

Practice Paper of the Academy of Nutrition and Dietetics:

Nutrition and Women's Health

ABSTRACT

Women account for 51% of the U.S. population. Currently, cardiovascular disease (CVD) is the leading cause of death in women, followed by cancer and stroke. Breast cancer, while associated with lower mortality than most other cancers, is the leading cause of cancer-related morbidity in women. Osteoporosis also threatens women, particularly after menopause. Importantly, each of these diagnoses in aging women share a commonality in that lifestyle choices, including diet, play a primary role in prevention and treatment of these diseases. This practice paper provides a synopsis of current dietary recommendations for CVD, osteoporosis, and breast cancer in women. Registered dietitian nutritionists (RDNs) and dietetic technicians,

registered play important roles in risk reduction for these diagnoses and RDNs are uniquely qualified to provide medical nutrition therapy. For CVD, osteoporosis, or breast cancer current recommendations for nutritional care suggest women should achieve and maintain a healthy body weight with avoidance of visceral adiposity. Nutrient density, with an emphasis on consumption of a variety of foods to acquire important micronutrients and bioactive components, is also central to effective medical nutrition therapy. Furthermore, RDNs should have a working knowledge of the therapeutic role of dietary supplementation, particularly for osteoporosis prevention.

Women account for approximately 50.8% of the total U.S. population.¹ The leading causes of death in women, which include cardiovascular disease (CVD) (24%), cancer (22.2%), and stroke (6.3%), all suggest that lifestyle choices, including diet, play a role in determining overall morbidity and mortality. In addition, women suffer disproportionately from fractures and osteoporosis, making bone health a significant health care issue.² This practice paper provides an overview of the salient evidence supporting current dietary recommendations for CVD, osteoporosis, and breast cancer in women. The provision of nutritional care for these conditions will certainly vary; however, risk factors for these conditions as well as nutritional therapies do share several commonalities (see Figure 1). Specifics of the evidence base for nutritional care planning in individual conditions is described in separate sections of the manuscript below. Registered dietitian nutritionists (RDNs) and dietetic technicians, registered (DTRs) are advised that this practice document should not be considered a comprehensive review of the evidence for diet and these important health conditions in women. For a more comprehensive understanding, RDNs and DTRs should supplement their knowledge through review of relevant published literature, much of which is cited herein. Figure 2 provides relevant links as well, including the Academy's Evidence Analysis Library.

CARDIOVASCULAR DISEASE

The cardiovascular system is complex, and disease or dysfunction can occur within one or more components of this system. This practice paper focuses primarily on atherosclerosis, with an emphasis on primary prevention. Progress has been made recently in our understanding of its etiology and while inflammation appears to be key, it has not yet been shown to be causal.¹¹

Risk for CVD has been estimated using the Framingham Risk Score and includes the measurement of lipoproteins, smoking status, and blood pressure (BP).¹² However, newer American Heart Association (AHA) guidelines include additional variables specific to women (see Figure 3).³ Interventions target lifestyle choices (cigarette smoking, physical activity, and diet) to optimize body weight, BP, blood lipids, and diabetes control.

CVD is the primary cause of death in women over age 65, as high as deaths from cancer, chronic lower respiratory disease, and Alzheimer's disease combined.⁴ The AHA estimates that healthy women after age 40 have a one in two lifetime risk for any CVD (two in three for men).

