and DHA; confounding factors
Medical nutrition therapy[ef]	Dietary intervention provided by registered dietitian nutritionist (credentialed in the United States; has a reciprocity agreement with the Commission on Dietetic Registration or reasonably equivalent); >1 medical nutrition therapy visit; individualized approach	Dietary intervention not provided by a registered dietitian nutritionist (or equivalent); only 1 medical nutrition therapy visit; approach not individualized
Anticancer Treatment[e]	Undergoing chemotherapy or radiation therapy during nutrition intervention	Not undergoing chemotherapy or radiation therapy during nutrition intervention
Validated tools[g]	Must include reference standard used for malnutrition screening or nutrition assessment tool validation	No reference standard used for tool validation

[a]Criteria applicable only to the following subtopic: fish oil.

[b]Criteria applicable only to the following subtopics: nutritional status and outcomes, malnutrition screening tools.

[c]EPA=eicosapentaenoic acid.

[d]DHA=docosahexaenoic acid.

[e]Criteria applicable only to the following subtopics: medical nutrition therapy and chemotherapy; medical nutrition therapy and radiation treatment.

[f]Medical nutrition therapy is provided by a registered dietitian nutritionist.

[g]Criteria applicable only to the following subtopics: malnutrition screening tools; nutrition assessment tools.

Figure 1. Search strategy and inclusion and exclusion criteria for articles for the Oncology Guideline 2013.

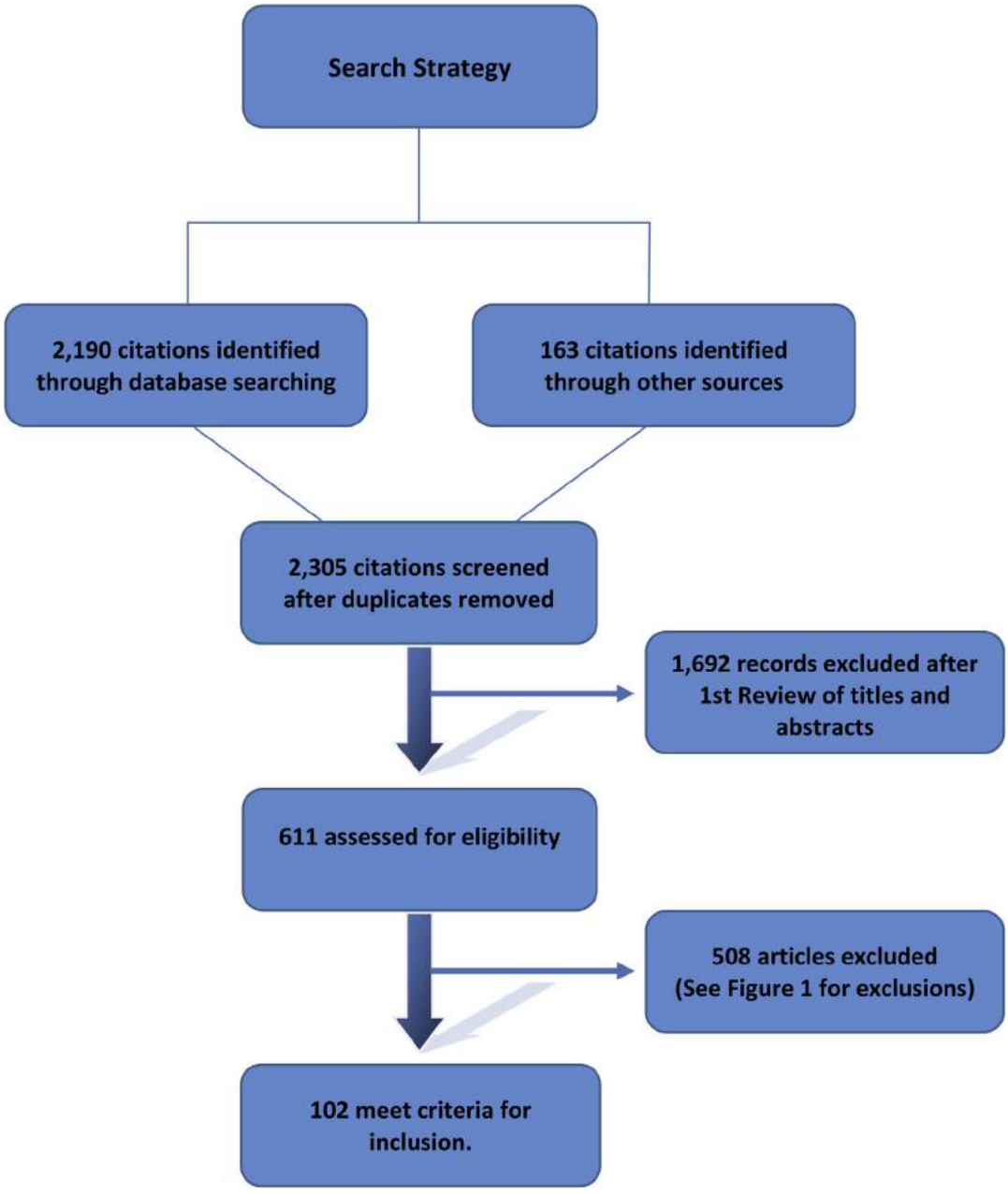

Figure 2. Flow diagram of the search strategy and selection process used in the Evidence Analysis Library systematic review for the Oncology Guideline 2013. Flow diagram template adapted from Moher and colleagues.[14]

opinion only), or V (Not assignable). A complete description of the grading definitions is described on the EAL and elsewhere.[12]

The 16 conclusion statements for the four EAL oncology subtopic areas were integrated into the formulation of seven recommendations. In addition to the seven evidence-based recommendations, the workgroup incorporated five nutrition-related recommendations based on external organization guidelines and 11 consensus recommendations to broaden the comprehensiveness of the guideline. In all, 23 nutrition practice recommendations were created.

The workgroup used expert consensus to write conditional (clearly defines a specific situation) or imperative (broadly applicable to a target population, with restraints on their pertinence) recommendation statements. The recommendations were rated as strong, fair, weak, consensus, or insufficient, based on standardized rating rubrics developed by the Academy. A complete description of the criteria for recommendation rating is available on the EAL. For the inclusion of specific oncology nutrition recommendations from sources outside of the Academy, the Evidence-Based

External Guideline[a] Recommendation rating scale	EAL rating[b] equivalent
American Society of Parenteral and Enteral Nutrition Clinical Guidelines: Nutrition Support Therapy During Adult Anticancer Treatment and in Hematopoietic Cell Transplantation, 2009[9]	
A: Supported by at least 2 level I investigations	Strong
B: Supported by 1 level I investigation	Fair
C: Supported by level II investigations only	Fair
D: Supported by at least 2 level III investigations	Weak
E: Supported by level IV or level V evidence	Consensus
Clinical Oncological Society of Australia: Evidence-Based Practice Guidelines for the Nutritional Management of Adult Patients with Head and Neck Cancer, 2011[10]	
A: Body of evidence can be trusted to guide practice	Strong
B: Body of evidence can be trusted to guide practice in most situations	Fair
C: Body of evidence provides some support for recommendation(s) but care should be taken in its application	Fair
D: Body of evidence is weak and recommendation(s) must be applied with caution	Weak
Oncology Nursing Society: Putting Evidence into Practice, 2009[11]	
Recommended for practice Effectiveness is demonstrated by strong evidence from rigorously designed studies, meta-analyses, or systematic reviews. Expected benefit exceeds expected harms.	Strong
Likely to be effective Evidence is less well established than for those listed under recommended for practice	Fair, or Consensus (if based on consensus documents)
Benefits balanced with harms Clinicians and patients should weigh the beneficial and harmful effects according to individual circumstances and priorities	Weak
Effectiveness not established Data currently are insufficient or are of inadequate quality	Weak
Effectiveness unlikely Lack of effectiveness is less well established than those listed under not recommended for practice	Weak
Not recommended for practice Ineffectiveness or harm clearly is demonstrated, or cost or burden exceeds potential benefit	Strong, Fair, or Weak

[a]Guidelines published outside of the Academy of Nutrition and Dietetics.

[b]EAL Guideline Recommendation Rating System (www.andeal.org/recommendation-ratings).

Figure 3. Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) external guideline rating equivalencies.

Practice Committee approved the use of guidelines from three external organizations[9-11] that had similar methodology. Because the grading systems were not correlated clearly to the Academy's EAL rating scale, the Evidence-Based Practice Committee approved a rating equivalency (Figure 3), which allowed the Academy's ratings to be applied consistently.

The guideline underwent both an internal and external review, the latter of which consisted of an interdisciplinary group of health professionals. The guideline was adjusted by consensus of the expert work group and approved by the Academy's Evidence-Based Practice Committee before publication on the EAL. The final recommendations and the conclusion statements (or external guidelines) supporting them are listed in order of the Nutrition Care Process in Figure 4 (available online at www.andjrnl.org) and are on the EAL website (www.andeal.org).[15] For each of the recommendations below, the rationale summarizes the evidence, followed by the rationale based on external guidelines, and finally the rationale for recommendations based on consensus publications.

GUIDELINE APPLICATION

This guideline was developed for RDNs caring for adult oncology patients in

ambulatory and acute care settings; therefore, clinical judgment is crucial in the application of these guidelines to adult oncology patients in other settings or to children and adolescents with cancer. Careful consideration should be given to the application of these guidelines for patients receiving hospice, palliative care, or those with significant medical comorbidities. Advance directives may also indicate whether treatment is desired or not.

EAL RECOMMENDATIONS

Validated Tools for Malnutrition Screening and Nutrition Assessment

Recommendation

- Adult oncology patients should be screened using a malnutrition screening tool validated in the setting in which the tool is intended for use. The following tools have been shown to be valid and reliable in identifying malnutrition risk in adult oncology patients:
  - Inpatient settings: Malnutrition Screening Tool (MST), Malnutrition Screening Tool for Cancer Patients, and Malnutrition Universal Screening Tool.
  - Ambulatory/outpatient settings: MST.

Rating: Strong; Imperative

Recommendation

- RDNs should use an assessment tool validated in the setting in which the tool is intended for use as part of the complete nutrition assessment. The Patient Generated–Subjective Global Assessment (PG-SGA) and Subjective Global Assessment tools have been shown to elicit valid and reliable data as part of a comprehensive nutrition assessment of adult oncology patients in ambulatory and acute care settings.

Rating: Strong; Imperative

Rationale: Malnutrition screening and rescreening identifies patients who would benefit from nutrition assessment and intervention by an RDN. The importance of using a tool validated in the population and setting in which it is intended has been described elsewhere.[16] Seven studies,[17-23] shown in Table 1 (available online at www.andjrnl.org), evaluated the validity and reliability of one malnutrition screening tool (ie, MST) in the ambulatory setting and five tools in the acute care setting (ie, the 2-item nutrition screen from the Zung Self-Rating Depression Scale, Malnutrition Advisory Group Malnutrition Screening tool, MST, Malnutrition Screening Tool for Cancer Patients, and Malnutrition Universal Screening Tool). In the ambulatory setting, the MST[19,21] was found to be valid and reliable for identifying malnutrition risk in adult oncology patients. In acute care settings, three tools were found to be valid and reliable for identifying malnutrition risk in adult oncology patients: the MST,[17,20] the Malnutrition Screening Tool for Cancer Patients,[20] and Malnutrition Universal Screening Tool,[17] whereas the Malnutrition Advisory Group Malnutrition Screening tool[18] and the 2-item nutrition screen from the Zung Self-Rating Depression Scale[23] were not found to be valid and reliable in this setting. The PG-SGA tool is often used as both a screening tool (to determine risk for malnutrition) and an assessment tool (to determine presence of malnutrition) in adult oncology patients. At the time this review was completed, there were no validation studies for the PG-SGA short form, which consists of four history-related questions completed by the patient. Thus, the tool was included in the nutrition assessment evidence below, rather than as a separate malnutrition screening tool.

Seven studies,[24-30] shown in Table 1 (available online at www.andjrnl.org), evaluated the validity and reliability of nutrition assessment tools. The PG-SGA[24-29] and the Subjective Global Assessment[28] were found to be valid and reliable in identifying malnutrition as part of a comprehensive nutrition assessment in adult oncology patients in both ambulatory and acute care settings. The Malnutrition Assessment[30] was evaluated in patients in ambulatory care settings, and was found to have the sensitivity to diagnose oncology patients with malnutrition in the ambulatory setting, but was only moderately specific in identifying malnutrition when compared with the PG-SGA. The Malnutrition Assessment was not evaluated in an acute care setting.

Of the 14 studies included in the malnutrition screening and nutrition assessment tool questions, six studies[18-20,24,25,27] used the Subjective Global Assessment as the reference standard, whereas four[21-23,30] used the PG-SGA as the reference standard. Other reference standards included anthropometric[26] and biochemical measures,[28] food and nutrition practitioner assessment,[20,29] and the Nutritional Risk Screening 2002 (NRS-2002).[17]

Evaluation of Nutritional Status as Key Component in Patient Care Process

Recommendation

- RDNs should collaborate with other health care professionals, administrators, and public policy decision makers to ensure that the evaluation of nutritional status is a key component of the adult oncology patient care process.

Rating: Strong; Imperative

Rationale: The workgroup selected six outcomes where the impact of nutritional status could be measured. These outcomes included mortality because it relates to the cancer diagnosis, and five morbidity outcomes (hospital admissions and readmissions, hospital length of stay [LOS], quality of life [QoL], and RT and CT treatment tolerance). The studies included in this topic may have included other outcomes that were not reviewed in this analysis.

Forty-five studies,[17,25,29,31-72] shown in Table 2 (available online at www.andjrnl.org), examined the associations among nutritional status and the six outcomes. Several studies reported on more than one outcome. Nutritional status was measured in a number of ways, including body composition (eg, LBM,[62,67] loss of subcutaneous fat,[38] and sarcopenia[60,61]), weight status (eg, body mass index[44,71]), weight loss,[38,41,44,47,52,56,67] functional status (eg, handgrip strength[41,49]), biochemical indicators (eg, albumin[40,44,46,49,50]), and food and nutrition intake.[37] In addition, a number of studies measured nutritional status using

nutrition assessment tools that use multiple indicators to score nutritional status (eg, Subjective Global Assessment[34,37] and PG-SGA[25,29,32,38,45,46,53,54]).

The studies provide strong evidence that poor nutritional status in adult cancer patients is associated with higher rates of hospital admissions or readmissions (six studies[33,36,45,50,55,58]), increased LOS (11 studies[17,32,33,35,46-49,51,63,70]), lower QoL (14 studies[25,34,37,38,41,44,47,49,54,56,64-66,69]), and mortality (17 studies[29,36,39,41-44,47,52,53,63,67,70,71]), and with decreased tolerance to CT (11 studies[31,36,40,45,55,57,59,61,62,67,68]) and RT (six studies[36,45,55,64,66]).

Only four studies did not find associations between poor nutritional status and a negative outcome. These outcomes included QoL,[44] hospital LOS,[47] and mortality.[47] One study found decreased nutritional status associated with greater numbers of hospital admissions, but the magnitude of the effect was not statistically significant.[33] Another study[55] did not find a significant difference between groups in dose of CT received in esophageal cancer patients, although the trend was toward fewer dose reductions in nutrition pathway patients.

Eight studies specifically recommended nutrition intervention by an RDN or other food and nutrition practitioner for adult oncology patients.[34,47,54,56,64-66,69] Two studies found that dietary counseling using regular foods was superior in maintaining QoL to interventions providing only oral supplements.[65,66] Because of the strong connection between nutritional status and QoL, one study suggested that all adult oncology patients be provided with a plan for nutrition care upon diagnosis, and that nutrition therapy should be an integral part of the overall care provided to patients.[54]

MNT in Patients Undergoing CT and RT

Recommendation

- If an adult oncology patient is undergoing CT or RT, RDNs should provide MNT.

Rating: Strong; Conditional

- RDNs should be members of interdisciplinary teams providing multimodal therapy to adult oncology patients undergoing CT or RT.

Rating: Fair; Conditional

Rationale: Nineteen studies,[55,56,64-66,73-86] mostly international, examined the effect of MNT intervention on patients undergoing anticancer treatments (eg, CT, RT, or combined therapy) in ambulatory and inpatient oncology centers. Accepted studies were those in which an RDN (or international equivalent food and nutrition practitioner) provided the dietary intervention. That is, the RDN practiced in a country holding a reciprocity agreement with the Commission on Dietetic Registration or the description of the practitioner was reasonably equivalent. Studies are shown in Table 3 (available online at www.andjrnl.org).

Early and intensive MNT intervention was effective in improving multiple treatment outcomes in patients with a variety of cancers (eg, breast, ovary, lung, leukemias, head and neck, colorectal, upper gastrointestinal [GI]) undergoing CT (five studies) and RT (11 studies). Improvement in treatment outcomes related to MNT included weight gain and preservation of desirable weight status[56,66,77,78] and LBM,[80,81] enhanced QoL,[55,64,66,78,81] perceived health benefits and patient satisfaction,[79] reduction in hospital admissions,[55] reduced hospital LOS,[55] better appetite, better treatment tolerance,[55,65,66] and increased energy and protein intake.[64-66,78,79,83,84] One small study showed that nutrition intervention to manage symptoms resulted in improved nutrition impact symptoms, including patient weight status, function score, endurance, grip strength, and C-reactive protein value.[77]

Four studies[73-75,85] examined the effectiveness of RDNs as members of multidisciplinary teams providing multimodal therapy, a treatment approach combining multiple elements or modalities that work together and support each other to optimize a patient's care. All studies found that MNT provided by an RDN as part of multimodal therapy was effective in improving one or more outcomes, including weight preservation,[75] general well-being,[85] and disease-free survival[73] in patients receiving CT[73] and RT.[74,75,85] One study found that timely and multidisciplinary care, including MNT, is feasible in clinical oncology settings[74] and that nutrition care recommendations result in an a decrease in symptom distress.[85]

DIETARY SUPPLEMENTS OR MFS CONTAINING FISH OIL

Recommendation

- If suboptimal symptom control or inadequate dietary intake has been addressed and the adult oncology patient is still experiencing loss of weight and LBM, an RDN may consider use of dietary supplements containing EPA as a component of nutrition intervention.

