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Position of the American Dietetic Association: Nutrition Intervention and Human Immunodeficiency Virus Infection

ABSTRACT

It is the position of the American Dietetic Association that efforts to optimize nutritional status through individualized medical nutrition therapy, assurance of food and nutrition security, and nutrition education are essential to the total system of health care available to people with human immunodeficiency virus (HIV) infection throughout the continuum of care. Broad-based efforts to improve health care access and treatment have stabilized HIV prevalence levels in many parts of the world and led to longer survival for people living with HIV infection. Confounding clinical and social issues, such as medication interactions, comorbidities, wasting, lipodystrophy, food insecurity, aging, and other related conditions further complicate disease management. With greater understanding of the mechanisms of HIV disease and its impact on body function, development of new treatments, and wider ranges of populations affected, the management of chronic HIV infection continues to become more complex and demanding. Achievement of food and nutrition security and management of nutrition-related complications of HIV infection remain significant challenges for clients with HIV infection and health care professionals. Registered dietitians and dietetic technicians, registered, should integrate their efforts into the overall health care strategies to optimize their clinical and social influence for people living with HIV infection.

J Am Diet Assoc. 2010;110:1105-1119.

POSITION STATEMENT

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0002-8223/\$36.00
doi: 10.1016/j.jada.2010.05.020

This American Dietetic Association (ADA) Position Paper includes the authors' independent review of the literature in addition to systematic review conducted using ADA's Evidence Analysis Process and information from the ADA Evidence Analysis Library. Topics from the Evidence Analysis Library are clearly delineated. The use of an evidence-based approach provides important added benefits to earlier review methods. The major advantage of the approach is the more rigorous standardization of review criteria, which minimizes the likelihood of reviewer bias and increases the ease with which disparate articles may be compared. For a detailed description of the methods used in the evidence analysis, access ADA's Evidence Analysis Process at <http://adaeal.com/eaprocess/>.

Conclusion Statements are assigned a grade by an expert work group based on the systematic analysis and evaluation of the supporting research evidence. Grade I=Good; Grade II=Fair; Grade III=Limited; Grade IV=Expert Opinion Only; and Grade V=Not Assignable (because there is no evidence to support or refute the conclusion). Evidence-based information for this and other topics can be found at www.adaevidencelibrary.com and subscriptions for nonmembers are available for purchase at www.adaevidencelibrary.com/store.cfm.

mize nutritional status through individualized medical nutrition therapy, assurance of food and nutrition security, and nutrition education are essential to the total system of health care available to people with human immunodeficiency virus infection throughout the continuum of care.

Human immunodeficiency virus (HIV) infection is part of social, political, and economic struggles worldwide. These issues present significant challenges to health care systems in both the prevention and treatment of HIV infection (1). According to the 2008 Report on the Global AIDS Epidemic (2), the prevalence of HIV appears to have leveled off at <1% of the global population. New annual infections have declined from 3 million in 2001 to 2.7 million in 2007. By the end of 2007, an estimated 33 million people were living with HIV infection, including 2 million children younger than age 15 years and more than 15 million women. Other trends include the increased percentage of new infections in women, declining numbers of vertical infections from mother to child, and declining death rates. Overall, the number of people living with HIV has continued to grow, which can be largely attributed to population expansion and the life-prolonging effects of antiretroviral therapies (ARTs). The consequences of the HIV pandemic include a high risk for debilitation and mortality among adults during their most productive years (3). Particularly in more vulnerable developing countries, this leads to a lack of sustainable infrastructure for education, food insecurity, economic instability, and lack of access to health care services, which in turn contributes to increased risk for malnutrition. Children are hard-hit by the HIV/acquired immunodeficiency syndrome (AIDS) pandemic worldwide and the growing numbers of orphans tend to be malnourished, uneducated, and live in poverty.

In the United States, prevalence rates increased between 2003 and 2006 as the result of improved survival and efforts to encourage testing

and awareness of HIV infection status. By the end of 2006 an estimated 1.1 million people in the United States were living with HIV infection, an increase of 11% over 2003 estimates (3,4). New case definitions published by the Centers for Disease Control and Prevention (CDC) in December 2008 may alter future reporting of HIV infection and AIDS cases (5). Whereas 35,314 new cases of HIV and AIDS were reported in the 33 states with longer-term surveillance, the CDC estimated that the total number of new infections in 2006 was 56,300 (6). More than two thirds of people living with HIV infection in the United States were between 25 and 49 years of age, about one quarter of infections were in people older than age 50 years, and about 5% were in 13- to 24-year-olds. Unlike the global statistics, about 75% of HIV-infected people in the United States were men, and nearly half of those infected were men who have sex with men.

The impact on minorities has been disproportionate. The prevalence rate was six times higher for black men compared to white men and 18 times higher for black women compared to white women. Latinos had three times the prevalence rate of whites. The most affected minority groups were usually diagnosed at a later stage of HIV infection, when related or concurrent diseases were present. Delayed care may be more common in these groups due to lack of economic, insurance, and other resources or competing subsistence needs (7,8). Health literacy levels can also affect treatment adherence (9).

NUTRITION AND HIV INTERACTIONS

Food and Nutrition Insecurity

In addition to HIV disease and its complications, many clients face economic insecurity, social isolation and stigmatization, incarceration or institutionalization, substance use, and additional comorbidities. As a result, many people with HIV and AIDS face hunger and multiple barriers to food and nutrition security. "Food availability and good nutrition are thus essential for keeping people living with HIV healthy for longer" and able to resist opportunistic infections such as tuberculosis, according to a United Nations Policy Brief (10). Food and nutrition insecurity can exacerbate

both malnutrition and a number of medical, psychosocial, and economic consequences of the HIV pandemic. Food insecurity can encourage behaviors that increase risk for exposure and transmission of HIV, affect treatment adherence and effectiveness, and diminish the progress of programs to improve health, economic status, and other development efforts. The American Dietetic Association's (ADA's) position papers on domestic and world food and nutrition security exhort dietetics practitioners to build food and nutrition security through competent and collaborative practice as part of health care teams (11,12).