The prevalence of CVD in women is slightly lower than that in men,⁴ but the protective effect of sex declines with age and disappears in those with diabetes. Among women,

	Cardiovascular disease	Osteoporosis	Breast cancer
Optimize weight, ^a adiposity	Body mass index (BMI) <25, waist circumference <35 inches	BMI 18.5 – 24.9	Be as lean as possible without being underweight; BMI 18.5 – 24.9 throughout life
Fruits and vegetables	≥4.5 c/d	2.5 cups vegetables and 2 cups fruit + juices/d	Eat at least 2.5 c/d; increase variety; emphasize a plant-based diet
Whole grains	≥3 servings/d, replacing refined grains	≥3 oz/d	Choose whole grains instead of refined grain products
High fiber foods	30 g fiber/d (1.1 g/10 g carbohydrate)	Choose more fruits, vegetables, beans, and whole grains	Emphasize a plant-based diet
Nuts, legumes (including soy), and seeds	≥4 servings/wk	No specific recommendation	No specific recommendation- soy, flax may lower estrogen
Fish and shellfish, especially oily fish ^b	≥2 servings /wk	No specific guidance	Choose fish instead of red or processed meat; fatty fish (n-3 fatty acids) may reduce inflammation and associated with lower risk in some studies
Dairy products	2–3 servings/d	3 c/d	No specific guidance; chose lower fat options
Vegetable oils	2–6 servings/d	Limit dietary fats	Limit dietary fats
Saturated fat	<7% of caloric intake	No specific guidance	No specific guidance; recommends low fat selections
Cholesterol	<150 mg/d	No specific guidance	No specific guidance
Industrially-produced <i>trans</i> fats	Avoid industrially-produced <i>trans</i> fats	No specific guidance	Avoid <i>trans</i> fats
Red and processed meats	≤2 servings/wk processed meats	No specific recommendation	Limit both red and processed meats
Alcohol	≤1 drink/d	If alcohol is consumed, it should be consumed in moderation—up to 1 drink/d for women	≤ 1 drink/d, if any; monitor portion
Sodium	<1,500 mg/d	Reduce daily sodium intake to <2,300 mg and further reduce intake to 1,500 mg among persons who are 51 and older and those of any age who are African American or have hypertension, diabetes, or chronic kidney disease	No specific guidance
Sugar, including sugar sweetened beverages	≤5 servings/wk, including ≤450 cal/wk from sugar-sweetened beverages	No specific guidance	Suggest avoidance of low nutrient sweetened beverages and avoidance of foods that contribute excess energy and may promote undesirable weight gain
Dietary Supplements	None, except possibly fish oil	Possibly calcium and/or vitamin D	Not recommended

Figure 1. Summary of dietary recommendations. Adapted from references 3–10.^a All of the recommended servings are based on a 2,000 calorie diet—servings may need to be adjusted down if weight loss is needed.^b High mercury fish should be avoided (shark, swordfish, king mackerel, and tilefish) or limited (albacore tuna) for those women of childbearing age.

GENERAL WEB-BASED RESOURCES AND INFORMATION

Academy of Nutrition and Dietetics

www.eatright.org

- * Includes access to patient education materials, as well as the Evidence Analysis Library

Choose MyPlate

www.choosemyplate.gov/information-healthcare-professionals.html

- * Provides recipes and some sample menus

“Clinical Preventive Services for Women: Closing the Gaps”

www.iom.edu/Reports/2011/Clinical-Preventive-Services-for-Women-Closing-the-Gaps.aspx

- * 2011 Institute of Medicine report that includes recommendations for nutrition counseling

ClinicalTrials.gov

<http://clinicaltrials.gov/>

- * National Institutes of Health (NIH) database that is both a registry of clinical trials and a database of results
- * Covers publicly and privately supported studies using human participants

Dietary Guidelines for Americans 2010

www.cnpp.usda.gov/dgas2010-policydocument.htm

- * Appendices provide recommended food patterns for various caloric levels (1000–3200 cal), including vegetarian (lacto-ovo and vegan) and DASH (Dietary Approaches to Stop Hypertension) diets
- * Website and appendices also include suggested messages, key consumer behaviors, and potential strategies for change

Nutrition.gov

www.nutrition.gov

- * Links to other government sites for both policy and educational resources

PubMed

www.ncbi.nlm.nih.gov/pubmed

- * U.S. National Library of Medicine, NIH searchable database for biomedical literature