Rating: Strong; Imperative

- If suboptimal symptom control or inadequate dietary intake has been addressed and the adult oncology patient is still experiencing loss of weight and LBM, an RDN may consider use of MFS containing EPA as a component of nutrition intervention.

Rating: Strong; Imperative

Rationale: A dietary supplement is a single nutrient supplement in the form of a pill, capsule, liquid, chew, or other form. Twelve dietary supplement studies,[87-98] shown in Table 4 (available online at www.andjrnl.org), examined the effect of EPA on weight status and five studies[89,92,96-98] reported LBM outcomes. Actual consumption of EPA in the studies ranged from approximately 0.77 to 6 g/day. Dietary supplements containing fish oil resulted in statistically significant preservation of weight or increase in weight in eight of 12 studies, which included 10 solid tumor types.[87,90,92,94-98] Three studies, including one in patients with leukemia,[88] showed similar results, and the improvements in weight may have been clinically relevant, although they were not statistically significant.[88,91,93] One study showed a positive effect for a subgroup of the population (GI cancer patients), but not for the total population.[89] Four studies in weight-losing patients with mainly lung, pancreatic, and GI cancers showed statistically significant increase or preservation in LBM with use of dietary supplements containing fish oil.[92,96-98] Another study showed a non-statistically significant gain of 0.9 kg in LBM, although this was accompanied

by a significant improvement in functional status compared with placebo.[89] The change in functional status is likely due to improvement in LBM.

An MFS is a commercial or prepared food or beverage that supplements energy, protein, carbohydrate, fiber, or fat intake. Eleven studies[99-110] of MFS containing EPA reported on weight[99,104,110] and nine studies reported LBM outcomes.[99,102,104,107,110] Actual consumption of EPA in the studies ranged from 1.2 to 2.2 g/day. All but one study,[102] used the same commercially available MFS product containing EPA. Slight variations in international regulation account for the differences in nutrient labeling.

MFSs containing fish oil showed statistically significant increase or preservation in weight status in nine of 11 studies in patients with lung,[105,109] pancreatic,[97-99] head and neck,[102,103,109,110] or GI cancers.[107] Seven studies in weight-losing patients with solid tumors of the lung,[109] pancreas,[99,100,104] GI tract,[107,108] and head and neck[110] showed a statistically significant increase or preservation in LBM. Whereas four other studies did not find a statistically significant improvement in weight[104,106] or LBM,[101,102] the studies showed similar trends. These small gains may have been clinically relevant, although they were not statistically significant.

RECOMMENDATIONS BASED ON EXTERNAL ORGANIZATION SYSTEMATIC REVIEW

Glutamine (GLN) and Oral Mucositis in Patients with Solid Tumors and Hematologic Malignancies

Recommendation

- If use of parenteral GLN is proposed to prevent or treat oral mucositis in oncology patients with solid tumors, RDNs should advise that its use may or may not be beneficial.

Rating: Weak; Conditional

Rationale: Research was evaluated by the Oncological Nursing Society in head and neck and stem cell transplantation patients receiving parenteral L-alanyl-L-glutamine to treat or preventing oral mucositis. Because of the limited research available on its effectiveness, the Oncological Nursing Society gave parenteral GLN a grade of *Effectiveness Not Established*.[111]

Parenteral GLN and Hematopoietic Cell Transplantation

Recommendation

- When parenteral nutrition is required for patients undergoing hematopoietic cell transplant, RDNs may or may not recommend parenteral GLN in doses ranging from 0.2 to 0.5 g/kg/day.

Rating: Fair; Conditional

Rationale: Research evaluated by the American Society for Enteral and Parenteral Nutrition (A.S.P.E.N.) showed that for patients undergoing hematopoietic cell transplant, parenteral GLN in doses ranging from 0.2 to 0.5 g/kg/day should be initiated early in the treatment course.[112,113] Parenteral GLN was associated with improved nitrogen balance and decreased morbidity. However, decreased hospital LOS was found only when data from allogeneic and autologous transplants were combined. Enteral or oral provision of glutamine was not evaluated. A.S.P.E.N. concluded that parenteral GLN in pharmacologic doses may be beneficial in patients undergoing hematopoietic cell transplant and the evidence was given a *Grade C*.

Nutritional Substances and Chemotherapy-Induced Peripheral Neuropathy (CIPN)

Recommendation

- If an adult oncology patient is at risk for or has CIPN, RDNs should advise the patient that the use of nutritional substances (eg, vitamin E, calcium and magnesium infusions, acetyl-L-carnitine, GLN, and glutathione) may or may not be beneficial as a means of preventing or improving CIPN.

Rating: Weak; Conditional

Rationale: CIPN is a significant debilitating symptom directly related to the administration of neurotoxic CT for the treatment of cancer. Oncological Nursing Society found that the following nutritional substances (vitamin E, calcium and magnesium infusions, acetyl-L-carnitine, GLN, and glutathione) had only limited success in preventing or improving CIPN in oncology patients receiving specific chemotherapeutic agents.[114] Their conclusion received a Weight of the Evidence Category grade of *Effectiveness was not established.*

Neutropenic Dietary Precautions

Recommendation

- If an adult oncology patient has neutropenia, RDNs should provide dietary counseling on safe food handling and foods that may pose infectious risks during the period of neutropenia. A neutropenic diet is not necessary, but safe food counseling is recommended as a prudent precaution.

Rating: Fair; Conditional

- If an adult oncology patient is undergoing bone marrow transplant (BMT), RDNs should provide dietary counseling on safe food handling and foods that may pose infectious risks during the period of neutropenia. A neutropenic diet is not necessary, but safe food counseling is recommended as a prudent precaution.
- **Rating:** Weak; Conditional

Rationale: Research on the effectiveness of low-microbial diets was evaluated by Oncological Nursing Society, in patients undergoing BMT,[115] and by A.S.P.E.N. in non-BMT patients with neutropenia.[112,113] In non-BMT patients, the Oncological Nursing Society grade for Low Microbial Diet for Neutropenic Patients was *Effectiveness Unlikely*. In BMT patients, A.S.P.E.N. recommended safe food counseling regarding which foods may pose infectious risks during the period of neutropenia as a prudent precaution, but graded the evidence for neutropenic diets as *Grade C*. Based on these findings, the workgroup suggested safe food counseling for both BMT and non-BMT patients.

RECOMMENDATIONS BASED ON CONSENSUS PUBLICATIONS

Screening for Malnutrition Risk and Referral to RDNs

Recommendation

- All adult patients should be screened for malnutrition risk on

entry into oncology services. Rescreening should be repeated routinely throughout treatment to facilitate referral as needed.

Rating: Consensus: Imperative

- If an adult oncology patient has been identified at screening to be at risk for malnutrition, the patient should be referred to an RDN for evaluation. In cases where it is indicated, an RDN conducts a nutrition assessment and provides MNT, including the Nutrition Care Process.

Rating: Consensus; Conditional

Rationale: Nutrition screening triggers the entry of a patient into the Academy's Nutrition Care Process.[16] Timely screening and rescreening and prompt identification of malnutrition facilitates referral to an RDN for nutrition management and leads to improved outcomes.[116]

Malnutrition has been defined as "a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein, and other nutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function and clinical outcome."[117] The work group limited the definition of malnutrition in the oncology population to undernutrition. Patients may have a cachexia syndrome in addition to malnutrition.

Nutrition Assessment Criteria

Recommendation

- RDNs should assess the following:
  - Food, beverage, and nutrient intake and related history, including but not limited to energy and protein intake; changes in food and fluid/beverage intake; adequacy and appropriateness of nutrient intake or nutrient administration; actual daily intake from enteral nutrition and parenteral nutrition and other nutrient sources; changes in type, texture, or temperature of food and liquids; use of MFS; food avoidance and intolerances; meal or snack pattern changes; prescription medications, over-the-counter medications, herbal preparations, and complementary or alternative medicine products; and factors affecting access to food.

Rating: Consensus; Imperative

- Anthropometric measurements in adult oncology patients: height and weight, weight change, and body mass index.

Rating: Consensus; Imperative

- RDNs should evaluate available data regarding:
  - Biochemical data, medical tests, and procedures of adult oncology patients. Examples include glucose; white blood cell count; nutritional anemia profile (ie, hemoglobin, hematocrit, folate, vitamin B-12, and iron values); electrolyte and renal profile; liver function; inflammatory profile, including C-reactive protein value; and GI function tests (ie, swallowing study, abdominal films, gastric emptying, and transit time). In cases where biochemical data are not available, RDNs should recommend, as indicated.

Rating: Consensus; Imperative

- Nutrition-focused physical findings and client history of adult oncology patients, including but not limited to age older than 65 years, loss of muscle mass, loss of subcutaneous fat, presence of pressure ulcers or wounds, nutrition impact symptoms, changes in appetite or vital signs, change in functional indicators (ie, Karnofsky performance scale[118] and grip strength), and localized or generalized fluid accumulation. Client history—patient/family/client medical/health history, including but not limited to dysphagia, depression, and pain fatigue; medical treatment or therapy; other diseases, conditions, and illnesses, including cancer cachexia. Social history should include psychological/socioeconomic factors (eg, social support).

Rating: Consensus; Imperative

Rationale: Assessment is needed to effectively determine nutrition diagnoses and plan nutrition interventions. An adult oncology nutrition assessment should characterize and document the presence of, or expected potential for altered nutritional status[119] and nutrition impact symptoms, shown in Figure 5. These symptoms that impede intake, digestion, or absorption can be caused by the cancer itself or the oncology treatment.[120-122]

Any unintended weight loss (UWL) in adult oncology patients has potential significance because oncology patients often experience weight loss.[119] Accurate determination of a baseline weight and documentation of any weight loss before diagnosis or during treatment is vital to intervene and impact outcomes. In elderly patients, studies have shown an association between increased mortality and underweight with UWL of 5% in 30 days or a body mass index <20 rather than the usual <18.5.[71,123,124] Low muscle mass is an independent predictor of mortality,[60] is

- Adverse effects on weight or body composition
- Impaired immune response
- Decreased muscle strength
- Increased fatigue
- Impaired wound healing
- Impaired glucose function
- Impaired psychosocial function, including depression
- Reduced quality of life
- Reduced response to treatment
- Increased treatment toxicities
- Treatment delays
- Increased hospitalizations or length of stay

Figure 5. Common nutrition impact symptoms in adult oncology patients. Adapted from references 120, 121, and 122.

The presence of two or more of the following criteria or characteristics supports a nutrition diagnosis of malnutrition in adult oncology patients:

- Insufficient energy intake[119]
- Unintended weight loss[119]
- Loss of subcutaneous fat[71,119,129]
- Loss of muscle mass[61,119]
- Localized or generalized fluid accumulation (that may mask weight loss)[119]
- Reduced grip strength[119,128]

Figure 6. Criteria for nutrition diagnosis of malnutrition in adult oncology patients. Adapted from references 61, 71, 119, and 128.

a particularly adverse prognostic indicator in obese patients, and is associated with greater toxicities of CT leading to treatment interruptions, dose reductions, and delays or terminations of treatment.[59,61,124-126]

In addition to the five domains of the Nutrition Care Process (Food/Nutrition Related History; Anthropometric, Measurements; Biochemical Data, Medical Tests, and Procedures; Nutrition-Focused Physical Findings; and Client History), RDNs should consider the six identifiers of malnutrition, shown in Figure 6. The identifiers of malnutrition in the Academy/A.S.P.E.N. consensus statement[119] (pending validation) were adapted by the Oncology Workgroup for the Adult Oncology Population. The characteristics of malnutrition should be considered within the context of systemic inflammation and/or the presence of cachexia.[119,127,128]

Nutrition Assessment for the Stages of Cancer Cachexia

Recommendation

- As part of a nutrition assessment in patients with lung, pancreatic, or head and neck and GI cancers or those who are at high risk for weight loss or have experienced UWL, RDNs should assess for nutrition impact symptoms, markers of inflammation (eg, elevated C-reactive protein value), and other signs of wasting that may indicate precachexia or cancer cachexia.

Rating: Consensus; Conditional

Rationale: Further nutrition assessment is needed for patients with lung, pancreatic, or head and neck and GI cancers or those who are at high risk for weight loss or have experienced UWL. Patients with these diagnoses are more at risk for cachexia and therefore have more to gain from timely identification and nutrition intervention.

Nutrition assessment and intervention by an RDN is most effective when provided in the stages of precachexia and cachexia.[129] The stages of cancer cachexia are shown in Figure 7.

The metabolic response to cancer is heterogeneous, so it is important to intervene and manipulate the factors that are behavior-related, to address the direct causes of decreased intake (eg, obstruction or dysphagia), and address the secondary causes (eg, depression, fatigue, pain, or GI function). Symptom management in patients with advanced cancer can improve survival.[130]

Cancer cachexia A multifactorial syndrome characterized by an ongoing loss of skeletal muscle mass (with or without loss of fat mass) that cannot be fully reversed by conventional nutritional support and leads to progressive functional impairment. The pathophysiology is characterized by a negative protein and energy balance, driven by a variable combination of reduced food intake and abnormal metabolism.[129]

Precachexia (in general) Defined by the presence of all of the following criteria: underlying chronic disease, unintended weight loss of up to 5% usual body weight during the past 6 months, chronic or recurrent systemic inflammatory response, and anorexia or anorexia-related symptoms.[130]

Precachexia (in cancer) Characterized by early clinical and metabolic signs such as loss of appetite and impaired glucose tolerance. Can precede substantial involuntary weight loss (ie, up to 5%). The risk of progression is variable and depends on cancer type, stage, presence of systemic inflammation, low food intake, and lack of response to anticancer therapy.[129]

Refractory cachexia May be a result of very advanced cancer (preterminal) or the presence of rapidly progressive cancer unresponsive to anticancer therapy. This stage is associated with active catabolism or the presence of factors that make active management of weight loss no longer possible or appropriate. Refractory cachexia is characterized by a low performance score (eg, World Health Organization grade 3 or 4) and a life expectancy <3 months.[129]

Figure 7. Definitions of cachexia. There are several stages of cancer cachexia: precachexia, cachexia, and refractory cachexia. Adapted from references 129 and 130.

Nutrition Diagnosis of Malnutrition

Recommendation

- RDNs should use clinical judgment in interpreting nutrition assessment data to diagnose malnutrition in adult oncology patients. The presence of two or more of the following criteria or characteristics supports a nutrition diagnosis of malnutrition in an adult oncology patient: insufficient energy intake, UWL, loss of subcutaneous fat, loss of muscle mass, localized or generalized fluid accumulation (that may mask weight loss), and reduced grip strength.

Rating: Consensus; Imperative

Rationale: Although there is no universally accepted approach to the diagnosis and documentation of adult malnutrition, the workgroup developed guidance for adult oncology patients, based on the Academy/A.S.P.E.N. consensus document guidance,[119] shown in Figure 6. RDNs should use clinical judgment in interpreting nutrition assessment data to make a

nutrition diagnosis of malnutrition in adult oncology patients.

Nutrition Intervention

Recommendation

- Cachexia In adult oncology patients who have been identified to have precachexia or cancer cachexia, prompt and aggressive intervention to address nutrition impact symptoms and preserve or prevent loss of LBM and weight should be initiated by an RDN.

Rating: Consensus; Conditional

Rationale: Early rather than later intervention to prevent weight loss in patients with precachexia or cancer cachexia (Figure 7) is more likely to be effective. The metabolic derangements in cancer cachexia that promote wasting can lead to loss of weight and LBM and poor outcomes.

Monitoring and Evaluation

Recommendation

- To check progress, an RDN should monitor and evaluate the following components of adult oncology patients at each visit and compare with desired individual outcomes. This may include, but is not limited to anthropometric measurements; food- and nutrition-related history; biochemical data, medical tests, and procedures; nutrition-focused physical findings; client history; patient/family/client medical/health history; social history; and psychological/socioeconomic issues.

Rating: Consensus; Imperative

- In patients with lung, pancreatic, or head and neck and GI cancers, or those who are at high risk for weight loss or have experienced UWL, RDNs should monitor and evaluate nutrition impact symptoms, markers of inflammation (eg, elevated C-reactive protein values), and other signs of wasting, which may indicate precachexia or cancer cachexia.

Rating: Consensus; Conditional

Rationale: Frequent monitoring and evaluation should be performed to document the presence of (or expected potential for) altered nutritional status, nutrition impact symptoms or measureable adverse effects on body composition, function, QoL, or clinical outcome and includes the six indicators of malnutrition, as well as laboratory values and planned oncology treatments. Monitoring and evaluation of these factors is needed to correctly/effectively diagnose nutrition-related problems that should be the focus of further nutrition interventions. Inability to achieve optimal nutrient intake may contribute to poor outcomes.