Nutrition-Related Clinical Issues

Poor nutritional status, including both undernutrition and overnutrition, can affect immune function independent of HIV infection (13,14). Death rates are higher among HIV-infected clients with malnutrition, including those receiving ART (15-17). HIV infection and its treatment may initiate a complex dysregulation of metabolism that can be associated with changes in nutritional status, such as energy expenditure, lipid metabolism, hormonal balances, immune function, constitutional symptoms, and others (18-21). Macro-nutrient and micronutrient needs may change significantly with one or a combination of these interrelated factors. Common manifestations of nutrient deficiencies include protein-energy malnutrition, anemias, and other micronutrient status alterations (22-24).

A well-nourished person with HIV who has a controlled viral load is more likely to be able to withstand the effects of HIV infection, supporting immune status and possibly delaying the progression of HIV disease (25,26). There are several nutrition indicators that have correlated with survival, such as an appropriate body mass index (BMI), adequate body cell mass (crucial body protein stores), and others (27,28). Weight loss has been associated with both morbidity and mortality (29). With a loss of body cell mass to a level of 54% of the expected value based on height, death is likely to occur in clients with HIV infection regardless of the presence or absence of infectious complications (30). Because metabolism of nutrients and medications occurs primarily in

the body cell mass compartment (composed mostly of organ and muscle tissues), preservation of these body tissues may support the efficacy of medication therapies.

The Nutrition Care Process includes nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation (31). Registered dietitians (RDs) and dietetic technicians, registered (DTRs), can play a significant role in assisting people living with HIV and AIDS and their health care teams to address diet-and nutrition-related issues. The role of RDs and DTRs is outlined later in the section "Roles and Responsibilities of RDs and DTRs."

ASSESSMENT

Nutrition plays an essential role in supporting the health and quality of life of people living with HIV. The negative effects of malnutrition are often preventable and are usually not easily reversed. Nutrition-related alterations can occur early in HIV infection; thus, nutrition intervention should begin soon after diagnosis. This part of the Nutrition Care Process includes assessment and diagnosis features. A complete assessment includes collecting timely and appropriate data, analyzing and interpreting data with evidence-based standards, and documenting data in patient records. Nutrition diagnosis includes identification and labeling of problems, determining risk factors or causes, defining characteristics of the problem, and documenting information in patient records.

A complete baseline nutrition assessment should be performed as part of the multidisciplinary care plan, with regular follow-up care as appropriate to achieve care plan goals. For optimal care, an RD should perform nutrition evaluation and follow-up. There are many formats for a nutrition evaluation, including the ABCD nutrition evaluation of anthropometric, biochemical, clinical, and dietary parameters (32). An RD, DTR, or other qualified clinician can use these assessment parameters in partnership with clients to form the basis for a nutrition care plan.

Anthropometry and Body Composition

Malnutrition is not an AIDS-defining medical diagnosis at this time. How-

ever, AIDS-related wasting syndrome is an AIDS-defining medical diagnosis described by the CDC as a 10% weight loss from baseline in a 6-month period accompanied by diarrhea or chronic weakness and fever for more than 30 days without a known cause (33). Though the rate of opportunistic infections has declined in the past few years, the incidence of AIDS-related wasting syndrome according to this AIDS-defining diagnosis appears to have held steady (34,35). Recommendations for a revision to the current CDC definition includes time frames for weight loss and body composition alterations, with specific attention to the body cell mass compartment, to identify detrimental wasting of lean tissues that may occur even without weight loss (36). The loss of lean tissue central to body metabolism may be present throughout the disease process, regardless of weight maintenance, suggesting that significant weight change is not a good early indicator of alterations related to HIV, its treatment, and declining nutritional status (37,38). Lipodystrophy, or the abnormal metabolism and deposition of fat, includes lipoatrophy (loss of subcutaneous fat) and lipohypertrophy (gain of truncal fat). Lipodystrophy syndrome definitions also include dyslipidemia and insulin resistance. These fat and insulin resistance abnormalities can also negatively affect metabolic stability and may be different according to sex and racial/ethnic origins (39,40).

It is likely that there are a combination of mechanisms for weight and protein losses, including a loss of appetite and increased utilization associated with inflammatory responses. Although simple starvation (including decreased intake, malabsorption, and increased losses of nutrients) may lead to a relative preservation of body cell mass compared to fat stores, it is expected that 80% to 90% of weight loss during acute events is accounted for by protein tissue losses, whereas less protein is lost during the starvation process (41).

Measures of body weight, dimensions, and estimates of subcutaneous fat stores are a noninvasive way to characterize changes in body composition or growth-related nutritional status. Monitoring weight and calculating BMI are important parts of identifying wasting, and even small amounts of weight loss have long

been associated with poor outcomes in HIV (17,42). Additional anthropometry that may be helpful for serial measure comparisons includes thigh circumference and mid-upper arm circumference (43).

This position paper uses ADA's Evidence Analysis Process and information from the ADA Evidence Analysis Library for selected nutrition assessment and interventions (44).

Body Composition Measurement. Monitoring for body composition may be helpful to determine nutritional risk and apply appropriate interventions. Body composition evaluation may include both assessments of compartment volume and fat deposition patterns.

Although no single method provides all of the useful information about body composition and shape, if used appropriately each can provide valuable clues and information in tracking nutritional status. Since the introduction of highly active ART, altered patterns of body composition—such as peripheral loss of fat (lipoatrophy), central fat deposition (lipohypertrophy), and the visual manifestations of lipodystrophy—can be tracked using anthropometric and other body composition measures, such as soft tissue dual energy x-ray absorptiometry (45). An increase in longevity in patients with HIV suggests that both clients and health care professionals will have to address these physical alterations, including obesity, as part of routine health care provision (46,47).

What is the evidence to support the assessment of body composition for people with HIV infection? EAL Conclusion Statement:

Twenty-seven studies were reviewed to evaluate the assessment of body composition of people with HIV infection. The majority of research in men, women, children, and adolescents report that fat-free mass and fat mass are generally lower in people with HIV infection.

Grade I=Good.