U.S. Department of Agriculture Food Composition Tables

www.ars.usda.gov/main/site_main.htm?modecode=12-35-45-00

- * Searchable on-line food composition tables

WomensHealth.gov

www.womenshealth.gov

- * Links to information on health topics, including nutrition

CARDIOVASCULAR DISEASE

Academy of Nutrition and Dietetics, Evidence Analysis Library

<http://andevidencelibrary.com/category.cfm?cid=14&cat=0&auth=1>

- * Pertinent topics: Adult Weight Management, Chronic Kidney Disease, Diabetes Mellitus Types 1 and 2, Disorders of Lipid Metabolism Update, and Hypertension

American Heart Association

www.heart.org/HEARTORG

- * Current guidelines:
http://my.americanheart.org/professional/StatementsGuidelines/Statements-Guidelines_UCM_316885_SubHomePage.jsp
- * AHA public education site: <http://mylifecheck.heart.org>

Centers for Disease Control and Prevention

www.cdc.gov/heartdisease

- * Links to statistics and educational materials

National Heart, Lung, and Blood Institute (NHLBI)

www.nhlbi.nih.gov/health/indexpro.htm

- * 2013 guidelines in development: www.nhlbi.nih.gov/guidelines/indevelop.htm
 - Managing Blood Cholesterol in Adults
 - Managing Blood Pressure in Adults
 - Managing Overweight and Obesity in Adults
 - Assessing Cardiovascular Risk
 - Lifestyle Recommendations to Reduce Cardiovascular Risk
- * “Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III),” 2002
www.nhlbi.nih.gov/guidelines/cholesterol/atp3full.pdf
 - Current guidelines
 - Appendices include sample TLC (Therapeutic Lifestyles Changes) diets with nutrient calculations as well as limited food composition data
- * “The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure,” 2004
www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.pdf
 - Current guidelines
 - Includes guidance on the relative impact of lifestyle modifications, including dietary modifications
- * “Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report,” 1998
www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf
 - Current guidelines
 - Includes estimated caloric expenditures for various types of exercise
 - Includes limited food composition data, compares some regular and reduced fat products
 - Includes sample menus, with nutrient calculations, and food preparation guidelines
- * “Your Guide to Lowering Your Blood Pressure with DASH”
www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf
 - Consumer booklet on the DASH diet
 - Includes servings for multiple calorie (1,600–3,100 cal) and sodium (1,500 mg, 2,300 mg) levels, as well as recipes
 - Includes limited food composition data

WomensHealth.gov

www.womenshealth.gov/publications/our-publications/fact-sheet/heart-healthy-eating.cfm

- * “Heart Healthy Eating Fact Sheet”
- * Includes a comparison of the MyPyramid, DASH, Heart Healthy, and TLC Diets

Figure 2 (Part 1). Selected web-based resources for clinicians including information on clinical practice recommendations and patient support materials regarding cardiovascular disease, osteoporosis, and breast cancer. (continued on following page)

OSTEOPOROSIS

American College of Rheumatology

www.rheumatology.org/practice/clinical/patients/diseases_and_conditions/osteoporosis.asp

- * Patient information
- * Links to educational materials and other government sites

FRAX: World Health Organization Fracture Risk Assessment Tool

www.shef.ac.uk/FRAX

- * Risk assessment tool used by many physicians

International Osteoporosis Foundation

www.iofbonehealth.org

- * Patient and healthcare provider education materials
- * Links to training courses and research working groups

Medline Plus Osteoporosis

www.nlm.nih.gov/medlineplus/osteoporosis.html

- * Links to educational materials and other government sites

NIH Osteoporosis and Related Bone Diseases National Resource Center

www.niams.nih.gov/health_info/bone

- * Links to educational materials and other government sites

National Osteoporosis Foundation

www.nof.org

- * Patient education and support groups
- * Healthcare provider education at www.nof.org/hcp

BREAST CANCER

Academy of Nutrition and Dietetics, Oncology Practice Group

www.oncologynutrition.org

- * Oncology Nutrition Toolkit
- * Clinical Guide to Oncology Nutrition
- * Standards of professional practice

Figure 2 (continued). Selected web-based resources for clinicians including information on clinical practice recommendations and patient support materials regarding cardiovascular disease, osteoporosis, and breast cancer.