SUGGESTIONS FOR FUTURE RESEARCH

During the literature review process several points regarding future research directions became clear. We suggest that research methods and consistency in outcomes reporting by investigators be addressed as follows:

1. The qualifications of clinicians (eg, RDN; nutrition and dietetics technician, registered; or nurse) providing the nutrition intervention can be described for studies to be compared or repeated in other settings.
2. Validated malnutrition screening and nutrition assessment tools can be used and clearly stated. Nutritional status (reported as PG-SGA or Subjective Global Assessment score)[24,27,131] may improve, although weight does not.
3. Research is needed in US patients, under the US health care system, with RDNs providing or leading the intervention as MNT.
4. Body weight (reported as kilograms and pounds) and LBM can be reported as lost, gained, or maintained.
5. Use of validated tools for measuring QoL can include oncology-specific instruments such as the Functional Assessment of Anorexia Cachexia Therapy[132] and European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (QLQ-C30).[133]
6. Performance status as a means of quantifying patients' general well-being can be reported using Karnofsky Performance Score or Eastern Cooperative Oncology Group score,[134,135] (also called World Health Organization [WHO] or Zubrod score). A translation of Zubrod and Karnofsky scales has been validated in lung cancer[135]; performance is sometimes used as a QoL surrogate.
7. Research is needed on oncology treatment outcomes anticipated to change by nutrition intervention, such as dose reductions, treatment delays, treatment completion, or treatment toxicities (reported as Common Terminology Criteria for Adverse Events current version).[136]
8. Efforts can be made to blind investigators who report and evaluate outcomes.
9. Because trials are in the design phase, investigators can have inclusion of the study in meta-analyses or systematic reviews as a goal. Inclusion of studies in meta-analyses or systematic reviews is a means to the creation of strong guidelines.

SUMMARY

The Academy of Nutrition and Dietetics Oncology Evidence-Based Nutrition Practice Guideline for Adults is a valuable resource for RDNs as well as other clinicians involved in the care of adult oncology patients. The Academy has published the Oncology Guideline 2013[15] on the EAL. MNT provided by an RDN is effective and essential to securing the best possible clinical outcomes for patients undergoing cancer treatments. These evidence-based guidelines highlight the importance of malnutrition screening and rescreening, timely referral to an RDN for patients identified as being at nutritional risk, and nutrition assessment and periodic reassessment using tools validated in the appropriate setting and with an oncology population. Early identification and diagnosis of malnutrition leading to intervention can positively impact body composition, functional status, QoL, treatment tolerance, and other clinical outcomes. Use of dietary supplements or an MFS containing EPA may be considered as an intervention because both have a significant effect on preserving weight and LBM in adult oncology patients. Finally, nutrition monitoring and evaluation of anthropometric measurements; food- and nutrition-related

history; biochemical data; medical tests and procedures; and nutrition-focused physical findings, client history, and social history help determine whether the nutrition-related goals and expected outcomes are met.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
Nutrition Screening and Referral	
1. Malnutrition screening tools for adult oncology patients	
Which malnutrition screening tools have been found to be valid and reliable for identifying malnutrition risk in adult oncology patients in ambulatory and acute care settings? *Conclusion:* These tools were found to be valid and reliable for identifying malnutrition risk in adult oncology patients as follows: MST[d] *(Ambulatory and acute care settings)* and MSTC;[e] MUST[f] *(Acute care setting only).* The MAG-MST[g] and the 2-item nutrition screen from the ZSDS[h] were not found to be valid and reliable for identifying malnutrition risk in adult oncology patients in acute care settings. Validity and reliability of the MSTC, MUST, MAG-MST, and 2-item nutrition screen from the ZSDS tools were not evaluated in adult oncology patients in the ambulatory setting.	7 studies (5+; 2Ø); Grade I
Recommendation: Adult oncology patients should be screened using a malnutrition screening tool validated in the setting in which the tool is intended for use. The following tools have been shown to be valid and reliable in inpatient settings: MST, MSTC, and MUST and in ambulatory/outpatient settings: MST.	Strong; Imperative
2. Screening for malnutrition risk and referral of adult oncology patients	
2.a. Screening for malnutrition risk and rescreening of adult oncology patients	
Conclusion: None *Recommendation:* All adult patients should be screened for malnutrition risk on entry into oncology services. Early identification and management of malnutrition risk improves and protects nutrition status and QoL,[i] which leads to improved outcomes. Rescreening should be repeated routinely throughout treatment to facilitate referral as needed.	Not applicable Consensus: Imperative
2.b. Referral of adult oncology patients identified at malnutrition risk to RDN[j]	
Conclusion: None *Recommendation:* If an adult oncology patient has been identified at screening to be at risk for malnutrition, the patient should be referred to an RDN for evaluation. If indicated, an RDN conducts a nutrition assessment and provides MNT,[k] including the nutrition care process: Nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation. Management of malnutrition risk improves and protects nutrition status and QoL, which leads to improved outcomes.	Not applicable Consensus; Conditional
MNT	
3. MNT in adult oncology patients	
3.a. MNT in adult oncology patients undergoing CT[l] and RT[m]	
Is MNT provided by an RDN effective in adult oncology patients receiving CT? *Conclusion:* MNT provided by an RDN (or equivalent food and nutrition practitioner) was effective in improving multiple treatment outcomes[n] in adult oncology patients with a variety of cancers (breast, ovary, lung, leukemias, colorectal, and upper GI[o]) receiving CT in ambulatory and inpatient oncology centers.	5 studies (1+; 4Ø); Grade: II
Is MNT provided by an RDN effective in adult oncology patients receiving RT? *Conclusion:* MNT provided an RDN (or equivalent food and nutrition practitioner) was effective in improving multiple treatment outcomes[n] in adult oncology patients with a variety of high-risk cancers (head and neck or GI) receiving RT or combined RT in ambulatory and inpatient oncology centers.	11 studies (6+; 5Ø); Grade: I

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Figure 4. Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
Recommendation: If an adult oncology patient is undergoing CT or RT, the RDN should provide MNT. MNT has been shown to be effective in improving multiple treatment outcomes[n] in patients undergoing CT, RT, or chemoradiotherapy in ambulatory or outpatient and inpatient oncology settings.	Strong; Conditional
3.b. MNT as part of multimodal therapy in adult oncology patients undergoing CT and RT	
Is MNT provided by an RDN as part of multimodal therapy effective in adult oncology patients receiving RT? *Conclusion:* MNT provided by an RDN (or equivalent food and nutrition practitioner), as part of multimodal therapy, was effective in improving outcomes[p] in adult oncology patients receiving RT.	3 studies (3Ø); Grade: II
Is MNT provided by an RDN as part of multimodal therapy effective in adult oncology patients receiving CT? *Conclusion:* MNT provided by an RDN, as part of multimodal therapy, was found to be effective in improving outcomes[q] in adult breast cancer patients receiving CT.	1 study (1+); Grade: III
Recommendation: RDNs should be members of interdisciplinary teams providing multimodal therapy to adult oncology patients undergoing CT or RT.	Fair; Conditional
NUTRITION ASSESSMENT	
4. Nutrition assessment tools for adult oncology patients	
Which nutrition assessment tools have been found to be valid and reliable to assess nutritional status of adult oncology patients in ambulatory and acute care settings? *Conclusion:* The PG-SGA[r] and SGA[s] tools have been found to be valid and reliable in assessing the nutritional status of adult oncology patients in ambulatory and acute care settings. The Mini Nutrition Assessment tool was found to have the sensitivity to diagnose oncology patients with malnutrition in ambulatory settings, but was only moderately specific in identifying malnutrition when compared with the PG-SGA. The Mini Nutrition Assessment tool was not evaluated in an acute care setting.	7 studies (5+; 2Ø); Grade: I
Recommendation: RDNs should use an assessment tool validated in the setting in which the tool is intended for use as part of a complete nutrition assessment. Research indicates that the PG-SGA and SGA tools elicit valid and reliable data as part of a comprehensive nutrition assessment of adult oncology patients in ambulatory and acute care settings.	Strong; Imperative
5.a. Assessment of food/nutrition-related history of adult oncology patients	
Conclusion: None. *Recommendation:* RDNs should assess the food, beverage, and nutrient intake and related history of adult oncology patients including, but not limited to the following: • Energy and protein intake • Changes in food and fluid/beverage intake • Adequacy and appropriateness of nutrient intake or nutrient administration • Actual daily intake from enteral and parenteral nutrition and other nutrient sources • Changes in type, texture, or temperature of food and liquids • Use of MFS[t] • Food avoidance and intolerances • Meal or snack pattern changes • Prescription medications, over-the-counter medications, herbal preparations, and complementary or alternative medicine products • Factors affecting access to food.	Not applicable Consensus; Imperative

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
Assessment of the above factors is needed to effectively determine nutrition diagnoses and plan the nutrition interventions. Inability to achieve optimal nutrient intake may contribute to poor outcomes.	
5.b. Assessment of anthropometric measurement in adult oncology patients	
Conclusion: None *Recommendation:* RDNs should assess the following anthropometric measurements in adult oncology patients: • Height and weight • Weight change • BMI[u] Any weight loss that is unintended in adult oncology patients has potential significance, because oncology patients often experience weight loss before admission to oncology services. Low muscle mass is a common and independent predictor of immobility and mortality; is a particularly adverse prognostic indicator in obese patients; and is associated with greater toxicities of CT leading to treatment interruptions, including dose reductions, treatment delays, and treatment termination. Assessment of the above factors is needed to effectively determine nutrition diagnoses and plan the nutrition interventions.	Not applicable Consensus; Imperative
5.c. Assessment of biochemical data, medical tests, and procedures on adult oncology patients	
Conclusion: None *Recommendation:* RDNs should evaluate available data and recommend as indicated: biochemical data, medical tests, and procedures of adult oncology patients. Examples include: • Glucose; • White blood cell count; • Nutrition-related anemia profile (hemoglobin, hematocrit, folate, B-12, and iron); • Electrolyte and renal profile; • Liver function; • Inflammatory profile, including C-reactive protein; and • GI function tests (ie, swallowing study, abdominal films, gastric emptying, and transit time). Assessment of these factors is needed to effectively determine nutrition diagnoses and plan the nutrition interventions.	Not applicable Consensus; Imperative
5.d. Assessment of nutrition-focused physical findings and client history of adult oncology patients	
Conclusion: None *Recommendation:* RDNs should evaluate available data regarding the nutrition-focused physical findings and client history of adult oncology patients, including but not limited to: Nutrition-focused physical findings: • Older than age 65 y; • Loss of muscle mass; • Loss of subcutaneous fat; • Presence of pressure ulcers or wounds;	Not applicable Consensus; Imperative

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
• Nutrition impact symptoms, including but not limited to nausea, vomiting, diarrhea, constipation, stomatitis, mucositis, alterations in taste, and smell and anxiety; • Changes in appetite; • Vital signs; • Functional indicators (ie, Karnofsky performance scale[118] score and grip strength); and • Localized or generalized fluid accumulation. Client history: • Patient/family/client medical/health history: • Nutrition impact symptoms, including but not limited to dysphagia, depression, and pain fatigue; • Medical treatment or therapy; • Other diseases, conditions, and illnesses, including cancer cachexia. Social history: Psychological/socioeconomic factors (eg, social support). Assessment of the above factors is needed to effectively determine nutrition diagnoses and plan the nutrition interventions	
6. Nutrition assessment for the stages of cancer cachexia in adult oncology patients	
Conclusion: None *Recommendation:* As part of the nutrition assessment, in patients with lung, pancreatic, or head and neck and GI cancers or those who are at high risk for weight loss or have experienced unintended weight loss, RDNs should assess for nutrition impact symptoms, markers of inflammation (eg, elevated C-reactive protein level) and other signs of wasting that may indicate precachexia or cancer cachexia. The presence of cachexia does not always indicate end of life or need for hospice. Therefore, the identification of cachexia leading to intervention can positively impact clinical outcomes.	Not applicable Consensus; Conditional
NUTRITION DIAGNOSIS	
7. Nutrition diagnosis of malnutrition in adult oncology patients	
Conclusion: None *Recommendation:* RDNs should use clinical judgment in interpreting nutrition assessment data to diagnose malnutrition in adult oncology patients. Early identification and diagnosis of malnutrition leading to intervention can positively impact body composition, function, QoL, treatment tolerance, and clinical outcomes. The presence of two or more of the following criteria or characteristics supports a nutrition diagnosis of malnutrition in adult oncology patients. • Insufficient energy intake, • Unintended weight loss, • Loss of subcutaneous fat, • Loss of muscle mass, • Localized or generalized fluid accumulation (that may mask weight loss), and • Reduced grip strength.	Not applicable Consensus; Imperative
NUTRITION INTERVENTION	
8. Nutrition intervention of adult oncology patients with cancer cachexia	
Conclusion: None *Recommendation:* In adult oncology patients who have been identified to have precachexia or cancer cachexia, prompt and aggressive intervention to address nutrition impact symptoms	Not applicable Consensus; Conditional

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
and preserve or prevent loss of LBM[v] and weight should be initiated by an RDN. Early rather than later intervention to prevent weight loss in this population is more likely to be effective. The metabolic derangements in cancer cachexia that promote wasting can lead to loss of weight and LBM and poor outcomes.	
9. Fish oil, weight, and lean body mass in adult oncology patients	
9.a. Dietary supplements containing fish oil for adult oncology patients	
What is the effect of a dietary supplement containing fish oil on weight in adult oncology patients? *Conclusion:* Eight studies found that dietary supplements containing fish oil (actual consumption 0.77-6.0 g EPA[w]/d), resulted in weight gain or weight stabilization in adult oncology patients with weight loss. Three studies showed the same effect, but were not statistically significant. One study showed a positive effect for a subgroup of the population (GI cancer patients), but not for the total population. More research is needed to determine the optimal dose.	12 studies (7+; 3Ø; 2-); Grade: I
What is the effect of a dietary supplement containing fish oil on lean body mass in adult oncology patients? *Conclusion:* Four studies found that dietary supplements containing fish oil (actual consumption approximately 0.77-6.0 g EPA/d) resulted in improvement or preservation of LBM in adult oncology patients with weight loss. The fifth study showed the same effect, but was not statistically significant. More research is needed to determine the optimal dose.	5 studies (2+; 2Ø; 1-); Grade: II
Recommendation: If suboptimal symptom control or inadequate dietary intake has been addressed and the adult oncology patient is still experiencing loss of weight and LBM, an RDN may consider use of dietary supplements containing EPA as a component of a nutrition intervention.	Strong; Imperative
9.b. Medical food supplements containing fish oil for adult oncology patients	
What is the effect of MFS containing fish oil on weight in adult oncology patients? *Conclusion:* Nine studies found that MFS containing fish oil (actual consumption 1.2-2.2 g EPA/d) resulted in weight gain or weight stabilization in adult oncology patients with weight loss. Two studies showed the same effect, but were not statistically significant. More research is needed to determine the optimal dose.	11 studies (6+; 5Ø); Grade: I
What is the effect of MFS containing fish oil on LBM in adult oncology patients? *Conclusion:* Seven studies found that MFS containing fish oil (actual consumption 1.2-2.2 g EPA/d) resulted in improvement or preservation of LBM in adult oncology patients with weight loss. Two studies showed the same effect, but were not statistically significant. More research is needed to determine the optimal dose.	9 studies (4+; 5Ø); Grade: I
Recommendation: If suboptimal symptom control or inadequate dietary intake has been addressed and the adult oncology patient is still experiencing loss of weight and LBM, an RDN may consider use of an MFS containing EPA as a component of a nutrition intervention.	Strong; Imperative
10. Glutamine and oral mucositis in adult oncology patients with solid tumors and hematologic malignancies	
Guideline: The effectiveness of treating of oral mucositis with glutamine has not been established.[111] *Recommendation:* If use of parenteral glutamine is proposed to prevent or treat oral mucositis in oncology patients with solid tumors, an RDN should advise that its use may or may not	Weight of Evidence Category: Effectiveness Not Established. Weak; Conditional

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
be beneficial. Limited research in head and neck and stem cell transplantation patients receiving parenteral glutamine has not established the effectiveness of L-alanyl-L-glutamine in treating or preventing oral mucositis. Enteral or oral provision of glutamine was not evaluated.	
11. Parenteral glutamine and hematopoietic cell transplantation in adult oncology patients	
Guideline: Parenteral glutamine in pharmacologic doses may be beneficial in patients undergoing hematopoietic cell transplantation.[112,113] *Recommendation:* When parenteral nutrition is required for patients undergoing hematopoietic cell transplantation, an RDN may or may not recommend parenteral glutamine in doses ranging from 0.2-0.5 g/kg/d. Research indicates parenteral glutamine should be initiated early in the treatment course. Parenteral glutamine is associated with improved nitrogen balance and decreased morbidity. However, decreased hospital LOS was found only when data from allogeneic and autologous transplants were combined.	Grade: C Fair; Conditional
12. Nutrition substances and CT-induced peripheral neuropathy	
Guideline: No nursing interventions (vitamin E, calcium, and magnesium infusions; acetyl-L-carnitine; glutamine; and glutathione) for the prevention or treatment of CIPN[x] can be categorized as recommended for practice or likely to be effective.[114] *Recommendation:* If an adult oncology patient is at risk for or has CIPN, an RDN should advise the patient that the use of nutritional substances (vitamin E, calcium, and magnesium infusions; acetyl-L-carnitine; glutamine; and glutathione) may or may not be beneficial as a means of preventing or improving CIPN. Research indicates that these substances have had only limited success in preventing or improving CIPN in oncology patients receiving specific chemotherapeutic agents.	Weight of the Evidence Category: Effectiveness Not Established Weak; Conditional
13. Neutropenic dietary precautions for adult oncology patients	
13.a. Neutropenic dietary precautions for adult oncology patients with neutropenia (nonbone marrow transplant)	
Guideline: Patients should receive dietary counseling regarding foods that may pose infectious risks and safe food handling during the period of neutropenia.[112,113] *Recommendation:* In a case where a an adult oncology patient has neutropenia, an RDN should provide dietary counseling on safe food handling and foods that may pose infectious risks during the period of neutropenia. A neutropenic diet is not necessary, but safe food counseling is recommended as a prudent precaution. Research has not demonstrated the effectiveness of low-microbial diets.	Grade: C Fair; Conditional
13.b. Neutropenic dietary precautions for adult oncology patients undergoing bone marrow transplant	
Guideline: Studies have linked dietary restrictions with a lower risk of infection for neutropenic patients with cancer; however, basic principles, such as avoiding uncooked meats, seafood, eggs, and unwashed fruits and vegetables, may be prudent.[115] *Recommendation:* If an adult oncology patient is undergoing bone marrow transplant, an RDN should provide dietary counseling on safe food handling and foods that may pose infectious risks during the period of neutropenia. A neutropenic diet is not necessary, but safe food counseling is recommended as a prudent precaution. There is conflicting research regarding the effectiveness of neutropenic diets in the bone marrow transplant population.	Grade: Effectiveness Unlikely Weak; Conditional