What is the evidence to support certain methodologies in the measurement of body composition of people with HIV infection? EAL Conclusion Statement:

Eighteen studies were reviewed to evaluate certain methodologies in the measurement of body composition of people with HIV infection. Six studies in men, two studies in women, and six studies in

men and women report that dual-energy x-ray absorptiometry, bioelectrical impedance analysis, bioimpedance spectroscopy, and skinfold thickness measurements provide acceptable estimations of body composition and for measuring change in body composition. Results of bioelectrical impedance analysis vary with the prediction equation used and the equipment manufacturer; studies in children report the need for bioelectrical impedance analysis equations developed for use in children with HIV infection. Results in skinfold thickness measurements vary with the number of sites measured and the prediction equation used. Further research is needed regarding methodology for body composition measurement in women and children, as well as in conditions of lipodystrophy, areas of the body and different ethnic groups. **Grade II=Fair.**

Biochemical Assessment

Biochemical assessment provides laboratory measurements of serum protein, lipids, and micronutrients. Metabolic abnormalities—including changes in organ or other tissue function, leading to altered use, storage, and excretion of nutrients—may occur as a result of immune dysfunction, medication side effects, infection, alterations in hormonal milieu, or through the effects of HIV itself in adults and children (48,49). In addition, metabolic abnormalities of elevated blood lipid levels, altered insulin sensitivity or glucose dysregulation, mitochondrial toxicity, and lactic acidosis have been reported (50,51). Altered levels of plasma proteins, micronutrients, and other nutrition-related markers have been documented early in the disease process and have been associated with increased risk of mortality in HIV infection (23,52-55). Some of these problems may have occurred independently and before the use of ART.

Indicators of disease complications and prognosis include nutrition-related laboratory values such as albumin, transthyretin, hemoglobin, hematocrit, creatinine, urea nitrogen, transferrin, glucose, vitamin B-12, C-reactive protein, and others (56,57). Alterations in nutrition-related laboratory values may reflect inflammatory responses rather than nutri-

tional compromise alone. Alterations in micronutrient and macronutrient metabolism—such as zinc, iron, selenium, vitamin B-12, carbohydrate, and fat—have been reported during asymptomatic and symptomatic disease states (58,59). Levels of zinc and albumin, both acute phase reactants, may fall rapidly during the physical stress of infection and quickly increase when an infection is resolved. Iron may be shunted to a storage form during inflammation. Various types of anemias occur with chronic HIV infection and may sometimes include anemias associated with nutrient deficiencies, but more often may reflect anemias of chronic disease and related to medication interactions (60,61). Anemias should be evaluated to determine the role of nutrition intervention in treatment, such as dietary iron and supplementation of folate or vitamin B-12.

Although shifts in nutrient levels may not represent deficiency, other body tissues, such as blood, may be at risk for depletion of shunted nutrients, such as iron in inflammatory states (62). It has been well established that deficiencies and sometimes excesses of nutrients adversely affect immune and other normal body processes. Though nutritional repletion of micronutrients has been recommended, it is not yet clear whether the cause of nutrient deficiency is true deficiency or if it is a result of altered metabolism associated with HIV infection and the inflammatory response or a combination of both (58).

Clinical Assessment

Longer survival of people with HIV infection may translate to an increase in the comorbidities experienced by clients. These comorbidities will both add to and change disease management strategies (63). Clinical assessment includes obtaining a medical history and performing a nutrition-related physical examination. A medical history will provide insight into comorbidities that have nutritional implications, including renal disease, hepatitis, pulmonary diseases and tuberculosis, diabetes, cardiovascular disease, neurologic disease, cancers, and osteoporosis. Other key areas in the clinical assessment include determining presence of opportunistic infections that may affect metabolism,

occurrence of gastrointestinal complications, potential food and drug interactions, use of complementary and alternative therapies, and nutrition-related side effects of prescription and nonprescription drugs. Risk factors for disease that affect or are affected by diet and nutritional status should be included in a complete nutrition evaluation. For instance, clients with a family history of renal dialysis, diabetes, and/or heart disease should be evaluated for these disease states on a routine basis. Other risk factors, such as smoking, alcohol or other drug use, age, sex, obesity or underweight, and medication profiles can help to determine the need to monitor for bone mineral density losses, lactic acidosis, and other common complications of chronic HIV.

Medication and Nutrition Interactions. In addition to nutrition and disease interaction, health care professionals must consider the adverse influences various medications have on indicators of nutritional status and on metabolic indicators of disease risk. It is apparent that the efficacy of ART and other medications is important to nutritional status maintenance (64–66). Conversely, nutrients and nutritional status can affect absorption, utilization, elimination, and tolerance to medications (67,68). Adherence to medications is affected by nutrition-related concerns of medication side effects and the potential for the development or exacerbation of body fat changes, as seen in lipodystrophy. Some clients may consider stopping treatment because of body image issues.

There are currently six classes of antiretroviral medications, including nucleoside reverse transcriptase inhibitors, non-nucleoside reverse transcriptase inhibitors, protease inhibitors, fusion inhibitors, entry inhibitors, and integrase inhibitors. There are also dual-class fixed-dose combination drugs that allow for fewer pills or once daily doses. Drugs in the pipeline include a class of maturation inhibitors and other medications that boost the levels of antiretroviral medications. Life-long pharmacotherapy with combinations of these medications may be required for continuous disease management and presents challenges to nutritional status maintenance by introducing potential interactions with food, body metabolism, and side effects. Poten-

tial side effects may be reduced in incidence or severity with nutritional status maintenance and strategies aimed at symptom management. Medication therapies, including the types, duration of use, and history of use should be carefully considered by RDs planning dietary interventions. Some of the potential nutrition-related adverse effects that are related to medications include dyslipidemia, insulin resistance and glucose intolerance, and anemia (69,70). Evaluation of potential adverse effects of medications along with risk factors may help in the early identification of disease complications. For instance, a diagnosis of diabetes may alert a clinician to the possibility of an increased risk for neuropathies that can affect physical activity necessary for the maintenance of body composition.

Response to ART can vary according to sex, and men and women with HIV infection may experience problems associated with medication interactions differently (71,72). For instance, women experienced higher elevations in blood lipid levels, whereas the expected differences between the sexes in ratios of low-density lipoprotein to high-density lipoprotein diminish with ART. A higher percentage of women experienced perceived fat accumulation whereas men tended to experience subcutaneous fat losses. In the use of ritonavir- and nelfinavir-containing regimens, men experienced more diarrhea while women experienced nausea, vomiting, and abdominal pain more frequently than men.