Agency for Healthcare Research and Quality

www.ahrq.gov

- * Select reviews of evidence for dietary supplements used in cancer prevention and/or the treatment of therapy-related symptoms

American Cancer Society

www.cancer.org

- * Patient and healthcare provider education materials
- * Diet and cancer information
www.cancer.org/healthy/eathealthygetactive/acsguidelinesonnutritionphysicalactivityforcancerprevention/index
- * "American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention"
www.cancer.org/acs/groups/cid/documents/webcontent/002577-pdf
- * "Lifestyle Changes That Make a Difference: Nutrition and Physical Activity Guidelines for Cancer Survivors"
www.cancer.org/acs/groups/content/@editorial/documents/document/acspc-037186.pdf

American Institute for Cancer Research

www.aicr.org

- * Recipes, newsletters and funded research findings
- * Annual meeting on diet, physical activity and cancer

National Cancer Institute

www.cancer.gov

- * Breast cancer home page: www.cancer.gov/cancertopics/types/breast
- * Includes statistics, patient and healthcare provider information, including information on research trials
- * "Eating Hints Before, During, and After Cancer Treatment"
www.cancer.gov/cancertopics/coping/eatinghints
- * Tips for patients who experience side effects from cancer therapies that alter food intake

the prevalence is highest among African Americans (48.9%) and non-Hispanic whites (32.4%), followed by Hispanics (30.7%). American Indian/Alaska Natives may also be at particular risk. Stroke is a more common outcome of CVD in women than in men; with black women's rates doubling those of non-Hispanic white women. Importantly, both CVD prevalence and mortality rates have increased in women ages 35–54³ recently, primarily with the rise in obesity.

Nutrition Recommendations for Prevention of CVD

The AHA's current paper on CVD prevention in women³ modifies their 2006 recommendations.⁵ An update of the 2005 Evidence Analysis Library project on lipid metabolism,¹³ as well as two newer reviews^{6,14} also address the issue of a cardioprotective diet. All recommend consuming nutrient-dense foods and adopting healthy eating patterns rather than focusing on specific nutrients because

of the likely synergistic interactions. They recommend higher fiber, healthy fats, vitamins, minerals, antioxidants, phytochemicals, and lower refined carbohydrates, sugars, salt, saturated fats (SFA), dietary cholesterol, and *trans* fats.⁶ Specifically, they recommend replacing refined carbohydrates with higher levels of fats than before (from oils, not solid fats). Focus has shifted from cooking with less salt to limiting the consumption of processed foods.⁶ Consistently helpful are fruits, vegetables, whole grains, nuts, and fish. Those foods consistently associated with increased disease risk include processed meat, packaged foods, fast food, and sugar-sweetened beverages. Specific recommendations are summarized in Figure 1.

While the AHA³ recommends a DASH-like (Dietary Approaches to Stop Hypertension) diet, multiple dietary patterns have been shown to be effective in reducing CVD risk, often without weight loss. However, while these diets