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
Nutrition monitoring and evaluation	
14. Nutrition monitoring and evaluation in adult oncology patients	
14.a. ONC: Nutrition monitoring and evaluation of adult oncology patients	
Conclusion: None *Recommendation:* Following the nutrition intervention, to check progress, an RDN should monitor and evaluate the following components of adult oncology patients at each visit and compare with desired individual outcomes relevant to the nutrition diagnosis and intervention. This may include, but is not limited to: Anthropometric measurements: • Weight change, and • BMI. Food- and nutrition-related history: • Energy and protein intake; • Changes in food and fluid/beverage intake; • Adequacy and appropriateness of nutrient intake or nutrient administration; • Actual daily intake from enteral and parenteral nutrition and other nutrient sources; • Changes in type, texture, or temperature of food and liquids; • Use of MFS; • Food avoidance and intolerances; • Meal or snack pattern changes; • Prescription medications, over-the-counter medications, herbal preparations, and complementary alternative medicine products; • Factors affecting access to food; and • Feeding method or need for placement (eg, oral, enteral, or parenteral). Biochemical data, medical tests, and procedures: • Biochemical indexes, and • Implications of diagnostic tests and therapeutic procedures. Nutrition-focused physical findings: • Vital signs; • Loss of muscle mass; • Loss of subcutaneous fat; • Nutrition impact symptoms, including but not limited to nausea, vomiting, diarrhea, constipation, stomatitis, mucositis, alterations in taste and smell, and anxiety; • Presence of pressure ulcers or wounds; • Functional indicators (ie, Karnofsky performance scale score and grip strength); and • Localized or generalized fluid accumulation. Client history: • Patient/family/client medical/health history: ○ Nutrition impact symptoms, including but not limited to dysphagia, depression, and pain fatigue; ○ Medical treatment or therapy; and ○ Other diseases; conditions; and illnesses, including cancer cachexia.	Not applicable Consensus; Imperative

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
Social history: • Psychological/socioeconomic issues (eg, social support). Monitoring and evaluation of the above factors is needed to correctly and effectively diagnose nutrition problems that should be the focus of further nutrition interventions. Inability to achieve optimal nutrient intake may contribute to poor outcomes.	
14.b. Nutrition monitoring and evaluating adult oncology patients with cancer cachexia	
Conclusion: None *Recommendation:* As part of monitoring and evaluation, in patients with lung, pancreatic, or head and neck and GI cancers, or those who are at high risk for weight loss or have experienced unintended weight loss, an RDN should monitor and evaluate nutrition impact symptoms, markers of inflammation (eg, elevated C-reactive protein value), and other signs of wasting that may indicate precachexia or cancer cachexia.	Not applicable Consensus; Conditional
Outcomes management	
15. Nutritional status and outcomes in adult oncology patients	
What is the relationship between nutritional status and hospital admissions or readmissions in adult oncology patients? *Conclusion:* Poor nutritional status is associated with higher rates of hospital admissions or readmissions in adult oncology patients. Five studies found that a decreased nutritional status is associated with greater numbers of hospital admissions. A sixth study showed the same effect, but was not statistically significant.	6 studies (2+; 4Ø); Grade: II
What is the relationship between nutritional status and hospital LOS[y] in oncology patients? *Conclusion:* Poor nutritional status is associated with increased LOS in adult oncology patients. Ten studies found that a decreased nutritional status is associated with longer LOS, whereas one study found no statistical difference between groups.	11 studies (9+; 2Ø); Grade: I
What is the relationship between nutritional status and QoL in oncology patients? *Conclusion:* Poor nutritional status is associated with lower QoL in adult oncology patients. Thirteen studies found that a decreased nutritional status is associated with a lower QoL. All 8 studies using the PG-SGA found that a higher score (higher nutritional risk) was associated with a lower QoL in oncology patients.	14 studies (9+; 5Ø); Grade: I
What is the relationship between nutritional status and RT tolerance in oncology patients? *Conclusion:* Poor nutritional status is associated with decreased tolerance to RT in adult oncology patients undergoing RT. All studies found positive associations between nutritional status and 2 or more of the following: reduced treatment interruptions, unplanned hospital admissions, treatment toxicity, PG-SGA score over time, and QoL.	6 studies (4+; 2Ø); Grade: I
What is the relationship between nutritional status and CT tolerance in oncology patients? *Conclusion:* Poor nutritional status is associated with decreased tolerance to CT treatment in adult oncology patients undergoing CT. Ten studies found positive associations in 1 or more of the following: treatment interruptions, infections, unplanned hospital admissions, treatment toxicity (including dose-limiting treatment toxicity), neutropenic fever, fatigue, and severe thrombocytopenia. One additional study showed a similar trend toward fewer dose reductions, but the difference was not significant.	11 studies (4+; 7Ø); Grade: I

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Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Conclusion statements[a] and recommendations Green shading = recommendations supported by EAL systematic review No shading = recommendations supported by consensus publications Gray shading = recommendations supported by external guidelines	Number of studies (quality rating),[b] conclusion statement grade,[c] and EAL recommendation rating
What is the relationship between nutritional status and mortality in oncology patients? *Conclusion:* Poor nutritional status is associated with mortality in adult oncology patients. Sixteen studies found positive associations among one or more of the following and mortality: weight loss, malnutrition, poor scores on validated malnutrition and QoL screening tools, sarcopenia, cachexia, and fatigue.	17 studies (9+; 8Ø); Grade: I
Recommendation: RDNs should collaborate with other health care professionals, administrators, and public policy decision-makers to ensure that the evaluation of nutritional status is a key component of the adult oncology patient care process.	Strong; Imperative

[a]Conclusion statement for EAL systematic review questions or guideline statement for external guidelines.

[b]Number of studies and quality rating [positive (+), neutral (Ø) or negative (-)] included in the EAL systematic review conclusion statement.

[c]Grade for external guideline statements. See Figure 3 for EAL rating equivalents.

[d]MST=Malnutrition Screening Tool.

[e]MSTC=Malnutrition Screening Tool for Cancer Patients.

[f]MUST=Malnutrition Universal Screening Tool.

[g]MAG-MST=Malnutrition Advisory Group Malnutrition Screening Tool.

[h]ZSDS=Zung self-rating depression scale.

[i]QoL=quality of life.

[j]RDN=registered dietitian nutritionist.

[k]MNT=medical nutrition therapy.

[l]CT=chemotherapy treatment.

[m]RT=radiation therapy or treatment.

[n]Improvement in treatment outcomes included weight gain and preservation of weight, QoL, increased energy and protein intake, and management of nutrition impact symptoms resulting in improved weight status, function score, endurance, grip strength, and C-reactive protein status.

[o]GI=gastrointestinal.

[p]Improvement in treatment outcomes included weight gain and preservation of weight and LBM, QoL, increased energy and protein intake, appetite, perceived health benefits and patient satisfaction, reduction in hospital admissions, and LOS, better treatment tolerance, and management of nutrition impact symptoms, as above.

[q]Improvement in treatment outcomes included weight status, patient satisfaction, decreased symptom distress, improved function, and provision of care in patient's preferred outpatient setting.

[r]PG-SGA=Patient Generated Subjective Global Assessment.

[s]SGA=Subjective Global Assessment.

[t]MFS=medical food supplement.

[u]BMI=body mass index.

[v]LBM=lean body mass.

[w]EPA=eicosapentaenoic acid.

[x]CIPN=chemotherapy-induced peripheral neuropathy.

[y]LOS=length of stay.

Figure 4. *(continued)* Oncology Guideline 2013 Evidence Analysis Library (EAL) conclusion statements and recommendations.

Table 1. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the validity and reliability of malnutrition screening tools and nutrition assessment tools used with adult oncology patients in ambulatory and acute care settings

Author(s), year Study design Location Quality rating	Population Cancer site	Tool Reference standard	Results Sensitivity/specificity (%)	Interrater reliability	Positive predictive value/negative predictive value (%)	Other	Recommended for Use[a]
Malnutrition screening tools							
Amaral and colleagues, 2008[17] DVR[b] Portugal Positive	N=130 inpatients Various	MST[c] MUST[d] NRS-2002[e]	48.7/94.6 97.3/77.4	NR[f] NR	78.3/82.2 63.2/98.6	Agreement: 81.50% (k[g]=0.49) Agreement: 83.10% (k=0.64) Malnutrition risk identification: MUST, n=57 (43.8%); NRS-2002, n=37 (28.5%); MST, n=23 (17.7%)	Yes, MUST had higher concurrence with NRS-2002 than MST
Bauer and colleagues, 2003[18] Cross-sectional Australia Neutral	N=65 inpatients Lymphoma, breast	Malnutrition Advisory Group Malnutrition Screening tool SGA[h]	59/75	NR	88/38	Significant linear trends toward agreement with SGA for % BW[i] ↓ over past 6 mo, $F_{(1, 64)}$=26.5; P<0.0001 and for BMI,[j] $F_{(1, 58)}$=7.9; P<0.007	No
Ferguson and colleagues, 1999[19] Cross-sectional Australia Positive	N=106 outpatients undergoing radiation therapy Various	MST SGA	100/81	NR	40/100	NA[k]	Yes
Ferguson and colleagues, 1999[20] DVR Australia Positive	N=408 inpatients Various	MST SGA; dietitian	93/93	93-97% k=0.84-0.93 (P<0.01)	98.4/72.7	NA	Yes

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Table 1. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the validity and reliability of malnutrition screening tools and nutrition assessment tools used with adult oncology patients in ambulatory and acute care settings (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Tool Reference standard	Results: Sensitivity/ specificity (%)	Interrater reliability	Positive predictive value/negative predictive value (%)	Other	Recommended for Use[a]
Isenring and colleagues, 2006[21] Cross-sectional Australia Positive	N=50 outpatients undergoing chemotherapy Head and neck, rectum, abdomen	MST PG-SGA[l]	100/92	k=0.83-0.88; n=20	80/100	NA	Yes
Kim and colleagues, 2011[22] DVR Republic of Korea Positive	N=257 inpatients Various	MST for Cancer Patients PG-SGA	Low risk: 94/84.2 High risk: 85.4-98.3/ 78.2-89.1	NR	Low risk: 67.8/97.6 (95% CI) High risk: 57.3-77.1/ 93.9-99.3 (95% CI)	k=0.7 for low risk; k=NR for high risk	Yes, recommend further research
Kirsh and colleagues, 2003[23] DVR United States Neutral	N=50 inpatients Various	2-item ZSDS[m] (Item #5 and #7) PG-SGA	50/88 For 2-item screen	NR	NR/NR	Significant relationship between PG-SGA and ZSDS (R=0.63; P<0.01); and items #5/#7 of ZSDS (F=13.99; P<0.001)	No, recommend further research
Nutrition assessment tools							
Bauer and colleagues, 2002[24] Cross-sectional Australia Positive	N=71 inpatients Lymphoma, breast, prostate, esophagus, lung, sarcoma, myeloma	PG-SGA[n] SGA	98/82	NR	95/93	NA	Yes

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Table 1. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the validity and reliability of malnutrition screening tools and nutrition assessment tools used with adult oncology patients in ambulatory and acute care settings (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Tool Reference standard	Results				Recommended for Use[a]
			Sensitivity/ specificity (%)	Interrater reliability	Positive predictive value/negative predictive value (%)	Other	
Isenring and colleagues, 2003[25] DVR Australia Positive	N=57 outpatients undergoing radiation therapy Head and neck, abdominal, rectal	PG-SGA SGA and global quality of life (EORTC QLQ-C30)[o]	NR/NR	NR	NR/NR	Significant linear trend between PG-SGA scores for each SGA classification ($P<0.001$) Change in PG-SGA score was significantly different between subjects who improved, maintained, or deteriorated in status according to SGA ($F_{(3,53)}=23.48$; $P<0.001$) PG-SGA score was correlated with baseline BMI ($P<0.008$) and 6 mo BW ↓ prior to baseline ($P<0.001$)	Yes
Kwang and Kandiah, 2010[26] Cross-Sectional Malaysia Positive	N=58 inpatients and outpatients Advanced cancers	PG-SGA Anthropometric measures[p]	NR	NR	NR	Significant difference ($P<0.05$) in anthropometric measures for the 3 PG-SGA stages Low readings of anthropometric measures were associated with higher PG-SGA scores ($R=$ -0.32; $P<0.05$)	Yes, recommend further research
Laky and colleagues, 2008[27] DVR Australia Positive	N=194 outpatients Gynecologic	PG-SGA SGA	NR/NR	NR	NR/NR	Area under the curve: For scored PG-SGA: 0.92 (95% CI, 0.83-1.01; $P<0.001$) For pretreatment albumin: 0.92 (95% CI 0.84-1.01; $P<0.001$) For total body potassium: 0.77 (95% CI 0.61-0.94; $P<0.005$) For triceps skinfold: 0.70 (95% CI 0.53-0.88; $P<0.041$)	Yes

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Table 1. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the validity and reliability of malnutrition screening tools and nutrition assessment tools used with adult oncology patients in ambulatory and acute care settings (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Tool Reference standard	Results Sensitivity/specificity (%)	Interrater reliability	Positive predictive value/negative predictive value (%)	Other	Recommended for Use[a]
Li and colleagues, 2010[28] Descriptive China Neutral	N=148 inpatients Lung; benign lung cancer	PG-SGA SGA BMI and biochemical parameters	NR/NR	NR	NR/NR	Weight/BW ↓ predicted SGA and PG-SGA ratings in both groups Albumin, total lymphocyte count, hemoglobin, transferring, and prealbumin predicted SGA rating for lung cancer Transferrin and hemoglobin predicted SGA rating for benign lung cancer; transferrin predicted PG-SGA rating for benign lung cancer Albumin, total lymphocyte count, transferring, and prealbumin predicted PG-SGA for lung cancer Prealbumin was the only predictor of SGA (severe malnutrition) for both groups. Prealbumin accurately predicted PG-SGA (severe malnutrition for lung cancer only) Highest receiver-operating characteristic area under the curve was for PG-SGA score, BMI, and BW	Yes
Persson and colleagues, 1999[29] DVR Sweden Neutral	N=87 outpatients GI, urologic	PG-SGA Physician, dietitian	NR/NR	NR	NR/NR	PG-SGA classification agreement: 90% Muscle wastage: 53% Subcutaneous fat ↓: 61% Multivariate analysis for PG-SGA predictors of nutritional status classification: Level of food intake (odds ratio 35.87; $P<0.02$), BW ↓ past 6 mo (odds ratio 7.54; $P<0.02$), muscle wastage (odds ratio 20.09; $P<0.001$)	Yes

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Table 1. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the validity and reliability of malnutrition screening tools and nutrition assessment tools used with adult oncology patients in ambulatory and acute care settings (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Tool Reference standard	Results				Recommended for Use[a]
			Sensitivity/ specificity (%)	Interrater reliability	Positive predictive value/negative predictive value (%)	Other	
Read and colleagues, 2005[30] DVR Australia Positive	N=126 outpatients reassessed at Weeks 4-6 N=104 outpatients reassessed at Weeks 8-12 Colorectal, lung, esophageal, gastric, or pancreatic	Mini Nutrition Assessment PG-SGA	97/54 (Baseline) 79/69 (at 4-6 wk) 93/82 (At 8-12 wk)	NR	59/NR 54/NR 66/NR	χ^2 goodness-of-fit test confirmed nonsignificant (P=0.631) difference between the 2 methods	No

[a]Tool recommended by author for use in the studied population.
[b]DVR=diagnostic, validity, or reliability study.
[c]MST=Malnutrition Screening Tool.
[d]MUST=Malnutrition Universal Screening Tool.
[e]NRS-2002=Nutrition Risk Screening 2002 tool.
[f]NR=not reported.
[g]k=kappa.
[h]SGA=Subjective Global Assessment.
[i]BW=body weight.
[j]BMI=body mass index.
[k]NA=not applicable.
[l]PG-SGA=Patient Generated Subjective Global Assessment.
[m]ZSDS=Zung Self-Rating Depression Scale.
[n]The PG-SGA was evaluated as a nutrition assessment tool in this systematic review, because no validation studies for the PG-SGA short form were available within the search inclusion dates.
[o]EORTC QLQ=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire.
[p]Height, weight, BMI, midarm muscle circumference, triceps skinfold, and % BW change within 1 and 6 mo.

Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Alexandre and colleagues, 2003[31] Case-control France Positive	N=107 Advanced solid tumors (primarily breast, gynecologic, and GI[a]; also lung and other)	Nutritional and Inflammatory status score	Nutritional and inflammatory status score and performance status were determinants of severe hematologic toxicity associated with CT
Amaral and colleagues, 2008[17] DVR[b] Portugal Positive	N=130 Various (head and neck, GI, gynecologic, and other)	MST[c] score MUST[d] score NRS-2002[e] score (reference standard)	Mean LOS: 12.5 d for undernourished vs 7.5 d for well nourished (P=0.016) Undernourished or at nutritionally at risk patients (classified by NRS-2002 or MUST), respectively, had an independent higher risk of ↑ LOS (≥7 d)
Antoun and colleagues, 2009[32] Prospective cohort France Positive	N=275 Various	Weight loss PG-SGA[f] score NRI[g] score	BW[h] loss ≥10% significantly (P=0.02) correlated with LOS (P<0.05) BW loss ≥15% significantly correlated with LOS (P<0.001) PG-SGA score and NRI significantly correlated with LOS (P<0.001 and P=0.001, respectively)
Barlow and colleagues, 2011[33] Randomized, controlled trial United Kingdom Positive	N=121 Upper GI	NRI score Unintended weight loss	NS[i] differences in hospital readmissions between patients receiving early enteral nutrition vs nil by mouth within 6 wk of discharge or between 6 and 12 wk after discharge Patients receiving early enteral nutrition had shortened LOS (16 vs 19 d; P=0.023)
Bauer and colleagues, 2005[34] Noncontrolled trial Australia Neutral	N=7 Pancreatic or NSCLC[j]	PG-SGA score	Over 8 wk, change in nutritional status (PG-SGA score) was significantly associated with change in QoL (R=−0.835; P=0.020)
Braga and colleagues, 1998[35] Randomized, controlled trial Italy Positive	N=166 Gastric or pancreatic	Weight loss	Length of postoperative stay was significantly reduced in the enriched early enteral nutrition group compared with the parenteral nutrition group (13.7±4.8 d vs 17.5±6.1 d; P<0.05)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Capuano and colleagues, 2008[36] Noncontrolled trial Italy Neutral	N=40 Head and neck	Weight loss	84% of patients who were noncompliant with nutrition program were admitted to hospital due to severe malnutrition and dehydration Rate of hospital readmission was 53% in patients with BW loss >20% vs 13% in patients with BW loss <20% ($P<0.003$) Treatment interruptions were correlated with BW loss percentage (Spearman test: $r=0.484$; $P=0.003$) Infections were higher in patients with BW loss >20% vs <20% BW loss (47% vs 4%; $P=0.002$) Mortality was higher in patients with BW loss of >20% (35% vs 4%; $P=0.029$)
Carey and colleagues, 2011[37] Case series Australia Positive	N=30 Upper GI	SGA[k] score Low BMI[l] % Weight change Nutritional intake Suboptimal triceps skinfold, midarm muscle circumference, hand grip strength	Malnourished participants had poorer QoL and more symptoms SGA and the Gastrointestinal Symptom Rating Scale were significant in explaining 50.3% of variance in global QoL ($F=13.646$; $P<0.001$)
Correia and colleagues, 2007[38] DVR Portugal Positive	N=48 Gastric	PG-SGA score Suboptimal hand grip strength TNF-α[m] Loss of fat-free mass, subcutaneous fat Weight loss	TNF-α values showed an excellent discriminative power to identify malnourished patients with a sensitivity of 93% and a specificity of 94%; TNF-α was the more significantly associated to worse QoL in both functional and symptom scales and also to anorexia

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Dewys and colleagues, 1980[39] Cross-sectional United States Neutral	N=3,047 Non-Hodgkin's lymphoma, breast, leukemia, sarcoma, colon, prostate, SCLC[n], NSCLC pancreatic, gastric	Weight loss	Survival was shorter in patients with BW loss compared with those without BW loss; statistically significant for 9 of 12 comparisons; when analyzed by weight loss categories, the greatest difference was between the no weight loss and the 0% to 5% weight loss categories for prostate and colorectal cancer; for each tumor extent category, survival was shorter in colon cancer patients with BW loss compared with those without
Eriksson and colleagues, 1998[40] Retrospective cohort Sweden Neutral	N=52 Acute leukemia	Suboptimal albumin Weight loss	BW change was statistically significant related to the number of days with fever ($R=-0.35$; $P=0.026$) Lowest recorded serum albumin value correlated negatively with the number of infections and number of days with fever ($R=-0.33$; $P=0.03$ and $R=-0.4$; $P=0.002$) 16% had unplanned breaks in RT, all of which experienced greater BW loss than those without treatment breaks (median change −3.1% vs −1.6%, respectively; $P<0.05$)
Fearon and colleagues, 2006[41] Prospective cohort Not specified Positive	N=175 Pancreatic	Cachexia Suboptimal hand grip strength Loss of LBM[o] Weight loss	QoL function variables ($P<0.001$), health status ($P<0.001$), Karnofsky performance scale ($P<0.001$), grip strength ($P<0.001$), and LBM ($P=0.003$) were significantly lower in patients meeting the cachexia profile definition (ie, BW loss, food intake, and inflammatory status) LBM (hazard ratio 1.028; $P=0.018$) and the 3-factor cachexia profile itself (hazard ratio 2.959; $P<0.001$) were prognostic
Gioulbasanis and colleagues, 2011[42] DVR Greece Positive	N=115 Metastatic lung	Mini Nutrition Assessment score	Mini Nutrition Assessment score was significantly associated with overall survival ($P=0.004$)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Gupta and colleagues, 2010[43] Retrospective cohort United States Positive	N=98 Ovarian	SGA score	At baseline, median survival for SGA-A (n=46) was 20.3 mo whereas SGA-B/C (n=52) was 9.8 mo (P=0.03); at 3 mo, median survival for SGA-A (n=63) was 19.9 mo, whereas SGA-B/C (N=35) was 3.7 mo (P<0.001) Patients with improved nutritional status at 3 mo had a significantly better survival than those with deteriorated nutritional status independent of age, stage at diagnosis, prior treatment history, and tumor response, as determined by cancer antigen 125
Hammerlid and colleagues, 1998[44] Descriptive Sweden Neutral	N=58 Head and neck	Weight loss Weight Index Low BMI Suboptimal albumin	When comparing malnourished with normal nutritional status, malnourished patients scored worse for 12 of the 16 functions/symptoms (NS) Patients with >5% BW loss vs those with no BW loss scored worse for 11 of 16 QoL functions, with significant differences between groups for "swallowing difficulties" and "problems swallowing food" (both P values <0.01) Survivors scored better than deceased patients for all 16 QoL functions/symptoms. Significant difference between the 2 groups for appetite loss (P<0.01), fewer problems swallowing food (P<0.01)
Hill and colleagues, 2011[45] Prospective cohort Australia Positive	N=73 GI cancers	PG-SGA score Weight loss	Toxicity severity was higher in those who experienced unplanned hospital admission compared with those without admission (42.1% vs 9.3%, respectively; P<0.001). Severity of RT toxicity was strongly correlated with PG-SGA score (R=0.839; P<0.001) 16% of patients had unplanned breaks in RT and experienced greater weight loss than those without treatment breaks (median change −3.1% vs −1.6%, respectively; P<0.05) Patients not completing prescribed CT had a significantly greater change in PG-SGA score throughout RT, than those who did complete CT (median increase 17 vs 3; P<0.05)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Horsley and colleagues, 2005[46] Case Australia Positive	N=66 Patients requiring peripheral blood stem cell transplantation	PG-SGA score Suboptimal albumin	Significant correlation between PG-SGA score and LOS posttransplant (R=0.308; P=0.013) and serum albumin (R= −0.338, P=0.006) Well-nourished 16.9±6.3 days vs malnourished 23.9±9.9 d; P<0.002; −7.0±2.1 d difference between groups in posttransplant LOS
Hyltander and colleagues, 2005[47] Randomized, controlled trial Sweden Positive	N=126 Upper GI	Preoperative weight loss >10% Suboptimal triceps skinfold, arm muscle circumference Loss of LBM	LOS among groups was NS The Psychological General Well-Being Index improved more in the patients receiving parenteral nutrition, than enteral and oral nutrition postoperatively. The difference in the Psychological General Well-Being Index total emerged from 6 mo onward after the operation (P<0.05) The Psychological General Well-Being Index dimensions of anxiety and positive well-being followed the same pattern with less anxiety and more positive well-being in the parenteral nutrition group (P<0.05) Emotional functioning according to EORTC QLQ-C30[p112] had improved significantly more in the parenteral nutrition group compared with the oral group after 6 mo (P<0.01), but after 12 mo difference was NS Survival did not differ significantly between patients receiving parenteral, enteral, or oral nutrition
Ionescu and colleagues, 2009[48] Randomized, controlled trial Romania Positive	N=96 Colorectal	Prolonged time to mobilization postsurgically and delayed feeding	Fast Track protocol vs Conventional (fluid and solid food intake): High-dependency unit stay 0.92±1.11 d (fast track) vs 1.77±1.46 d (conventional); LOS 6.43±3.41 d (fast track) vs 9.16±2.67 d (Conventional); (P=0.001 for both)
Isenring and colleagues, 2003[25] DVR Australia Positive	N=60 Head and neck, abdominal, rectal	PG-SGA score	Significant correlation between PG-SGA score and global QoL at baseline (R=−0.66; P<0.001) and after 4 wk of RT (R=−0.61; P<0.001)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Iversen and colleagues, 2010[49] Prospective cohort Norway Neutral	N=15 Multiple myeloma	Suboptimal albumin, handgrip strength, triceps skinfold Low BMI Weight loss	All 4 symptoms scores (nausea or vomiting, appetite loss, fatigue, and pain) for global health-related QoL rose significantly during therapy, indicating worsening of symptoms before returning to pretherapy levels at the end of the observation
Kathiresan and colleagues, 2011[50] Retrospective cohort US Neutral	N=300 Gynecologic	Suboptimal albumin Low BMI/underweight	Malnutrition reflected by low albumin levels is associated with significantly higher post readmission (3.9 vs 3.5 g/dL; $P=0.01$), more reoperations (3.8 vs 3.4 g/dL; $P=0.03$), more intensive care unit admissions (3.9 vs 3.0 g/dL; $P<0.001$) Underweight significantly correlated with more hospital readmissions (0.8 vs 17.4%; $P=0.001$)
Laky and colleagues, 2010[51] Prospective cohort Australia Positive	N=157 Gynecologic	PG-SGA score	Malnutrition and low QoL predicted prolonged LOS; Stage III or IV ovarian cancer associated with prolonged LOS
Martin and Lagergren, 2009[52] Prospective cohort Sweden Neutral	N=176 Esophageal, gastric	Weight loss Obesity	Preoperative BW loss was more pronounced in those who died between 6 mo and 3 y. However, postoperative BW loss was similar in the 2 groups.

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Martin and colleagues, 2010[53] Prospective cohort Canada Neutral	N=1,164 Advanced cancer	PG-SGA score	Shortened survival was associated with increasing BW loss and BW gain compared with stable weight; survival was shorter for all BMI <30.0 Shortened survival was associated with the 3 low food-intake categories ("little solid food," "only liquids/nutritional supplements," "very little of anything") that were subsequently categorized as "abnormal food intake" Median survival fitness for patients with "normal intake" (5.0 mo; 95% CI 3.7-6.2 mo), "normal food at reduced amounts" (3.4 mo; 95% CI 3.0-3.8 mo) and "abnormal intake" (2.1 mo; 95% CI 1.7-2.4 mo) were different (P=0.001) Nutrition impact symptoms associated with shorter survival were no appetitive, feel full quickly, altered taste, dry mouth, and dysphagia Patient-reported PG-SGA performance status scores of 0-2 had longer median survival (4.3 mo [95% CI 3.8-4.8 mo]) than patients with PS 3 (2.5 mo [95% CI 2.2-2.8 mo]) or patients with PS 4 (1.3 mo [95% CI, 0.05-2.0 mo]; P<0.001)
Nourissat and colleagues, 2008[54] Cross-sectional France Positive	N=907 Various; at different management stages	NRI score PG-SGA score Weight loss	Patients who lost <10% BW since the start of their illness had a significantly higher QoL score compared with those who had lost >10% BW (62.8 vs 48.8; P<0.001) A significant difference in the QoL score was observed between patients who had and those who had not modified their diet at the time of the study (65.3 vs 52.5; P<0.001) A significant association was observed between the performance status score and percent BW loss (P<0.001)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Odelli and colleagues, 2005[55] Retrospective Australia Neutral	N=48 Esophageal	Nutrition assessment Weight loss	Control group patients were more likely to have an unplanned hospital admission during therapy than nutrition pathway patients ($P<0.04$) Total days of unplanned hospital admissions were less in nutrition pathway (3.2±5.4) than in the control group (13.5±14.1) ($P<0.002$) Nutrition pathway patients were more likely to receive nutrition intervention than control patients ($P<0.05$); nutrition pathway patients lost less BW over the treatment period ($P<0.03$); significant difference was observed between groups in the number who completed the prescribed course of RT: 92% (nutrition pathway) vs 50% (control) ($P<0.003$); Nutrition pathway group received a greater percentage of the desired RT dose ($P<0.004$). NS difference between groups in dose of CT received, although there was a trend toward fewer dose reductions in the nutrition pathway group ($P<0.33$)
Ollenschlager and colleagues, 1992[56] Randomized, controlled trial Germany Neutral	N=29 Acute leukemia	Weight loss	Fatigue/malaise correlated exclusively with BW loss, whereas nutrient intake correlated closely with tumor therapy side effects
Persson and colleagues, 1999[29] DVR Sweden Neutral	N=87 Various	PG-SGA score	Significant difference in survival between SGA-A and SGA B+C for total group, ($P<0.001$), GI tumors ($P<0.01$), and metastatic GI cancer ($P<0.05$)
Phippen and colleagues, 2011[57] DVR United States Neutral	N=58 Gynecologic	PG-SGA score	PG-SGA score of 7.5 predicted febrile neutropenia during CT

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Piquet and colleagues, 2002[58] Retrospective cohort Switzerland Neutral	N=90 Oropharyngeal	Weight loss	Significant differences were seen between patients receiving nutrition intervention and those who did not for BW loss (3.5%±0.7% intervention vs 6.1±0.7 control; $P<0.01$) and hospital admissions for dehydration (0% intervention group [n=0] vs 18% control group [n=8]; $P<0.01$). Overall hospital admissions were 9 intervention vs 14 control (NS)
Prado and colleagues, 2007[59] Prospective cohort Canada Neutral	N=95 Colon	Loss of LBM	Mean 5-fluorouracil/kg LBM values of the population varied with regard to presence or absence of toxicity ($P=0.036$); a cutpoint of 20 mg 5-fluorouracil/kg LBM was identified as a threshold and predictor for developing toxicity ($P=0.005$) (odds ratio 16.5; $P=0.013$)
Prado and colleagues, 2008[60] Prospective cohort Canada Positive	N=250 Lung, colorectal, or other GI sites	Sarcopenia Obesity	Sarcopenic obesity was shown to be a significant independent predictor of survival ($P<0.0001$) Survival was ~10 mo shorter for patients with sarcopenic obesity
Prado and colleagues, 2009[61] Prospective cohort Canada Neutral	N=55 Breast	Sarcopenia	Prevalence of dose-limiting toxicity was 50% in patients with sarcopenia (7 of 14) and 19.5% in the nonsacropenia (8 of 41; $P=0.039$; hazard ratio for toxicity 4.1); toxicity prevalence (sarcopenia vs nonsarcopenia): stomatitis 36% vs 4.9% ($P=0.008$); diarrhea 29% vs 2.4% ($P=0.01$) The administered dose of capecitabine was highly variable (range=67.4-137 mg/kg LBM); thus, patients with sarcopenia received a raised amount of capecitabine dose per unit of LBM
Prado and colleagues, 2011[62] Prospective cohort Canada Neutral	N=132 Breast	Loss of LBM	Mean LBM was lower for patients presenting with treatment toxicity compared with those where toxicity was absent (41.6 kg vs 56.2 kg; $P=0.002$)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Pressoir and colleagues, 2010[63] Prospective cohort France Positive	N=1,545 Various (breast, head and neck, and other)	Weight loss Low BMI	Moderate or severe malnutrition was associated with prolonged LOS (median LOS 19.3+19.4 d); malnourished vs 13.3±19.4 d well-nourished ($P<0.0001$) Mortality (18.4%) was significantly higher in malnourished patients than in the other group (26.7 vs 11.8%; $P<0.0001$; odds ratio 2.7 [1.9-3.9], especially in severe malnutrition (37.1%; odds ratio 4.4 [2.8-6.9]) compared with mild symptoms (20.2%; odds ratio 1.9 [1.2-2.9]) Multivariate analysis showed that only severe malnutrition was independently associated with mortality
Ravasco and colleagues, 2003[64] Before-after study Portugal Positive	N=125 Head and neck, GI (high risk) Prostate, breast, lung, brain, gallbladder, uterus (low risk)	PG-SGA score	QOL was always better in low-risk patients than in high-risk patients ($P<0.01$); patients with gastric and head and neck cancers reported the lowest QoL; for high-riskpatients, QoL improved throughout the study, and improvement was statistically correlated with a rise in nutritional intake ($P<0.001$); QoL remained stable throughout the study in low-risk patients Individualized nutrition counseling is able to overcome predicted nutrition deterioration associated with RT, but only high risk patients appear to benefit
Ravasco and colleagues, 2005[65] Randomized, controlled trial Portugal Positive	N=75 Head and neck	PG-SGA score	After RT, QOL scores improved proportionally with improved nutritional status and intake in dietary counseling and nutrition supplement groups ($P<0.05$) and ↓ in the ad libitum group ($P<0.05$); at 3 mo, diet counseling group maintained or improved overall QOL, whereas patients in the other 2 groups maintained or worsened 90% of patients experienced RT-induced toxicities; trend for reduced toxicity in the dietary counseling group ($P<0.07$); at 3 mo, grade 1 and 2 symptoms of anorexia, nausea and vomiting, xerostomia, and dysgeusia were improved in 90% of these patients, 67% of nutrition supplements patients, and 51% of ad libitum patients ($P<0.001$)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Ravasco and colleagues, 2005[66] Randomized, controlled trial Portugal Positive	N=111 Colorectal	PG-SGA score	Following RT completion, QoL function scores improved proportionally to adequate food intake or nutritional status ($P<0.05$) in those receiving dietary counseling; in patients receiving protein supplements, only half of the function scores improved ($P=0.04$). In the ad libitum group all scores worsened ($P<0.05$) Patients receiving dietary counseling had significantly fewer toxicity symptoms than the other groups. After RT and at 3 mo, rates of anorexia, nausea, vomiting, and diarrhea were highest in the ad libitum group ($P<0.05$) Overall greater toxicity symptoms were correlated with poorer nutritional status (ie, PG-SGA score) ($r\geq-0.63$; $P\leq0.002$)
Robinson and colleagues, 2008[67] Randomized, controlled trial United States Neutral	N=86 Pancreatic	FACIT-F and FAACT[q111] score Weight loss Loss of LBM	Patients reported impaired health across all Short Form-36 general health survey measures at baseline with the lowest mean scores being in physical role (32.1), physical component summary (36.2), physical functioning (37.9), and pain (37.8) Patients who lost ≤5% BW within 30 d of treatment had a median overall survival of 7.3 mo (95% CI 6.3-9.1); Patients who lost >5% BW survived for a median of 6.5 mo (95% CI 4.6-10.7; log rank $P=0.44$) Median overall survival was 9.1 mo (95% CI 7.2-11.4) for patients having low fatigue (indicated by higher scores >30, n=48 and 5.2 mo, 95% CI 4.0-7.2) for those with high fatigue (indicated by score ≤30; n=32; log rank $P=0.002$)