Dietary Assessment

Evaluation of dietary intake should examine eating patterns and current diet, and evaluate factors influencing a client's ability to achieve an adequate diet. Usual and current intake and any perceived changes should be evaluated, including ethnic and cultural food preferences and practices, food preparation limitations, food intolerances, and use of macronutrient and/or micronutrient supplements (73). Potential interactions of food with antiretroviral medications, nutrient supplements, other medications, and herbal treatments should be considered. Specific nutrients of interest include B vitamins; vitamins A, E, and D; selenium; and zinc (74–77).

What is the evidence to support the monitoring of food intake in people

with HIV infection? EAL Conclusion Statement: Fifteen articles were reviewed to evaluate the monitoring of food intake in people with HIV infection. Several studies reported variations in energy and nutrient intake and weight changes. Special considerations are needed for children, as well as individuals with fat deposition, those taking protease inhibitors, those with a history of drug abuse, and those with metabolic abnormalities. One study reported that 3-day food records may be more valid than food frequency questionnaires when reporting food intake in an HIV-infected population. Further research is needed regarding frequency of food intake monitoring. **Grade II=Fair.**

Psychosocial issues related to nutrition should also be evaluated. It is important to determine how a client is accessing food, including the use of food assistance programs; who is shopping for and preparing meals; how and where meals are prepared; whether there is a history of eating disorders or body image concerns; socioeconomic issues; and housing status. A discussion of lifestyle, living arrangements, cultural practices, and weight and food-related goals may help clinician and client work together to develop an appropriate nutrition care plan. A team approach that evaluates the factors affecting the ability of a patient to seek health care should be used to overcome barriers to achieving and maintaining adequate nutritional status. Comorbidities that affect diet and nutritional status should also be included in the evaluation. Risk factors associated with lifestyle such as smoking, alcohol, or other drug abuse, age, sexual behavior, obesity or underweight, and medication profiles can help to evaluate and prevent common complications of chronic HIV disease.

Pediatric-Specific Assessment

Children living with HIV experience similar nutrition issues as adults who have the disease, but because of the added demands for growth and development, the effects are often more devastating. Anthropometric assessment for children with HIV infection includes regular growth monitoring of height, weight, and head circumference with comparison to growth stan-

dards for age and sex. Inability to achieve a normal weight for height, growth stunting, failure to thrive, malnutrition, impaired cognitive development, and wasting are potential adverse nutrition-related outcomes in pediatric HIV (78).

Some children and their family, friends, and school personnel may not know their HIV status, which presents challenges for counseling and intervention for medication interactions and other nutrition-related problems. HIV-positive children are at high nutritional risk, and should be referred for ongoing nutrition assessment and counseling.

Clinicians should consider the following additional issues with nutritional implications in the pediatric population:

- perinatal factors in infants, including nutritional status of the mother, exposure to drugs or alcohol, and birth weight (79);
- the caregiver's choice of feeding method for neonates and children younger than age 2 years;
- serial growth measurements and assessment on a growth chart;
- inadequate nutritional intake because of limited food selectivity, poor appetite, nausea, vomiting, diarrhea, or malabsorption;
- developmental and oral motor feeding skills delays or regression due to HIV encephalopathy or other reasons;
- dental health;
- increased nutrient needs to achieve catch-up growth;
- disordered eating patterns;
- caregiver health and support system;
- any distortions in the feeding relationship between caregiver and child; and
- the food and economic security of the caregiver and child.

INTERVENTIONS

Reducing or eliminating malnutrition has the potential to significantly slow progression of disease, decrease its severity, and improve longevity (74,76,80). Individualized care that integrates medical and social services and is delivered by health care professionals with HIV-related experience, training, and expertise is necessary for optimal success (81,82). This part of the

Nutrition Care Process includes planning nutrition interventions, implementing nutrition interventions, and documenting interventions in patient records.

Medical nutrition therapy (MNT) includes setting goals and developing a nutrition plan that includes education, counseling, dietary modulation, and, in some cases, supplemental nutrients in oral, enteral, and/or parenteral forms. Examples of roles and responsibilities for RDs and DTRs are outlined in "Roles and Responsibilities of RDs and DTRs."

Goals for outcomes should be set during the planning of nutrition intervention stage of the Nutrition Care Process. All nutrition and nutrition-related interventions should be routinely monitored for effects and to adjust care. This part of the Nutrition Care Process includes monitoring progress, measuring outcome indicators, evaluating the outcomes, and documenting the information in patient care records.

Client Education and MNT

Education and counseling are essential features of MNT for people living with HIV. **Figure 1** lists categories and topics to consider for client education and counseling. General education may include nutrition principles, physical activity, water supply safety, and food hygiene.

Nutrition-related side effects have been shown to correlate negatively with quality-of-life measures in people infected with HIV (83). Nutrition-related symptoms and side effects could have a significant effect on dietary intake and ART adherence (84).

What is the evidence to support education on foodborne illness for people with HIV infection and their caregivers? EAL Conclusion Statement: Six studies were evaluated regarding education about foodborne illness in people with HIV infection. One narrative review concluded that people with HIV infection are more susceptible to foodborne illness. Two studies reported confusion and lack of knowledge regarding food safety. Two studies evaluating home-delivered meals programs for people with HIV infection reported strong adherence to food safety guidelines in the preparation and delivery of meals. One study evaluating a program that included a component of

Category	Examples
Pregnancy, lactation, infancy, and childhood	<ul style="list-style-type: none"> • Nutrition-related issues and concerns in pregnancy and lactation • Transmission risk in breastfeeding and replacement feeding alternatives • Growth failure and developmental delay in children • Support for normal growth trends in children
Lifestyle	<ul style="list-style-type: none"> • Basic nutrition concepts and habits • Physical activity levels • Body image and altered body weight and shape • Nutrition and food-related cultural behaviors and ethnic beliefs
Nutrition interactions	<ul style="list-style-type: none"> • Prevention, restoration, and maintenance of optimal body composition with an emphasis on lean tissues • Medication-nutrition interactions • Management of barriers to maintenance and restoration of nutritional status, such as nutrition-related side effects and symptoms • Review of nutrient supplements • Review of potential interactions with nonprescription medications and herbal supplements • Evaluation of interactions with alcohol and recreational drugs
Life skills and socioeconomic issues	<ul style="list-style-type: none"> • Food and water safety • Food and nutrition security issues' • Food preparation skills

Figure 1. Categories and topics to be considered during nutrition-related education and counseling of people living with human immunodeficiency virus infection.

foodborne illness education demonstrated a decrease in the number of symptoms and eating difficulties in people with HIV infection. **Grade I=Good.**

In addition to education, tailored counseling to develop meal plans to support medication regimens may include meal timing, macronutrient and micronutrient modulation, and symptom management strategies (11,12,85-89). Exercise and medications may be required in addition to MNT to manage nutrition-related adverse effects of disease treatment.