Risk status	Risk factors
High risk = ≥ 1 listed risk factor	Coronary heart disease, cerebrovascular disease, or peripheral arterial disease with clinical symptoms Abdominal aortic aneurysm End-stage or chronic kidney disease Diabetes mellitus 10-y predicted cardiovascular disease risk of $\geq 10\%$
At risk = ≥ 1 of listed risk factors	Cigarette smoking Systolic blood pressure ≥ 120 mm Hg, diastolic blood pressure ≥ 80 mm Hg, or treated hypertension Total cholesterol ≥ 200 mg/dL, high density cholesterol < 50 mg/dL, or treated for dyslipidemia Obesity, particularly central adiposity Poor diet Physical inactivity Family history of premature cardiovascular disease occurring in first degree relatives in men < 55 y of age or in women < 65 y of age Metabolic syndrome Evidence of advanced subclinical atherosclerosis Poor exercise capacity on treadmill test and/or abnormal heart rate recovery after stopping exercise Systemic autoimmune collagen-vascular disease (eg, lupus or rheumatoid arthritis) History of preeclampsia, gestational diabetes, or pregnancy-induced hypertension
Ideal cardiovascular health (all of these)	Total cholesterol < 200 mg/dL (untreated) Blood pressure $< 120/80$ mm Hg (untreated) Fasting blood glucose < 100 mg/dL (untreated) Body mass index < 25 Abstinence from smoking Physical activity at goal for adults > 20 y of age: ≥ 150 min/wk moderate intensity, ≥ 75 min/wk vigorous intensity, or combination Healthy (DASH-like) diet

Figure 3. Cardiovascular disease risk factors and classification in women. Reprinted from *Journal of the American College of Cardiology*; Volume 57, Issue 12; Mosca L, Benjamin EJ, Berra K, et al; Effectiveness-based guidelines for the prevention of cardiovascular disease in women — 2011 update: a guideline from the American Heart Association; pages 1404–1423; 2011; with permission from Elsevier.

have similarities, they vary with the inclusion of legumes, fish, red meat, alcohol, olive oil, cheese, eggs, and milk and the priority they give to sodium reduction. Comparisons of the following diets are available:^{5,6} DASH; two OmniHeart diets (DASH with higher monounsaturated fatty acids [MUFA], DASH with higher protein); Therapeutic Lifestyles Changes (TLC) from the National Heart, Lung, and Blood Institute (NHLBI); various Mediterranean diets; vegetarian; and Okinawan and Japanese diets. Also effective is the Portfolio diet,¹³ a vegetarian version of the TLC diet, with added viscous fiber, plant stanols/sterols, soy protein, and almonds, that has been shown to be as effective as a statin.¹⁵ The 2010 Dietary Guidelines for Americans are consistent with many of these diets.¹⁶

Weight Management Obesity is a primary risk factor for CVD.⁵ Evidence suggests that women should achieve or sustain a healthy weight (ie, a body mass index < 25 and waist size < 35 inches).³ Various caloric need estimations are

available, but may be as low as 1,600 cal/day for a sedentary woman over age 50, just to maintain weight.⁷ It appears that adherence to a weight-loss diet is more important than the macronutrient composition of that diet.⁶

The AHA advises women to accumulate ≥ 150 min/wk of moderate exercise, 75 min/wk of vigorous exercise, or an equivalent combination. Activity episodes should last at least 10 minutes. Muscle-strengthening activities involving all major muscle groups are recommended on ≥ 2 days/wk. To achieve or sustain weight loss, at least 60 to 90 minutes of moderate-intensity exercise on most, if not all, days may be necessary.³

Fruits and Vegetables Increasing fruit and vegetable consumption reduces risk of both heart disease and stroke in a dose-related manner,¹⁴ with each additional serving associated with a 4% reduced risk of coronary heart disease (CHD) and 5% reduced risk of stroke.⁴ Recommended intakes of 4.5 cups can cost less than \$2/day.⁴

Fruits and vegetables improve BP, blood lipids, insulin sensitivity, inflammatory biomarkers, endothelial function, and weight control.⁶ While consistently seen as helpful, the mechanisms are unclear and the different health effects among specific types of fruits, vegetables, or juices needs further study.