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Table 2. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the relationships among nutritional status and hospital admissions/readmissions, hospital length of stay (LOS), quality of life (QoL), radiation treatment (RT) tolerance, chemotherapy treatment (CT) tolerance, and mortality outcomes in adult oncology patients (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Ross and colleagues, 2004[68] Cohort United Kingdom Positive	N=780 Lung	Weight loss	Fewer patients with BW loss (n=315; 67%) completed 3 cycles of CT than those without BW loss (n=210; 81%; $P<0.001$); treatment was delayed significantly more frequently in patients with BW loss associated with NSCLC than those without (9.0% vs 4.0%; $P=0.04$) Overall survival was significantly shorter for patients with BW loss compared with those without BW loss with SCLC (6 vs 11 mo; $P=0.0003$), NSCLC (6 vs 9 mo; $P<0.0001$), and mesothelioma (5 vs 12 mo; $P=0.025$) Weight stabilization for patients with NSCLC resulted in significant improvement in both progression free (rise from 5-7 mo; $P=0.01$) and overall survival (rise from 7-9 mo; $P=0.006$)
Shahmoradi and colleagues, 2009[69] Cross-sectional Malaysia Neutral	N=61 receiving home hospice care Advanced cancer	PG-SGA score	PG-SGA scores significantly correlated with total QoL scores and the 3 subscale scores Patients with a higher PG-SGA score or poorer nutritional status exhibited a lower QoL
Sorensen and colleagues, 2008[70] Prospective cohort Various countries in Eastern and Western Europe, and the Middle East Positive	N=5,051 Various	NRS-2002 score	Death was more frequent in nutritionally at-risk patients than not at risk ($P<0.001$) LOS $\geq$28 d was related to age $\geq$70 y ($P<0.0001$), cancer ($P<0.0001$), and specialties other than intensive care unit ($P<0.0001$); longer LOS predictors: at-risk status, age $\geq$70 y, cancer, comorbidity, and complications; LOS was significantly related to the nutrition screening components when adjusted for confounding variables Six days (range=3-11 d) not-at-risk patients vs 9 d (range=5-16 d) at-risk patients, $P<0.001$; LOS <28 d not-at-risk patients: 7.3±0.1 d vs 9.7±0.2 d at-risk patients; $P<0.01$ LOS >28 d marginally associated with nutritional status; $P=0.053$

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Author(s), year Study design Location Quality rating	Population Cancer site	Nutritional status indicator(s)	Results
Tan and colleagues, 2009[71] Prospective cohort Canada Positive	N=111 Ampullary carcinoma, cholangio-carcinoma, neuroendocrine tumors	Sarcopenia Overweight/obesity	Median survival for patients who were both overweight/obese and sarcopenic was 55 days (interquartile range=43-207 d) compared with 148 d (interquartile range=80-369 d) for those without overweight/obese sarcopenia (log-rank test P=0.003) On multivariate analysis, age ≥59 y (hazard ratio 1.71, 95% CI 1.10-2.66; P=0.018) and overweight/obese sarcopenia (hazard ratio 2.07, 95% CI 1.23-3.50; P=0.006) retained independent prognostic value
Yoon and colleagues, 2011[72] Retrospective cohort United States Positive	N=778 Esophageal	Obesity	For disease-specific survival the BMI and smoking interaction term was significant (P=0.023), indicating that the prognostic impact of excess BMI differed significantly on the basis of smoking status. Among never smokers (n=236), univariate analysis revealed that obese patients had significantly shorter disease-specific survival compared with normal-weight patients (hazard ratio 1, 0.62, 95% CI 1.03-2.53; P=0.034). In multivariable analysis among never smokers, obesity was significantly associated with adverse disease-specific survival (hazard ratio 2.11, 95% CI 1.31-3.43; P=0.002), DFS (hazard ratio 2.03, 95% CI 1.30- .18; P=0.002), and OS (hazard ratio 1.97, 95% CI 1.24 to 3.14; P=0.004) compared with normal weight, after adjusting for tumor stage, grade, age, presurgical BW loss, and sex

[a]GI=gastrointestinal.
[b]DVR=diagnostics, validity, or reliability study.
[c]MST=Malnutrition Screening Tool.
[d]MUST=Malnutrition Universal Screening Tool.
[e]NRS-2002=nutritional risk screening 2002.
[f]PG-SGA=patient generated subjective global assessment.
[g]NRI=nutrition risk index; not validated in oncology populations.
[h]BW=body weight.
[i]NS=not significant.
[j]NSCLC=non–small cell lung cancer.
[k]SGA=Subjective Global Assessment.
[l]BMI=body mass index.
[m]TNF-α=tumor necrosis factor α.
[n]SCLC=small cell lung cancer.
[o]LBM=lean body mass.
[p]EORTC QLQ-C30=European Organization for Research and Treatment of Cancer quality of life questionnaire.
[q]FACIT-F and FAACT=Fatigue and Nutritional Health Assessment and Functional Assessment of Anorexia/Cachexia Therapy.

Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Block and colleagues, 2009[73] Case series United States Neutral	N=90 Final N=78 Metastatic breast cancer; attending community-based facility (Block Center for Integrative Cancer Treatment) undergoing CT[b]	**MNT:** Personalized nutrition and supplement regimen developed by oncologist; RDN provided patient education and hands-on training[c] **Duration:** Followed for survival for 5 y	Median survival time from metastasis: 38 mo (range=7-137 mo; 95% CI 27-48). 3-y survival: 52%; 5-y survival: 27% Disease-free interval <18 mo, age group (<40, 41-50, >50 y) and estrogen receptor status (positive or negative) significantly predicted survival Disease-free interval of >18 mo had a significantly longer survival than those with a shorter disease-free interval (P=0.007).
Danielson and Fairchild, 2011[74] Noncontrolled trial Canada Neutral	N=40 Final N=29 Nonhematologic cancers with brain metastases; planned for RT[d]	**MNT:** A multidisciplinary palliative RT clinic (radiation oncologist, radiation therapist, registered nurse, nurse practitioner, pharmacist, social worker, occupational therapist, and FNP) to optimize symptom control and QoL[ce] **Control:** None **Duration:** 4 wk	A total of 11 clinic patients (33%) were assessed by FNP for symptoms of weight loss, ↓ appetite, and 1 for ↑ appetite and weight gain Patient satisfaction: 86% reported very satisfied with the clinic experience; 97% would recommend the clinic although these data are not specific to patients being seen by an FNP. Too few patients were able to complete the QoL questionnaires at 4 wk for meaningful statistics.
Dawson and colleagues, 2001[75] Non-RCT[f] Scotland Neutral	N=71 (MNT: n=45 consecutive patients; Control: n=26) Final N=NR[g] Squamous cell carcinoma of the oral cavity; undergoing RT 4 wk following surgery	**MNT:** Continuous dietary supervision per FNP postsurgery through post-RT as frequently as required, usually once a week[c] **Control:** Historical controls received dietary supervision once every 2 wk, with a 4-wk gap postsurgery through pre-RT **Duration:** 1 y	Weight loss postsurgically: MNT group 2.42% vs control 3.67% (P<0.05) Weight loss post-RT: MNT group 4.83% vs 6.56% control (P<0.05) Weight loss after surgery and RT: MNT group 6.6% vs 9.83% control (P<0.05). Weight loss at 1 y: MNT group 5.9% vs 7.82% control (NS)
Dintinjana and colleagues, 2008[76] Non-RCT Croatia Neutral	N=388 (MNT: n=215; Control: n=173) Final N=388 CRC[h]; undergoing CT[i]	**MNT:** Counseling by FNP + enteral or parenteral nutrition or MGA,[j] as appropriate **Control:** No nutrition support; monitored retrospectively **Duration:** 12 visits according to CT schedule; time course unclear	Number of patients with BMI[i] <20: 15.3% ↓ MNT group vs 12.1% ↑ control (P value=NR) 65% of MNT group ↑ BW[k]; greatest BW gain in patients on MGA. MNT group had ↑ appetite scores, especially in those receiving MGA 39% of control group had BW ↓ ≥2 kg/mo during treatment KPS[l] scores: NS[m] change for either group

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Glare and colleagues, 2011[77] Prospective cohort Australia Neutral	N=54 Final N=25 Lung, CRC, and upper GI[n] cancers with anorexia cachexia syndrome; 81% undergoing CT, RT, or combined therapy	**MNT:** Individualized treatment program, including symptom management, supplements if needed, and strength training, if needed Patients were evaluated by the physician, FNP, and physical therapist **Duration:** 8 wk	Those who stayed in the program for 2 mo lost less weight (10% vs 11.8%), were better nourished (Subjective Global Assessment category A 30% vs 0%), were fitter (median 6-min walk test in meters, 464 vs 390), and were less likely to have ↑ C-reactive protein value (≤10, 29% vs 9%) Of the 35 participants attending the baseline physical therapy assessment, >90% reported that the cancer nutrition rehabilitation program was important to them
Glimelius and colleagues, 1992[78] Case-control Sweden Neutral	N=58 (n=58 MNT; n=22 QoL-C; n=81 Survival nutrition control) Final N=36 MNT; 22 QoL-C; 81 Survival nutrition control SCLC; undergoing CT with curative intent	**MNT:** Individualized nutrition counseling, MFS[o] and symptom management **Control 1:** Survival nutrition control historical controls **Control 2:** QoL-C preproject control group **Duration:** 8 treatment courses	NS differences in survival, responses to treatment, duration of responses to treatment, number of treatment days in hospital, number of days before patients reached course 8 or 16, septic episodes, or erythrocyte transfusions BW during treatment ($P<0.01$), BMI during treatment ($P<0.05$), and proportion of patients who experienced a ↓ in BW >10% ($P<0.05$) was significantly better in the MNT group Proportion of patients with a marked ↓ in serum albumin was higher in the Survival nutrition control group ($P<0.01$) PRO[p] intake improved during the study period to an average 50-80 g/d/patient; no patient reached desired PRO level Global scores for the CIPS[q] were improved for the MNT group ($P<0.001$) vs QoL-C group Significant differences for the study group were seen in physical ($P<0.001$), psychosocial ($P<0.001$), CIPS groups subsets MNT group: Strong trend toward ↓ CT-related adverse effects ($P=0.07$)

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Goncalves Dias and colleagues, 2005[79] Non-RCT Brazil Neutral	N=64 (n=32 oral group; n=16 Nasoenteral feeding; n=16 MFS) Final N=NR H&N[r] cancer; undergoing RT following surgery	3 MNT groups **MNT Oral:** Oral diet of appropriate consistency with 5-6 small meals/d **MNT NEF:** Home nasoenteral feeding **MNT MFS:** Oral diet+MFS 3/d All groups counseled by specialized nutritionist to maintain 40 kcal/kg intake during treatment period **Duration:** 70 d	Caloric ingestion ↑ pre- to postintervention in all 3 groups ($P<0.001$). Greatest ↑ occurred in MNT nasoenteral feeding group ($P<0.05$) PRO ingestion ↑ in all 3 groups ($P<0.001$) NS pre- and postintervention differences in anthropometric values between the 3 groups NS differences in lab values between the 3 groups, with the exception of total lymphocytes, which ↓ significantly for all groups following RT
Isenring and colleagues, 2003[80] RCT Australia Positive	N=36 (MNT: n=15; Control: n=21) Final N=32 H&N cancer; undergoing RT	**MNT:** Regular intensive nutrition counseling by FNP according to the ADA[s] MNT protocol for radiation oncology **Control:** General nutrition advice from the nursing staff, a nutrition booklet, and MFS samples **Duration:** 3 mo	Control lost significantly more BW than MNT group (4.3 kg vs 1.1 kg, 6.1% vs 1.1%, respectively; $P<0.019$). Control lost significantly more fat-free mass than MNT group (2.2 kg vs 0.3 kg; $P<0.029$). Control lost more fat mass than MNT group (NS)
Isenring and colleagues, 2004[81] RCT Australia Positive	N=60 (MNT: n=29; Control: n=31) Final N=NR GI or H&N cancers; undergoing RT	**MNT:** Regular, intensive counseling by an FNP **Control:** UC[t] educated by nurses; received nutrition booklet and MFS samples **Duration:** 12 wk	MNT group differed from control in BW change (MNT −0.4 kg, UC −4.7 kg; $P<0.001$), deterioration in nutritional status per PG-SGA[u] score ($P<0.02$); deterioration in and recovery of global QoL score ($P<0.009$); physical function over time ($P<0.012$); number who remained weight stable during treatment (MNT 24% vs UC 11%; $P<0.016$). MNT group maintained fat-free mass; control group lost fat-free mass (+0.4 kg vs −1.4 kg; $P<0.195$)
Isenring and colleagues, 2004[82] RCT Australia Neutral	N=60 (MNT: n=29; UC: n=31) Final N=53 GI or H&N cancers; undergoing RT	**MNT:** Early, intensive nutrition support by the same FNP + high energy/PRO MFS if required **UC:** Education from nurses, a nutrition booklet, and MFS samples **Duration:** 12 wk	MNT group scored staff interpersonal skills higher than the UC group ($P<0.001$), perceived health benefits ($P<0.008$), staff presentation skills ($P<0.044$), and overall patient satisfaction ($P<0.002$) Overall patient satisfaction measures remained significant regardless of age or level of family support

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Isenring and colleagues, 2007[83] RCT Australia Positive	N=60 (MNT: n=29; UC: n=31) Final N=54 GI or H&N cancers; undergoing RT	**MNT:** Regular intensive nutrition counseling by FNP using the ADA MNT radiation oncology protocol **Control:** General nutrition talk by nurses, nutrition and cancer booklet, high energy/PRO MFS sample. **Duration:** 12 wk	MNT group had a smaller ↓ and faster recovery in global QoL (P=0.009) and physical function (P=0.012) over time than the control group. MNT group lost less BW over the treatment period (P<0.03) MNT group ↑ mean energy and PRO intake/day vs control group (P=0.029 and P<0.0001, respectively) Similarly mean energy and PRO intake/kg BW/d was ↑ for the MNT group (P=0.022 and P=0.001, respectively) MNT group had a trend toward a ↑ in fiber intake (P=0.083) MNT group had ↑ PG-SGA scores 8 wks (P=0.02) and trended higher at 12 wks (P=0.065)
Odelli and colleagues, 2005[55] Retrospective cohort Australia Neutral	N=48 (MNT: n=24; Control: n=24) Final N=48 Esophageal cancer; undergoing CT/RT	**MNT:** Nutrition pathway at initiation of treatment by FNPs and weekly **Control:** Nutrition treatment in a reactive manner by FNP, only when problems occurred **Duration:** NR	Number of patients assessed at severe risk who received enteral nutrition was greater in the MNT group (P<0.003), than control NS difference between the 2 groups in dose of CT received, although there was a trend toward fewer dose reductions in the MNT group (P<0.33) MNT group completed the prescribed number of RT treatments (92% MNT vs 50% control group; P<0.003) and received a greater % of desired RT dose (P<0.004) MNT group had fewer unplanned hospital admissions (P<0.04) and shorter unplanned hospital length of stay (3.2±5.4 vs 13.5±14.1 days) (P<0.002) during therapy than the control group Hospitalization for nutrition support was less in MNT than control (1 vs 6; NS)