What is the evidence to support MNT for people with HIV infection? EAL Conclusion Statement: Seven studies were evaluated regarding MNT and nutrition counseling in people with HIV infection. One study, completed before initiation of highly active ART, stressed that early intervention may prevent progressive weight loss. Four studies of MNT report improved outcomes related to cardiovascular risk indexes and energy intake and/or symptoms with or without oral nutritional supplementation, especially with increased frequency of visits. Two studies regarding nutrition counseling (non-MNT) also reported improved outcomes related to weight gain, CD4 count, and quality of life. **Grade I=Good.**

Macronutrient undernutrition is the most immediate concern and a significant risk for mortality. Both unintentional weight loss and lean tissue wasting require strategies to ensure that adequate macronutrients are consumed, absorbed, and assimilated to prevent and reverse weight loss and wasting.

Numerous studies have reported higher energy expenditure in adults with HIV infection compared to healthy controls (90). Subjects with HIV infection were found to have a higher resting energy expenditure (REE) than controls, which has been correlated with fat free mass, but not always with weight or disease status (91). The relationship of energy intake and REE may be different for patients with HIV infection with or without altered fat deposition (92). These differences may be driven by compensation for the metabolic changes in lipodystrophy that cause abnormal storage of energy and should especially be taken into account when planning for weight reduction in patients with obesity.

Regardless of energy expenditure levels, there are other factors that affect energy requirements, such as malabsorption, diarrhea, and vomiting. Alterations in endocrine function and reduction of energy intake

have been associated with wasting (93). Successful treatment with ART decreased REE and promoted weight gain, whereas treatment failure was associated with wasting (94,95). Maintenance of energy balance is an important feature of MNT efforts.

What is the evidence to support a particular dietary intake of energy for people with HIV infection? EAL Conclusion Statement: Twenty-four studies were evaluated regarding energy intake in people with HIV infection. Eight out of nine studies reported increased REE in people with HIV infection, compared to healthy controls. However, total energy expenditure was similar to that of control subjects. Energy balance deficits resulted in growth failure in children with HIV infection. Factors related to energy needs in people with HIV infection include stage of disease, opportunistic infections and comorbidities, inflammation, and effects of medications. Further research is needed regarding energy requirements in people with HIV infection. **Grade II=Fair.**

Protein is essential for maintenance of body cell mass and normal body functions, including immunity (96). Many of the functional components of the different aspects of immunity in the body are proteins such as cytokines, complements, and im-

munoglobulins and their production is depressed in protein–energy malnutrition (97,98). Whereas higher protein diets seem to be beneficial for HIV-seropositive patients, protein requirements, protein turnover, and the effects of increasing protein intake need further study.

What is the evidence to support a particular dietary intake of protein for people with HIV infection? EAL Conclusion Statement: Adding protein to diets may be beneficial (eg, to maintain body cell mass) for individuals with HIV; however, specific protein requirements, protein turnover, and the effects of increasing protein intake were not addressed in these studies. Further research regarding the dietary intake of protein in people with HIV infection is warranted. **Grade III=Limited.**

High-fat and low-fiber diets are fairly common in people with HIV infection as well as the general population. Recommendations have been made for increasing fiber intake toward the levels suggested in general nutrition guidelines because of associations with lower prevalence of lipodystrophy (99). In addition, lower soluble fiber intake was associated with dyslipidemia in individuals with lipodystrophy (100).

What is the evidence to support a particular dietary intake of carbohydrate for people with HIV infection? EAL Conclusion Statement: Limited evidence supports a relationship between low dietary fiber or high glycemic index diets with increased risk of fat deposition. Further research regarding the dietary intake of carbohydrate in people with HIV infection is warranted. **Grade III=Limited.**

General recommendations for fat consumption have been applied to people living with HIV, mostly to reduce risk factors for cardiovascular disease (101). There may be some relationship between the type of fat intake and lipodystrophy that requires additional investigation (102).

n-3 fatty acid supplementation may play a role in several types of metabolic modulations, but requires further investigation to determine its role in managing hypertriglyceridemia (103). n-6 polyunsaturated fatty acid intake has been related to adverse changes in liver enzyme levels (104).

What is the evidence to support the

consumption of specific fatty acids for people with HIV infection? EAL Conclusion Statement: Studies report that people with HIV infection generally consume diets that are high in fat, saturated fat, and cholesterol. Evidence supports a relationship between diets that are high in saturated fat and hyperlipidemia, particularly hypertriglyceridemia. Studies indicate that diets low in saturated and total fat and including n-3 fatty acids resulted in reduced triglyceride levels, increased high-density lipoprotein cholesterol levels, and a lower risk of lipohypertrophy. Further research regarding dosage and duration of specific fatty acid supplementation in people with HIV infection is warranted. **Grade II=Fair.**

Micronutrients and Other Microsubstances

Important roles for specific micronutrients in the maintenance of the immune function, reduction of mortality from disease- and treatment-related symptoms, and rehabilitation of nutritional status have been described for specific nutrients, such as zinc, selenium, B vitamins, vitamin C, and vitamin E (105-107). It is difficult, however, to separate the effects of individual nutrient deficiencies from those of generalized malnutrition on the immune system (108).

Adequate and balanced intake of all nutrients is important in HIV-related care. Because infection with HIV is a chronic inflammatory condition, some differences from general population recommendations may apply. RDs should have a good understanding of both the potential benefits and problems that may be associated with the use of vitamin and mineral supplements. Dietary adequacy of vitamins and minerals and the potential for toxicities and interactions with other treatments should be considered before recommending supplementation.