Whole Grains Few Americans (8%) meet the recommendation of consuming at least 3 servings/day of whole grain.¹⁴ Increasing all high fiber foods, including replacing refined carbohydrates with whole grains, improves endothelial function and possibly decreases inflammation.^{6,17} Obesity is inversely associated with fiber intake and decreased visceral fat (without weight loss) is seen in intervention studies. Viscous fiber (oats, barley) decreases low-density lipoprotein (LDL) and BP and improves insulin responses. Insoluble fiber moderately lowers blood glucose and BP. The prebiotic effect of resistant carbohydrates varies by the type of grain but may affect caloric availability and improve both lipid metabolism and glycemic control.

Higher fiber provides only part of the benefit of whole grains; also important may be vitamins, minerals, phytochemicals, and fatty acids.^{6,17} The carbohydrate quality may affect postprandial blood glucose response, especially among those predisposed to insulin resistance.⁶

Nuts Modest nut consumption is associated with lower CHD incidence.⁶ Intakes of 1–2 oz/day lower LDL levels 2%–19%, with lean subjects showing greater response.¹⁶ Nuts appear to reduce total cholesterol, postprandial hyperglycemia, oxidative, inflammatory, and endothelial biomarkers, and are associated with less adiposity, in spite of being a concentrated energy source (160 cal/1.75 oz).⁶

Multiple components are being investigated, including the amount and types of both proteins and fats, as well as the fiber, vitamins, minerals, phytosterols, antioxidants, and phytochemicals.⁶ Most research has been done with almonds and walnuts and the effects of specific tree nuts and peanuts need further study.

Soy The Food and Drug Administration is re-evaluating the health claim that soy protein lowers blood cholesterol levels.¹⁸ However, while it decreases LDL less than previously thought (4%–6% vs. 12.9%), it's of the same magnitude as soluble fiber and is still meaningful. Adding another 4% reduction by replacing animal protein could reduce CHD risk by 8%–16% overall. Although the fat is primarily n-6 polyunsaturated fatty acids (PUFA) (55% linoleic acid), there is no evidence that soy foods are proinflammatory.

Two to four servings/day of soy foods provide the level of protein and isoflavones shown to be beneficial.¹⁸ Other

legumes may also be helpful, contributing micronutrients, phytochemicals, and fiber.⁶

Fish Consuming 1–2 servings of fish/wk (not fried) is recommended for primary prevention¹⁴ and is associated with 36% lower CHD mortality compared to eating no fish.⁶ Fish and/or fish oil is associated with lowered BP, triglycerides, improved endothelial function, and possibly decreased inflammation. Benefit is likely from the long-chain n-3 PUFAs, especially eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids, but may also include protein, unsaturated fats, vitamin D, and selenium. Whether the benefit with fish eating can be reproduced with fish oil supplements isn't yet known.

Those fish highest in DHA plus eicosapentaenoic acid include salmon (farmed and wild), anchovies, herring, sardines, trout, oysters, mackerel, and albacore tuna.^{6,7} Other fish also high in DHA (tilefish, shark, king mackerel, and swordfish) are not recommended for women of childbearing age because of their high methylmercury content.⁷

Dairy Diets including low-fat dairy are associated with decreased lipids, BP, and insulin resistance, with improved endothelial function, independent of weight changes.^{6,16} However, the active constituents aren't yet clear and may include specific peptides, fatty acids, and vitamins, as well as calcium and vitamin D.

Dairy products are now the largest source of SFA in the U.S. diet,¹⁹ but most observational studies have not found increased risk of CVD, CHD, or stroke with dairy fats, regardless of milk fat levels. Cheese appears to raise LDL levels less than does butter at equal SFA levels.^{16,19}

There are significant gaps in research on the specific effects of milk, yogurt, cheese, and butter.^{6,19} Because there appears to be no nutritional advantage to whole-fat dairy, most guidelines recommend low-fat or non-fat dairy to help maintain ideal weight.⁶

Dietary Fats The largest change in dietary guidance has been in the role of fats. Reducing the total fat content of the diet is not associated with a reduced incidence of CHD, stroke, or total CVD risk.^{4,14} Instead, attention has shifted to the fat quality, with oils recommended over the solid fats and the industrially-produced *trans* fats.