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Ollenschlager and colleagues, 1992[56] RCT Germany Neutral	N=32 (MNT: n=16; Control: n=16) Final N=29 Acute lymphocytic leukemia; acute nonlymphocytic leukemia; undergoing poly-CT: LAM-6; ULM; TAD	**MNT:** Intensive oral nutrition + FNP intervention **Control:** Diet ad libitum **Duration:** Mean 25.5 wk	Days with temperature >38.5°C, remission rate, or in-study mortality between groups (NS) No difference between groups in BW during the induction period, and nutritional status of all patients was highly impaired Both groups experienced a BW ↓of 8% of pretreatment weight up to third to seventh study week; one-third lost >10% After the period of weight loss, the MNT group demonstrated benefits MNT group receiving LAM 6 treatment showed more weeks with BW gain to the end of the induction phase than the control (BW ↑ during 33.8% vs 13.2% of the induction phase) Dietetic intervention resulted in many more weeks of stable BW in the study groups (48.7% vs 18.3% of the induction phase for the TAD groups; 53.1% vs 31.5% of the induction phase for the ULM groups; $P<0.05$) At the end of the induction period, 5 out of 16 MNT group and 11 out of 16 control group weighed <95% prestudy weight (*P* value NR). During the consolidation period, MNT group ↓ weight for 22.8% of treatment weeks; control groups ↓ weight during 49% of treatment weeks A significant correlation was found between nutritional intake and tumor-therapy side effects (eg, anorexia and fatigue) (*P* values <0.01)

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Ovesen and colleagues, 1993[84] RCT Denmark Positive	N=137 (MNT: n=57; Control: n=48) Final N=105 Breast, ovary, or lung (small cell) tumors; undergoing CT with curative intent	**MNT:** Individual counseling by FNP as desired + MFS to achieve nutrition goals **Control:** Nutrition education at physician's discretion **Duration:** 5 mo	No difference in BW between groups (NS) although energy and PRO intake was ↑ for MNT group ($P<0.5$) Both groups ↑ QoL ($P<0.05$) but no difference between groups (NS) No differences in tumor response or overall survival rate
Pituskin and colleagues, 2010[85] Prospective cohort study Canada Neutral	N=82 Final N=23 Prostate, breast, non−small cell lung cancer malignancies with painful bone metastases; attending Rapid Access Palliative RT program	**MNT:** Recommendations were made by multidisciplinary team including pharmacy, occupational therapist, FNP, and social worker for relief of symptoms*[c] **Duration:** 4 wk	FNP recommendations (n=24) included weight loss or gain counseling (n=21); nutritional education (n=21); tips on symptom management (n=16); and information related to physical problems limiting intake (n=9). ESAS[v] for all available patients at 4 wk showed improvements in pain relief ($P=0.001$), tiredness ($P=0.001$), depression ($P=0.013$), anxiety ($P=0.000$), drowsiness ($P=0.022$), and overall well-being ($P=0.035$) No difference from baseline in shortness of breath, ($P=0.383$), nausea ($P=0.196$), or appetite ($P=0.062$)
Ravasco and colleagues, 2003[64] Before−after study Portugal Positive	N=125 Final N=125 H&N, gastric, esophageal, CRC, prostate, breast, lung, brain, gallbladder, uterus; undergoing RT	**MNT:** Assessment, dietary intake, dietary counseling by FNP **HR:** High-risk group: H&N, gastric, esophageal, CRC **LR:** Low-risk group: prostate, breast, lung, brain, gallbladder, uterus **Duration:** End of RT, not otherwise specified	High-risk group ↑ in severity of symptoms during therapy ($P<0.0001$) High-risk group ↑ energy intake during therapy ($P<0.03$) High-risk group ↑ PRO intake during therapy, although remained substandard throughout the study High-risk group attributed ↑ in energy and PRO intake to individualized nutrition counseling provided by FNP QoL ↑ for high-risk group; improvement was correlated with ↑ nutritional intake ($P<0.001$) Baseline energy and PRO intake were ↑ in the low-risk group ($P<0.002$ and $P<0.003$, respectively) Baseline nutritional status was associated with nutritional intake ($P<0.007$; Kruskal-Wallis analysis adjusted by tumor staging)

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Ravasco and colleagues, 2005[65] RCT Portugal Positive	N=75 (MNT: n=25; MFS: n=25; Control: n=25) Final N=NR H&N cancer; undergoing RT	**MNT:** Counseling by FNP+regular diet **MFS:** Usual diet+MFS **Control:** Usual diet **Duration:** 3 mo	MNT and MFS: At end of RT energy ↑ ($P<0.002$ and $P<0.05$, respectively) with MNT intake greater than MFS group ($P=0.005$). PRO intake ↑ (26 g/d, $P<0.006$; and 35 g/d, $P<0.001$, respectively) and ↓ in control group (15 g/d, $P<0.01$) At 3-mo follow-up, MNT maintained energy intake; MFS and control groups returned to or below baseline levels ($P=0.005$); PRO intake patterns were similar Most patients experienced RT-induced toxicities (90%); however, there was a trend for ↓ toxicity in MNT group ($P<0.07$) At 3 mo, nausea, vomiting, xerostomia, and dysgeusia were improved in 90% of MNT group, 67% of MFS, and 51% of control group ($P<0.001$), despite controlling for adequate and appropriate medications to improve symptoms After RT, MNT group showed ↑ QoL function scores ($P<0.003$), which were proportional with improved nutrition status and intake. MFS group showed similar results ($P<0.009$) although proportional only to PRO intake. At 3 mo, MNT group showed ↑ global QoL. QoL 6 of 6 function scales, 3 of 3 symptom scales, with mixed results for single item symptoms. At 3 mo, MFS group showed ↑ global QoL, 6 of 6 function scales but ↓ symptom scales and single item symptoms. At end of RT and 3 mo, the control group showed ↓ global QoL scores in all areas.

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
Ravasco and colleagues, 2005[66] RCT Portugal Positive	N=111 (MNT: n=37; MFS: n=37; Control: n=37) Final N=111 CRC; undergoing RT	**MNT:** Counseling by FNP+regular diet **MFS:** MFS+regular diet **Control:** Ad libitum intake **Duration:** 3 mo	MNT and MFS: At end of RT, energy ↑ ($P<0.002$ and $P<0.04$, respectively); MNT intake greater than MFS group ($P=0.001$). Control group ↓ energy intake ($P<0.01$). At 3-mo follow-up, MNT maintained energy intake; MFS and control groups ↓ energy intake ($P=0.05$). PRO intake ↑ in MNT and MFS groups (27 g/d, $P<0.007$ and 30 g/d, $P<0.001$, respectively). Control group ↓ PRO intake by 10 g/d ($P<0.01$). At 3-mo follow-up MNT maintained PRO intake; MFS and control groups ↓ PRO intake ($P=0.06$). MNT group had less nutrition-related decline based on PG-SGA and BMI at the end of RT and at 3 mo ($P<0.001$) vs MFS or control MNT group experienced ↓ anorexia, nausea, vomiting, diarrhea ($P<0.001$, $P<0.0001$, and $P<0.0001$, respectively) vs MFS or control MNT group significantly ↑ global QoL, 6 of 6 function scales, 3 of 3 symptom scales, and improved or maintained single item symptoms at RT completion, which remained at 3 mo (specific *P* values for each item not shown for brevity)

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Table 3. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of the effectiveness of medical nutrition therapy (MNT) in adult oncology patients undergoing chemotherapy and radiation treatment (*continued*)

Author(s), year Study design Location Quality rating	Population Cancer site	MNT Intervention by an RDN/FNP[a] Duration	Results
van den Berg and colleagues, 2010[86] Non-RCT The Netherlands Neutral	N=38 (MNT: n=20; Control: n=18) Final N=38 H&N cancer; undergoing RT	**MNT:** Individualized, intensive counseling by FNPs **Control:** FNP visits before initiation of RT; nurse for nutrition care during RT **Duration:** 20 wk	2 wk following treatment: Both groups had 3% unintended weight loss (*P* value NR) and 0 out of 20 in MNT group vs 5 out of 18 in the control were malnourished (defined as unintended weight loss ≥5%) (*P*=0.02) 8 wk following treatment: MNT group had a 1% BW ↑ vs 1.5% BW ↓ for control (*P*=0.03). Total BW loss was 2% for MNT and 4.5% for control; 3 out of 18 controls remained malnourished NS difference in BMI between groups at any time during the study

[a]RDN=registered dietitian nutritionist; FNP=food and nutrition practitioner.
[b]CT=chemotherapy.
[c]Multimodal therapy.
[d]RT=radiation therapy.
[e]QoL=quality of life.
[f]RCT=randomized controlled trial.
[g]NR=not reported.
[h]CRC=colorectal cancer.
[i]MGA=megestrol acetate.
[j]BMI=body mass index.
[k]BW=body weight.
[l]KPS=Karnofsky performance status.
[m]NS=not significant.
[n]GI=gastrointestinal.
[o]MFS=medical food supplement.
[p]PRO=protein.
[q]CIPS=Cancer Inventory of Problem Situations.
[r]H&N=head and neck.
[s]ADA=American Dietetic Association, former name of the Academy of Nutrition and Dietetics.
[t]UC=usual care.
[u]PG-SGA=patient-generated subjective global assessment.
[v]ESAS=Edmonton Symptom Assessment System.

Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Dietary supplements containing fish oil				
Bonatto and colleagues, 2012[87] RCT[e] Single center, outpatient Brazil Positive	N=38 (EPA-DS: n=19; SOC[f]: n=19) Final N: NR[g] GI[h] (n=28) and other cancers (n=10) undergoing 5 fluorourocil/leucovorin CT[i] 3 times a week	**Experimental:** EPA-DS **Control:** SOC, no DS **Dosage:** 0.3 g EPA/d **Duration:** 8 wk	**DS:** NR **EPA:** NR; 0.3 g EPA planned	**Weight:** EPA-DS group ↑ (mean±SEM[j]) 1.7±0.9 kg; control group ↓ 2.5±0.8 kg; difference between groups ($P<0.002$)
Burns and colleagues, 2004[88] Before-after study Single center, outpatient United States Positive	N=43 Various cancers, including leukemia	**Experimental:** EPA-DS (ethyl ester form of EPA) **Dosage:** First 13 patients consumed 0.3 g/kg/d n-3 from fish oil twice a day for a minimum of 2 mo Dose ↓ for remainder of study to 0.15 g/kg/d (11 capsules for 70-kg patient=4.7 g EPA) due to patients unwilling or unable to take requested dose **Duration:** 1.5 mo	**DS:** NR; 0.3 g/kg planned; dose ↓ to 0.15 g/kg due to side effects. Authors stated "patients typically received assigned dose" **EPA:** Median 4.7 g[k] for a 70-kg patient (range=2.6-5.97 g[k]) **Actual duration:** Median 1.2 mo (range=0.5-3.1 mo)	**Weight:** Weight stabilization was associated with taking EPA-DS; many patients who did not respond were unable to tolerate capsules Median BW[l] ↓ of 0.8 kg or 1.2% (*P* value or range NR); n=12 ↑ BW; n=22 lost BW. (Includes patients who took only a few capsules and patients who had a truncated treatment course) Predicted BW loss would be at least a further 4.6%

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/ liquid) EPA[d] intake	Results
Fearon and colleagues, 2006[89] RCT Multicenter, outpatient United Kingdom Positive	N=518 Final N=270 Lung; Upper/lower GI; Unclassified GI not undergoing surgery, CT or RT[m] in the past 4 wk	**2 Experimental groups:** EPA-DS2: (2 g EPA diester/d) EPA-DS4: (4 g EPA diester/d) **Control:** Medium-chain triglyceride oil blended with unspecified diester oil capsules Compliance=80% of planned dose **Duration:** 8 wk	**DS: (% of patients taking prescribed capsules)** EPA-DS2: 68% took >80% of prescribed capsules EPA-DS4: 75% Control: 72% **EPA:** EPA-DS2: NR EPA-DS4: NR Control: 0 g	**Weight:** At baseline, mean BW ↓ was 18% Relative to placebo, at 8 wk mean BW↑ was 1.2 kg for the EPA-DS2 group (95% CI 0 to 2.3 kg) and 0.3 kg for the EPA-DS4 group (−0.9 to 1.5 kg); trend in favor of EPA-DS (P=0.066) **LBM**[n]: The EPA-DS2 group ↑ 0.9 kg LBM vs placebo (95% CI −0.3 to 2.0; NS[o]), whereas the EPA-DS4 group ↓ an average of 0.1 kg LBM (1.3-1.1 kg; NS)
Finocchiaro and colleagues, 2012[90] RCT Multicenter, outpatient Italy Positive	N=33 (EPA-DS: n=19; olive oil: n=14) Final N: 27 (EPA-DS: n=13; olive oil: n=14) Lung cancer, undergoing cisplatin/ gemcitabine CT	**Experimental:** EPA-DS (510 mg EPA/capsule) **Control:** 850 mg olive oil capsules **Dosage:** 4 capsules/d (2.04 g EPA) **Duration:** 66 d	**DS:** EPA-DS: NR; authors stated compliance "was good" Control: NR **EPA:** EPA-DS: NR; Based on dosing, estimate 2.04 g[k] EPA planned Control: 0 g	**Weight:** EPA-DS group experienced mean ↑ in BW of 3.4 kg (P<0.05); Control group (NS)
Gogos and colleagues, 1995[91] Non-RCT Single center, Outpatient Greece Negative	N=64 GI, lung, and breast cancer 4 mo from any treatment Final N: (EPA-DS: n=30 sugar tablet: n=30); both groups: well-nourished (n=15); malnourished (n=15); healthy control (n=15)	**Experimental:** EPA-DS (170 mg EPA/capsule) **Control:** Sugar tablets **Dosage:** 18 capsules/d (3.06 g EPA) **Duration:** 40 d	**DS:** NR **EPA:** EPA-DS: NR; Based on dosing, estimate 3.06 g[k] EPA planned Control: 0 g	**Weight:** Weight remained stable

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/ liquid) EPA[d] intake	Results
Murphy and colleagues, 2011[92] Non-RCT Single center, outpatient Canada Positive	N=41 (EPA-DS: n=17; SOC: n=24; Reference group: n=104) Final N: 40 (EPA-DS: n=16; SOC: n=24) NSCLC[p] undergoing first-line platinum-based doublet CT	**Experimental:** EPA-DS (2.2 g EPA/d either as 1-g fish oil capsules or 7.5 mL liquid/d) **Control:** SOC, no DS **Reference group**: Data were aggregated and used as a point of comparison for expected body composition changes during CT; not included in statistical analysis **Dosage:** 4 capsules or 7.5 mL liquid/d (2.2 g EPA) **Duration:** ≥60 d or 2 cycles of CT	**DS:** NR; Patients consuming <80% of planned dose of 2.2 g EPA/d were withdrawn, lowest dose=3.2 capsules or 6 g liquid fish oil **EPA:** Lowest dose 1.76 g[k] (range=1.76-2.2 g[k])	**Weight:** EPA-DS group ↑ 0.5±1.0 kg (mean ±SEM) BW, whereas control group ↓2.3±0.9 kg ($P<0.05$) BW 69% of patients in EPA-DS group vs 29% in control group ↑ or maintained BW (*P* value NR) **LBM:** EPA-DS group maintained muscle mass throughout 10 weeks of CT, despite a mean BW ↓ of 6.3% over 6 mo before study entry Positive linear relation noted between changes in plasma EPA concentration and rate of muscle change from baseline to end of study ($R^2=0.55$; $P=0.01$). Loss of skeletal mass was evident in the control group; some lost up to 5.2 kg muscle from baseline to end of treatment 69% of patients in EPA-DS group vs 29% in control group maintained or ↑ muscle (*P* value NR) Note: % of patients gaining weight and muscle is similar to the BW gain, suggesting that BW gain is muscle Loss of skeletal muscle occurred concurrently with ↑ in muscle fat mass content in the control group

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Persson and colleagues, 2005[93] Randomized, nonplacebo controlled trial (pilot study) Single center, outpatient Sweden Positive	N=24 (EPA-DS: n=13 Melatonin: n=11) Final N: 16 (EPA-DS: n=10; Melatonin: n=6) Weight-losing advanced GI cancer; CT was allowed	**2 Experimental groups:** First intervention period: EPS-DS (30 mL fish oil providing 4.9 g EPA) Melatonin: 18 mg/d melatonin **Dose:** 4.9 g EPA/d **Duration:** 4 wk Second intervention period: All patients took combined interventions above **Duration**: 4 wk	**DS:** 62% compliance for both intervention periods (compliance represents number of patients, not amount of fish oil) **EPA:** NR	**Weight:** In the first intervention period, BW loss was attenuated, with both groups experiencing median weight ↓ (0.6 kg in EPA-DS group and 1.8 kg in melatonin group; both NS) In the second intervention period, a small median BW ↑ was observed in both groups (0.2 kg in EPA-DS group and 0.8 kg in melatonin group; both NS)
Pratt and colleagues, 2002[94] RCT Single center, outpatient Canada Negative	N=29 (EPA-DS: n=13; Olive oil: n=10; Healthy: n=6, details NR) Final N: 19 (EPA-DS: n=9; olive oil: n=10) Various advanced cancers; high-dose CT	**Experimental:** EPA-DS (180 mg EPA/1g capsule) **Control:** 1 g olive oil in capsules **Duration:** 14 d **Dosage:** 18 capsules/d (3.24 g EPA)	**DS:** (mean±SEM) 12±1.0 capsules **Control:** 10±1.0 **EPA:** EPA-DS: 2.16±0.18 g[k] Control: 0 g	**Weight:** After 2 wk EPA-DS, the change in BW was directly related to the ↑ in plasma phospholipid EPA levels (r=0.86; P=0.006)
Silva and colleagues, 2012[95] RCT Single center, outpatient Brazil Positive	N=23 (EPA-DS: n=11; SOC: n=12) Final N: 18 (EPA-DS: n=10; SOC: n=8) Colorectal cancer eligible for CT	**Experimental:** EPA-DS (150 mg EPA + DHA[q]/ capsule); EPA NR separately **Control:** SOC, no DS **Dosage:** 4 capsules/d; 2 g fish oil (600 mg EPA + DHA) **Duration:** 9 wk	**DS:** 4 capsules **EPA:** NR 600 mg EPA+DHA (definition of non-compliance <80% of EPA-DS)	**Weight:** Before study entry, all patients were weight-losing Median BW ↑ of 0.5 kg (range=−0.6 to 1.0 kg) over 9 wk in EPA-DS group; control group had a median BW ↓ of 1.6 kg [range=−2.4 to 0.3 kg (P=0.01)]