What is the evidence to support micronutrient supplementation for people with HIV infection? EAL Conclusion Statement: Thirteen publications were reviewed to evaluate micronutrient supplementation for people with HIV infection, including a Cochrane review published in 2005. The authors of the Cochrane review concluded that there was no conclusive evidence to show that micronutrient

supplementation effectively reduces morbidity and mortality among HIV-infected adults, but that in children, there is evidence of benefit of vitamin A supplementation. Subsequent research reports that micronutrient deficiencies are common in individuals with HIV infection. Two randomized controlled trials based on adult men and women published since 2005 reported increased morbidity and mortality in those not receiving vitamin supplementation. In several publications of a randomized controlled trial in pregnant women with HIV infection, multivitamin supplementation improved nutritional status of their infants and children. Further research regarding type, dose, and duration of micronutrient supplementation is needed. **Grade II=Fair.**

Nutrition-Related Complications and Management

A combination of approaches may be necessary to address nutrition-related problems faced by people living with HIV infection. For instance, weight status and body composition may require combinations of nutritional counseling, nutrient supplements, and medication therapies to accomplish appetite stimulation, hormone modulation, and symptom management. Each of these and combinations of these interventions have all been successful in improving weight status, including fat and lean tissue volumes (109-112). The health care plan also may include medication therapy together with diet strategies to reduce adverse effects of nutrition-related disease complications. Increased protein intake, weight-bearing exercise, and the use of growth hormone, anabolic steroids, insulin sensitizing agents, and others have been shown to positively correlate with improved body composition and quality of life parameters (113-115).

Further support may be indicated to help reduce blood lipid levels, improve insulin sensitivity, and increase lean body mass. RDs and other clinicians should be familiar with both nutrient-based and non-nutrient treatments to improve nutritional status and nutrient metabolism. These treatments may range from exercise and complementary/alternative medicine therapies to pharmacologic modulation. Appropriate referrals for exer-

cise counseling may help to restore lean tissues and has been recommended as an adjunctive therapy to improve body shape alterations and metabolic alterations such as insulin resistance (116). Increases in progressive resistance exercise and lean body mass may help to stimulate bone formation and requires further study (117,118).

Along with lipodystrophy, increased risk of cardiovascular disease and decreased insulin sensitivity are important issues with nutritional implications (119). Increase in risk factors for cardiovascular disease related to ART are likely to require exercise and lipid-lowering medications in addition to dietary modification. Following a heart-healthy diet and exercise program has been shown to reduce blood lipid levels in patients who are HIV positive (119). Clients require support to attain a healthful body weight, reduce their intake of saturated fat, *trans*-fatty acids, salt, and dietary cholesterol. Clients with hypertriglyceridemia benefit from increasing fiber intake, limiting simple carbohydrates, and avoiding alcohol (119).

Abnormal glucose tolerance has been associated with medication therapies (120). Clients with insulin resistance may benefit from participation in diabetes education program that can be integrated into their health care, and where they can learn strategies to regulate their blood glucose levels through diet and exercise. The potential benefit in the treatment of insulin resistance with oral antidiabetic drugs has been explored with some promising and mixed results. Metformin and glitazones are being investigated for their potential to improve insulin sensitivity, but their effect on peripheral subcutaneous fat losses in those receiving ART are still being researched (121-123). Furthermore, medication support may be indicated to help reduce blood lipid levels, insulin resistance, and increase lean body mass.

What is the evidence to support lifestyle interventions for the treatment of hyperlipidemia in people with HIV infection? **EAL Conclusion Statement:** Twelve studies were reviewed to evaluate lifestyle interventions for the treatment of hyperlipidemia in people with HIV infection. Two studies demonstrated that protease inhibitor therapy was associated with hyperlipidemia. Three studies reported that other life-

style factors were associated with hyperlipidemia, such as exercise and the consumption of fat, fiber, and alcohol. Research on several lifestyle modification interventions for the treatment of hyperlipidemia in people with HIV infection reported improvements in serum lipid profile. **Grade I=Good.**

Symptoms that may affect nutritional status may include nausea, vomiting, diarrhea, anorexia, pain, chewing/swallowing difficulties, taste changes, and others. Providing specific strategies to support clients through these challenges is an important part of nutrition therapy.

What is the evidence to support dietary treatment of diarrhea/malabsorption in people with HIV infection?

EAL Conclusion Statement: Seven studies were reviewed to evaluate dietary treatment of diarrhea/malabsorption in people with HIV infection. Many of these studies did not provide information on medications. Two studies regarding fat malabsorption reported that consumption of medium chain triglycerides resulted in fewer stools, decreased stool fat and weight, and increased fat absorption. Two studies of vitamin A and beta carotene supplementation reported decreased gut permeability and risk of severe watery diarrhea. Further research regarding amino acid-based elemental diets, probiotics, pancreatic enzyme therapy, calcium carbonate, glutamine and the BRAT diet in people with HIV/AIDS is warranted, as is research regarding the effect of medications. **Grade II=Fair.**

Although the causes are still unclear, clients with HIV may experience progressive loss of bone mineral density leading to osteopenia or osteoporosis. Many have lower bone mineral density than expected for their age. Clients may have multiple risk factors for loss of bone mineral density, including low BMI, history of weight loss, steroid use, history of nucleoside reverse transcriptase inhibitors use, and smoking. Bone density should be monitored through the use of routine bone density tests such as dual energy x-ray absorptiometry. Modifiable risk factor reduction may include one or more of the following:

- maintaining an optimal weight and preventing rapid weight loss;
- reducing or discontinuing smoking, alcohol, and caffeine consumption;
- reducing or balancing the consump-

tion of foods and beverages high in phosphoric acid by choosing calcium-rich beverages (such as milk or fortified soy beverages) instead of high-phosphorous carbonated beverages and eating a variety of protein foods;

- working with primary care providers to adjust ART to minimize side effects;
- engaging in regular weight-bearing or resistance exercise; and/or
- eating calcium-rich and vitamin D-fortified foods and supplementing with 500 to 1,200 mg/day calcium (124).

Vitamin K, vitamin C, and zinc are also important for bone formation and should be included in counseling on an adequate diet.

Pediatric-Specific Interventions

The goals of intervention for children with HIV infection have the added dimension of growth and development. Guidelines for breastfeeding are slightly different in the context of HIV infection. Other goals include the maintenance of nutritional status and management of disease and its treatments.

Mothers with HIV should be made aware of the risks and benefits of different infant feeding options, including the risk of transmission of HIV through breastfeeding. The World Health Organization issued seven recommendations regarding infant feeding, including ensuring that mothers receive health care they need; maintaining exclusive breastfeeding for the first 6 months of life and the introduction of complementary foods; when and how to stop breastfeeding; which foods and formulas are appropriate to use when discontinuing breastfeeding; conditions that should be met to ensure safe formula feeding; heat-treated, expressed breastmilk as an interim feeding strategy; and feeding recommendations for infants and young children who are known to be infected with HIV (125). The World Health Organization maintains that any replacement feeding must be acceptable, feasible, affordable, sustainable, and safe. This would include the continued use of prophylactic antiretrovirals for mothers and children to reduce the risk of HIV transmission through breast milk during that period of time (126-129).

Still, some subsets of breastfeeding mothers, specifically those with poor immune status and low levels of hemoglobin, may pose a higher risk for transmission of HIV with mixed feeding (130).

Few studies of energy expenditure in children with HIV have been reported since the introduction of ART. In one study, energy expenditure was not found to be different in children with HIV infection compared to non-infected controls, which may suggest that other risk factors for growth failure may play a stronger role (131).

Nutrient supplementation has been suggested in resource-limited settings to reduce the rate of maternal to child transmission of HIV and to ameliorate symptoms associated with disease and treatment (132). Although single nutrients were initially explored, recent research suggests a role for multiple nutrient interventions (133).

Non-Nutrient Therapies

Non-nutrient therapies are recommended both to improve nutritional status and to augment HIV-related therapies. Treatment of HIV infection with combination ART has been associated with improved nutritional indicators, such as BMI and body cell mass, as well as detrimental toxicities and bone mineral density that affect nutritional status (64,134,135).

Exercise has been recommended as a strategy to maintain body function, restore and maintain adequate nutritional status, and assist in the management of altered glucose, lipid, and bone mineral metabolism. There have also been concerns about the safety of exercise in patients with diminished capacity.

What is the evidence to support physical activity for people with HIV infection? EAL Conclusion Statement: Eighteen publications were reviewed to evaluate physical activity for people with HIV infection. Two recent systematic Cochrane reviews concluded that performing constant or interval aerobic exercise, progressive resistance exercise, or a combination of both, for at least 20 minutes per session at a frequency of three times per week appeared to be safe in adults with HIV infection and may lead to significant improvements in cardiopulmonary fitness and reduc-

tions in depressive symptoms. Studies published since that time support those findings; however, research on the relationship between physical activity and immunity in people with HIV is inconclusive. Special considerations may be needed for people with HIV infection who have reduced aerobic capacity, metabolic changes, increased pain, fatigue, and impairments while exercising and those with a history of drug and alcohol abuse. Further research is needed on the effect of physical activity on serum lipid profiles in people with HIV infection. **Grade I=Good.**

Other treatments may be aimed at the control of comorbidities and symptoms that can affect nutritional status. Symptom management is a key strategy in both maintaining nutritional status and therapy adherence. Medications and other therapies may be used to control nausea, vomiting, diarrhea, mouth and throat sores, organ diseases, and others (136-138).

Testosterone replacement and anabolic steroids have been explored to assist in the restoration of body weight and body cell mass in addition to improving strength and quality of life (139). Potential for liver toxicity and changes in lipid profiles exists for anabolic steroid treatment. Testosterone and recombinant human growth hormone have been explored in the treatment of wasting and central fat accumulation (140). Growth hormone has been used at higher doses to recover from HIV-related wasting by restoring body cell mass and at lower doses to reduce central fat accumulation.

Anti-cytokine therapy, such as thalidomide, has been explored for treating tuberculosis and HIV-related wasting. Recently, thalidomide has been reported in use for recurrent aphthous ulcers and HIV-related colitis (141,142). However, the use of thalidomide is limited by the potential for teratogenicity, peripheral neuropathy, and other adverse effects (143).

Complementary and Alternative Medicine (CAM)

CAM therapies can be complex, wide ranging, and may be more commonly utilized by clients with HIV infection and cancers (144). CAM may include healing practices that are not generally considered a part of conventional medicine. Complementary therapies may be used along with conventional medi-

cal therapies and alternative therapies are used instead of conventional medical therapies. Examples include homeopathy, naturopathy, supplements of substances ranging from macro- or micronutrients to herbal therapies, massage, acupuncture, and others. Clients who integrate CAM into their health care plans often use CAM therapies to reduce symptoms and improve quality of life (145).

There is need for more specific research on the influence of CAM in HIV infection; however, RDs, DTRs, and other clinicians should be aware of the potential effects of CAM, especially if there are potential interactions or required "holidays" from conventional medical therapies. A risk vs benefit analysis should be conducted before the use of adjunctive therapies with careful attention to potential interactions with antiretroviral and other medications. Supplemental nutrients, herbs, and other medications may be processed by the same biochemical pathways that are utilized by antiretroviral medications and affect nutritional status. These supplements may reduce or raise levels of antiretroviral medications and, in turn, ART can reduce or raise expected levels of the supplemental nutrients, herbs, or other medications. This can lead to a decreased level and efficacy of the medications and/or increased toxicities.

Examples of potential interactions of supplements with medications include the reduction of drug efficacy during the concomitant use of supplemental St John's wort, garlic, and echinacea with protease inhibitors and/or non-nucleoside reverse transcriptase inhibitors. There have been few rigorous trials of herbal medicines and potential interactions and other health risks should be considered in evaluating their use (145,146). Critical evaluation of individual therapies that may affect nutritional status is an important part of counseling for clients.