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Taylor and colleagues, 2010[96] Time study Single center, outpatient Germany Neutral	N=31 Solid tumors Kidney, ureter prostate (n=3); Breast, ovary, cervix (n=8); GI (n=12); Other (N=8) Final N=17	**Experimental:** EPA-DS (0.278 g EPA/capsule) **Dosage:** 3 (500 mg) soft gel capsules/d: 1.5 g fish oil (0.834 g EPA[k]) **Duration:** 6 wk	**DS:** 94% (±2%) of capsules were consumed **EPA:** Range ~0.77-0.80 g[k]	**Weight:** 10 of 17 gained BW during EPA-DS intervention [median BW ↑ of 0.6% ($P<0.37$; NS)] Plasma phospholipid EPA correlated positively with BW change ($r=0.64$; $P=0.006$) **LBM:** LBM[b] remained stable during EPA-DS intervention (mean±SD[r] 39±8.6 kg baseline vs 39.6±7.7 kg Week 6)
Wigmore and colleagues, 2000[97] Time study Single center, outpatient Scotland Neutral	N=26 (Stage II: N=5; Stage III: N=8; Stage IV: N=13) Final N=14 Unresectable pancreatic cancer 4 weeks from any treatment	**Experimental:** EPA-DS (500 mg EPA/capsule; 95% pure EPA) - Week 1: 1 g/d - Week 2: 2 g/d - Week 3: 4 g/d - Week 4-12: 6 g/d **Dosage:** Escalating dose to 12 capsules/d **Duration:** 12 wk	**DS:** NR **EPA:** 6 g	**Weight:** EPA-DS group experienced a significant ↓ in the rate of BW loss, resulting in BW stabilization from baseline to 3 mo. At 1 mo intervals expressed as median and IQR[s]: Baseline= −2.0 kg (1.4-2.8 kg) vs 1 mo=0.5 kg (1.5-2.0 kg) 2 mo=0.2 kg (1.4-0.9 kg) 3 mo=0.3 kg (0.2-0.8 kg); $P<0.005$ for all **LBM:** Change in LBM[b] in EPA-DS group surviving at 4, 8, and 12 wk (NS)

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Wigmore and colleagues, 1996[98] Time study Single center, outpatient Scotland Negative	N=18 (Stage II: n=2; Stage III: n=7; Stage IV: n=9) Final N: NR Unresectable pancreatic cancer 4 wk from any treatment	**Experimental:** EPA-DS (180 mg EPA/capsule as 1-g fish oil capsule) - Week 1: 2 g/d - Week 2: 4 g/d - Week 3: 6 g/d - Week 4: 8 g/d - Week 5: 10 g/d - Week 6: 12 g/d - Week 7: 14 g/d - Weeks 8-12: 16 g/d **Dosage:** 12 capsules/d (2 g EPA) **Duration:** 12 w k	**DS:** Median tolerated dose=12 capsules **EPA:** 2.16 g[k]	**Weight:** Prior to study entry, median BW ↓ was 2.9 kg/mo. EPA-DS group demonstrated BW stabilization with ↑ of 0.3 kg/mo (IQR=0-0.5; $P<0.002$) **LBM:** EPA-DS group demonstrated LBM[b] stabilization or anthropometric body composition measures (*P* value=NS)
MFS containing fish oil				
Barber and colleagues, 2000[99] Non-RCT Single center, outpatient; Scotland Neutral	N=22 (EPA-MFS: n=16; Controls: n=6) Final N=NR Pancreatic cancer 4 wk from any treatment vs healthy, weight stable	**Experimental:** EPA-MFS (Per Container: 1.1 g EPA, 305 kcal, 16.1 g pro[t]) **Dosage:** 2 containers/d **Duration:** 3 wk	**MFS:** Median 1.9 (range=1.25 -2.0g) containers **EPA:** Median 2.07 g[k] (range=1.36-2.18 g[k])	**Weight:** Median BW ↑ of 1.0 kg (−0.25 to 1.75; $P<0.05$) **LBM:** Median LBM ↑ of 0.75 kg (0.1-1.6; $P<0.05$), whereas fat mass remained unchanged (NS)
Barber and colleagues, 1999[100] Time study Single center, outpatient Scotland Neutral	N=20 At 3 wk n=18 Final N=13 Pancreatic cancer 4 wk from any treatment	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 305 kcal, 16.1 g pro) **Dosage:** 2 containers/d **Duration:** 7 wk	**MFS:** Median 1.9 (range=1.2-2.0g) containers **EPA:** Median 2.07 g[k] (range=1.36-2.18 g[k])	**Weight:** Before study entry, median BW↓ of 2.9 kg/mo (−4.4 to 2.2). At 3 wk, median ↑of 1.0 kg BW (−0.1 to 2.0; $P=0.024$). At 7 wk median BW ↑of 2.0 kg BW (−0.4 to 4.6; $P=0.033$) **LBM:** At 3 wk, median LBM ↑ of 1.0 kg (0.6-1.4; $P=0.0064$). At 7 wk, median LBM ↑ of 1.9 kg (1.0- 3.0; $P=0.0047$)

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Bauer and colleagues, 2005[101] RCT Outpatient 12 international sites Positive	N=200 Final N=110 Weight-losing, unresectable pancreatic cancer 4 wk from any treatment divided into Compliant (C: n=87) or Noncompliant (NC: n=98) Compliant=average consumption over 4 wk of >1.5 containers MFS/d	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 305 kcal, 16.1 g pro) **Control:** Identical MFS without EPA (N=105) **Dosage:** 2 containers/d **Duration:** 8 wk	**MFS:** **4 wk** C=51.4% reached recommended dose of ≥1.5 containers NC=48.6% did not reach recommended dose **8 wk** C=53.6% reached recommended dose of ≥1.5 containers NC=46.4% did not reach recommended dose **EPA:** NR	**Weight:** Significant BW ↑ of 1.7 kg (SEM±0.4; $P<0.001$) in C group **LBM:** Change in LBM (NS)
de Luis and colleagues, 2008[102] RCT Single center, outpatient Spain Positive	N=65 (EPA-MFS high n-3:n-6: n=31; EPA-MFS low n-3:n-6: n=34) Final N=65 Postsurgical oral and laryngeal cancer	**2 Experimental groups:** EPA-MFS/H (per container: 1.01 g EPA, 295 kcal, 16 g pro [high n-3:n-6]) EPA-MFS/L (per container: 0.92g EPA, 310 kcal, 18 g pro) (low n-3:n-6) **Dosage:** 2 containers/d **Duration:** 12 wk	**MFS:** (mean±SD) 1.6±0.62 containers in both groups **EPA:** (mean±SD) EPA-MFS/H: 1.61±0.63[k] EPA-MFS/L: 1.47±0.57g[k]	**Weight:** BW maintained; between or within-group change (NS) **LBM:** LBM maintained; between or within-group change in LBM, triceps skinfold, or arm circumference (NS)

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
de Luis and colleagues, 2005[103] RCT Single site Spain Positive	N=73 (EPA-MFS: n=38; ARG-MFS: n=35) Final N=NR Postsurgical oral and laryngeal cancer	**Experimental:** EPA-MFS (per container: 1.01 g EPA, 295 kcal, 16 g pro [high n-3:n-6]) **Control:** ARG-MFS (per container: 7.4 g free arginine, 0.598 g EPA, 303 kcal, 16.7 g pro) **Dosage:** 2 containers/d **Duration:** 12 wk	**MFS:** (mean±SD) 1.5±0.52 containers in both groups **EPA:** EPA-MFS: 1.52±0.52 g[k] Control: 0.89±0.31 g[k]	**Weight:** EPA-MFS group showed significant improvement from baseline in BW, fat mass, and triceps skinfold ($P<0.05$); control group (NS)
Fearon and colleagues, 2003[104] RCT Outpatient 12 international sites Positive	N=200 (EPA-MFS: n=95; MFS: n=105) Final N: 110 (EPA-MFS: n=50; MFS: n=60) Pancreatic cancer (no cancer treatment in 4 wk; no plans to undergo treatment) Trend toward more Stage IV patients in the EPA-MFS group over control (52% vs 41%)	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 310 kcal, 16 g pro) **Control:** Identical MFS without EPA **Dosage:** 2 containers/d **Duration:** 12 wk	**MFS:** Mean 1.4 (SD NR) containers for both groups **EPA:** EPA-MFS: 1.54 g[k] Control: 0 g	**Weight:** At 8 wk, both MFS were equally effective in halting BW loss (EPA-MFS group: −0.25kg/ mo; control group: −0.37 kg/mo; $P=0.74$). **LBM:** In the EPA-MFS group, significant associations were found between plasma EPA and LBM ↑ ($P=0.043$) and between 8-wk plasma EPA and ↑ in BW ($P<0.001$) and LBM ($P=0.001$). No such associations were seen in the control group
Guarcello and colleagues, 2007[105] RCT Single site, outpatient Italy Neutral	N=46 (EPA-MFS: n=26; MFS: n=20) Lung cancer eligible for CT (SCLC[u] [n=5]; NSCLC [n=41]) Final N: 25 (EPA-MFS: n=14; MFS: n=11)	**Experimental**: EPA-MFS (per container: 1.1 g EPA, 310 kcal, 16 g pro) **Control:** MFS without EPA (per container: 275 kcal, 15 g pro) **Dosage:** 2 containers/d **Duration:** 60 d	**MFS:** Median 2 (range=1.5-2) containers for both groups **EPA:** EPA-MFS: Median 2.2[k] (range=1.65-2.2g)[k] Control: 0 g	**Weight:** EPA-MFS group showed significant ↑in BW (57.7 kg at T0 vs 58.6 kg at Day 30 and Day 60; $P<0.05$) whereas MFS group showed no ↑ in BW (59.1 kg at T0 vs 57.0 at Day 30 and 59.1 at Day 60; NS)

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Jatoi and colleagues, 2004[106] RCT Multicenter outpatient United States, Canada Positive	N=421 (EPA-MFS/placebo MA[v]: n=141; EPA-MFS/MA: n=140; MFS/MA: n=140) Final N: NR Variety of cancers (lung, GI, and others excluding hormone-sensitive tumors) vs MA alone	**3 Experimental groups:** EPA-MFS/placebo MA: EPA-MFS (per container: 1.1 g EPA, 300 kcal, 16 g pro) + placebo liquid suspension appearing identical to MA EPA-MFS/MA: EPA-MFS (per container: 1.1 g EPA, 300 kcal, 16 g pro) with MA liquid suspension 600 mg/d MFS/MA: 300 kcal, 16 g pro MFS without EPA + MA liquid suspension 600 mg/d **Duration:** ≥3 months	**MFS:** NR **EPA:** NR	**Weight:** 18% of patients in MFS/MA group showed a 10% ↑ in BW (P=0.01), whereas in the EPA-MFS group, 22% of patients showed a 1%-4% ↑ in BW and 9% of patients showed a 5%-9% ↑ in BW; no difference among the 3 treatment arms (P=0.24 and P=0.69, respectively) The area under the curve for absolute weight ↑ at 1 mo was also similar among the treatment arms
Read and colleagues, 2007[107] Prospective cohort Single center, outpatient Australia Positive	N=23 At 3 wk N=20 Final N=15 Advanced colorectal cancer treated with FOLFIRI[w]; life-threatening toxicities	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 310 kcal, 16 g pro) **Control:** MFS without EPA (per container: 275 kcal, 15 g pro) **Dosage:** 2 containers/d **Duration:** 9 wk	**MFS:** Mean 1.7 (SD NR) containers in both groups **EPA:** EPA-MFS: 1.9 g[k] Control: 0 g	**Weight:** Mean BW ↑ of 2.5 kg from baseline to end of Week 3 (P=0.03) in EPA-MFS group; BW remained stable during 3 cycles CT or 9 wk **LBM:** EPA-MFS group maintained LBM; change from baseline (NS)

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Table 4. Summary of studies included in the Academy of Nutrition and Dietetics Evidence Analysis Library systematic review of effectiveness of medical food supplements and dietary supplements containing fish oil (ie, eicosapentaenoic acid) on body weight and lean body mass in adult oncology patients (*continued*)

Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Ryan and colleagues, 2009[108] RCT Outpatient followed by inpatient surgery, single center Ireland Neutral	N=53 (EPA-MFS: n=28; MFS: n=25) Final N=53 Resectable esophageal cancer Patients unable to go on to surgery were discontinued	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 310 kcal, 16 g pro) orally for 5 d before surgery and identical enteral nutrition via jejunostomy postoperatively **Control:** MFS without EPA (1.5 kcal/mL, 0.054 g pro/mL) **Dosage:** 2 containers/d + standard enteral nutrition **Duration:** 21 d	**MFS:** Mean 2.0 (SD=NR) containers in both groups **EPA:** EPA-MFS: 2.2 g[k] Control: 0 g	**Weight:** 8% of EPA-MFS group vs 39% of control group lost ≥5% of BW during study period (P=0.03) **LBM:** EPA-MFS group demonstrated NS differences from baseline to 21 d postoperatively for any body composition measurement EPA-MFS group maintained fat-free mass (55 kg preoperatively vs 55.3 kg postoperatively; P=0.9), whereas there was a significant ↓ of fat-free mass in the control group (−1.9 kg±3.7 kg; P<0.03; 95% CI 0.17-3.6)
van der Meij and colleagues, 2010[109] RCT Single center The Netherlands Positive	N=40 (EPA-MFS: n=20; MFS: n=205) Final N: 33 (EPA-MFS: n=14; MFS: n=19) Stage III NSCLC undergoing concurrent chemoradiation treatment	**Experimental**: EPA-MFS (per container: 1.1 g EPA, 300 kcal, 16 g pro) **Control:** Isocaloric MFS without EPA and DHA **Dosage:** 2 containers/d **Duration:** 5 wk	**MFS:** (mean±SD) EPA-MFS: 1.1±1.0 containers Control: 1.0±0.9 containers **EPA:** EPA-MFS: 1.2±1.1 g[k] Control: 0 g	**Weight:**, The EPA-MFS group had better BW maintenance than control group; difference of 1.1 kg (P=0.07) at 1 wk, 1.3 kg (P=0.02) at 2 wk, and 1.7 kg (P=0.04) at 4 wk Mean BW ↑was 0.71 kg (n=27; P=0.245) from baseline to admission; ↑ 0.66 kg (n=30; P=0.519) from baseline to discharge **LBM:** Over time, fat-free mass ↓ in both groups, but less in EPA-MFS group vs control. Between-group differences after Weeks 3 and 5 (1.5 kg; P=0.05 and 1.9 kg; P=0.02, respectively)

(*continued on next page*)

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Author(s), Year Study design Location Quality rating	Population Cancer site	Intervention Dosage Duration	Actual consumption per day: MFS[a] 8 oz (240 mL) Containers[b] or DS[c] (capsules/liquid) EPA[d] intake	Results
Weed and colleagues, 2011[110] Prospective cohort Outpatient followed by inpatient surgery, single center United States Neutral	N=38 Final N=31 Head and neck (stage II, III, IV) scheduled for surgical resection with curative intent	**Experimental:** EPA-MFS (per container: 1.1 g EPA, 300 kcal, 16 g pro) starting 2 wk before surgery until discharge N=24 of 31 consumed the EPA-MFS before admission **Dosage:** 2 containers/d **Duration:** Trial entry to hospitalization: (mean ±SEM) 23±2.5 d **Hospitalization:** Median 10 d (range=4-19 d)	**MFS:** Mean 1.8 containers presurgery; 1.5 containers postsurgical hospitalization **EPA:** Mean 1.98 g[k] presurgery; 1.65 g[k] postsurgical hospitalization	**Weight:** 70% of 27 patients ↑ or maintained BW (0.71 kg; P=0.245) for the 2 wk before surgery; 57% of 30 ↑ or maintained BW (0.66 kg; P=0.519) from baseline to discharge (~11 d postsurgery). **LBM:** Significant ↑ in LBM (3.20 kg or ±7%) from baseline to discharge (N=23; P<0.001); significant ↓ in fat mass (3.19 kg; P<0.001)

[a]MFS=medical food supplement.
[b]As measured by multiple-frequency bioelectric impedance analysis.
[c]DS=dietary supplement.
[d]EPA=eicosapentaenoic acid.
[e]RCT=randomized controlled trial.
[f]SOC=standard of care.
[g]NR=not reported.
[h]GI=gastrointestinal.
[i]CT=chemotherapy.
[j]SEM=standard error of the mean.
[k]Calculated.
[l]BW=body weight.
[m]RT=radiation therapy.
[n]LBM=lean body mass.
[o]NS=not significant.
[p]NSCLC=non–small cell lung cancer.
[q]DHA=docosahexaenoic acid.
[r]SD=standard deviation.
[s]IQR=interquartile range.
[t]Pro=protein.
[u]SCLC=small cell lung cancer.
[v]MA=megestrol acetate.
[w]FOLFIRI=irinotecan with fluorouracil and folinic acid.