Cofactors in Nutritional Status Maintenance

In the era of ART, life spans are increasing and people with HIV are facing new sets of challenges. There are many other issues related to HIV disease and side effects of medication therapy, which may require nutrition intervention. Nutrition interventions should support a client's medication treatment goals while reducing any negative nutri-

Organization	Description	Web site
American Dietetic Association	<i>Living Well with HIV and AIDS:</i> (2009)	www.eatright.org/Shop/Product.aspx?id=4860
HIV/AIDS Dietetic Practice Group	Dietitians' resources, including continuing education	www.hivaidspg.org
AIDS Project Los Angeles	Client education materials; HIV nutrition provider certification program	www.apla.org
Association of Nutrition Services Agencies	Client educational materials and technical assistance for AIDS ^a meal provider organizations	www.ansanutrition.org
Centers for Disease Control and Prevention	Incidence and prevalence statistics and fact sheets; case definitions and treatment guidelines	www.cdc.gov/hiv/topics/surveillance/factsheets.htm and www.cdc.gov/hiv/topics/surveillance/resources/guidelines/index.htm
Gay Men's Health Crisis	Client education.	www.gmhc.org
God's Love We Deliver	Client education	www.gldw.org
AIDS Education and Training Center National Resource Center	Client education and nutrition manual; funding for education and training	www.aids-etc.org/aidsetc?page=home-search&post=1&SearchEntry=nutrition
HIV and Hepatitis	Conference and research updates and reviews	www.hivandhepatitis.com
Medscape Infectious Disease forum	Conference reviews, peer-reviewed articles, continuing education	www.medscape.com
New Mexico AIDS Infonet	Client handout downloads	www.aidsinfonet.org
Women, Children, and HIV	Website with information resources concentrated on maternal health, vertical transmission, and orphans and vulnerable children	www.womenchildrenHIV.org

Figure 2. Selected reliable education and information resources on human immunodeficiency virus (HIV) and nutrition topics for clients and health care providers. ^aAIDS=acquired immunodeficiency syndrome.

tion-related health effects of the disease and medication regimens. Prediabetes and diabetes may be more common in patients with HIV infection and will require dietary interventions. Lipodystrophy has emerged as a complex issue in HIV care. Body composition and anthropometry, signs and symptoms of insulin resistance, and alterations in blood lipids in both sexes and serum levels of total and free testosterone in men should be monitored regularly for changes indicative of a lipodystrophy and decreases in lean body mass.

Coinfections, such as hepatitis C infection, may require specific attention to organ systems and the potential for additional therapies to interact with nutritional status, food, and other medications (147,148).

REIMBURSEMENT FOR NUTRITION-RELATED SERVICES

Reimbursement for health care, including MNT and supplements, is impor-

tant for the access and integration of nutrition care and should be a part of efforts to improve access to care in the United States. Several sources of payment may be available, depending on insurance coverage, enrollment in state and federal support programs, and other resources. In some cases, AIDS Drug Assistance Programs and Medicaid programs may provide for medically necessary nutrient supplementation. In 2006, the Ryan White CARE Treatment Modernization Act included MNT in the Part B core medical services for funding (149). Through this Act, Title II funding may provide for nutrition services and meals or supplements, and Title III (Early Intervention Services) may provide support for nutrition services and food and nutrient supplementation provided or prescribed by qualified health care providers. Medicare and other funding sources may be available for nutrition-related care for diabetes, renal disease, and cardiovascular disease. Availability

and use of covered food and nutrition services and assistance may positively affect routine primary care utilization (150,151).

PROFESSIONAL RESOURCES

Because the research in HIV infection and related disease is constantly changing, RDs and DTRs and other care providers should keep updated on the evidence, guidelines, and experiences. Figure 2 contains information on selected resources for nutrition-related information for the care and treatment of people living with HIV.

ROLES AND RESPONSIBILITIES OF RDs AND DTRs

RDs and DTRs can be instrumental in ensuring that diet and nutritional status are optimized in clients with HIV infection. The roles and responsibilities of RDs and DTRs include:

- educating clients and their caregivers on the role of nutrition and diet in both restoration and maintenance of health;
- initial and periodic assessment of client nutritional status and challenges to maintenance and restoration of nutritional status to develop and update nutrition-related strategies with clients and caregivers;
- support for maintenance and recovery of the immune function through planning and implementation of MNT and strategies with clients;
- assistance in developing nutrition-related strategies to manage nutrition-related side effects of disease and medications such as dyslipidemia, insulin resistance and glucose intolerance, anemias, anorexia, nausea and vomiting, and diarrhea;
- support for medical treatment of HIV by promoting adherence to treatment and compliance with regular clinic visits; RDs and DTRs and other clinicians may be involved in discussions on the psychosocial impact of lipodystrophy with clients;
- updating knowledge and evaluating research on both nutrient-based and non-nutrient treatments to improve nutritional status and nutrient metabolism, ranging from exercise and CAM therapies to pharmacologic modulation;
- providing education for clients and caregivers on the potential interactions of nutrients and nutritional status with antiretroviral medications, other medications, CAM therapies, supplemental nutrients, herbs, and other therapies;
- maintaining familiarity with community and other programs available to clients for referral in cases of social, economic, and psychological needs; and
- being knowledgeable of issues pertaining to privacy and confidentiality when providing nutritional care and providing care in an equitable and nonjudgmental fashion.

CONCLUSIONS

It is clear that the influence of disease on nutritional status can affect the overall health and longevity of people living with HIV infection; however, the influence of nutrition interventions on HIV disease is limited. There is some research that supports the positive role of nutrition intervention in

the improvement of health for children and adults with HIV (74,76,80,144). More research is needed to understand the influence of nutrition on health, disease, and survival in HIV infection.

Research is important to establishing standardized practice guidelines on the integration of nutrition-related interventions into medical management. Training on nutrition-related issues of evaluation and treatment in HIV infection should be an ongoing process for RDs and other care providers. The team approach of collaboration with and referral to other specialties may help to overcome challenges with mental health, drug addiction, and economic constraints.

Goals for nutrition interventions should be individualized according to the problems identified. Medical nutrition protocols for adults and children with HIV disease have been developed (152,153). Among the goals in these protocols are achieving healthy body weights, body composition, and lab values. More research is needed on the effects of both the restoration and maintenance of nutritional status on ART and other treatment effectiveness. Other goals include a reduction in nutrition-related side effects and complications, enhanced quality of life, and expanded access to nutrition services. RDs have the opportunity to play an important role in advocating for food and nutrition security in collaboration with others (11,12).

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- We thank the reviewers for their many constructive comments and suggestions. The reviewers were not asked to endorse this position or the supporting paper.