Most harmful are the synthetic *trans* fats, with intakes of 2% of calories from *trans* fats associated with a 23% higher risk of CHD,⁴ worse than SFA.^{3,5,6,14,16} With mandatory labeling, intakes are now declining.⁷ The naturally occurring *trans* fats, conjugated linoleic acid and vaccenic acid, found in the milk and fat of ruminant animals¹³ are not considered harmful in the amounts normally consumed.¹⁴

The relationship between SFA and CVD is not as straightforward as previously thought¹⁹ and is no higher than the background risk of a normal diet,⁶ although reducing SFA to <7% and dietary cholesterol to <200 mg/day lowers LDL 9%–12%.¹³ More important is what replaces SFA as an energy source. There is no information on replacing SFA with dietary protein. Replacing 5% of energy from SFA with carbohydrate is associated with 7% higher risk of CHD.⁴ Switching from SFA to lower-glycemic, higher fiber carbohydrate is potentially beneficial, but the effect of someone's underlying predisposition to insulin resistance is unknown.⁶ Replacing solid fats with oils is helpful.⁶ However, the type of oil matters and which is optimal is still being debated.^{16,20} Long-chain n-3 PUFAs from fatty fish are beneficial,⁶ but evidence is mixed for alpha-linolenic acid, found in canola, soy, flaxseed, and walnuts.^{6,14}

Replacing SFA with either n-6 PUFA or MUFA reduces total cholesterol and LDL.^{6,13} Replacing 5% of energy from SFA with n-6 PUFA lowers CHD risk 13%.^{4,14} The n-6 PUFAs (primarily in soy, corn, and safflower oils)⁶ are often limited to <10% total energy because of concern for increased inflammation.²¹ However, while there is some disagreement,¹⁴ the AHA supports at least 5%–10% energy from n-6 PUFAs, saying that decreasing intakes below current levels may increase, not decrease, CVD risk.²¹ Replacing SFA for MUFA (primary component of olive oil, but also in canola oil, avocados, and nuts, as well as in animal fats) has no effect on CVD risk^{4,14,16} and data from research on animals suggests risk.^{6,20} All oils contain a mixture of fatty acids and the optimal balance of PUFA and MUFA is not yet known^{16,20} but limiting oil choices to just olive and canola oils may not be wise.

Fats are calorically dense.⁶ Adding oils to replace SFA and refined carbohydrate should be done with total energy balance in mind,^{21,22} especially important for those with insulin resistance. While weight loss is key for those who are overweight/obese, weight loss can be achieved without avoiding all oils.²²

Dietary Cholesterol Traditionally, limiting intake of dietary cholesterol has been recommended to reduce blood LDL levels and, therefore, reduce CVD risk. However, the relationship between dietary cholesterol and CHD is not linear¹⁵ with intakes of SFA, *trans* fats, n-3 and n-6 PUFAs, fruits, vegetables, legumes, and soluble fiber all likely important.

For many healthy adults, eggs can be a part of an overall heart-healthy diet,^{15,16} especially if SFA intakes are low.⁷ However, for people with excess adiposity and/or insulin resistance²³ risk for CVD increases with higher intakes¹⁶ in spite of their blunted response to dietary cholesterol.²³

Currently, the AHA recommends limiting intake of dietary cholesterol to <150 mg/day,³ which is lower than both their previous recommendations¹² and the current Dietary Guidelines for Americans.⁷ The NHLBI recommends no more than two egg yolks/wk as part of the TLC diet¹² (186 mg/large yolk), but other foods, including liver, brains, shrimp, and squid, are also high in cholesterol.²⁴

Meats Lowering red meat consumption is consistently recommended.⁶ However, the risk appears to be greater for processed meats, which contain high salt and preservatives (nitrites, phosphates) and are often cooked at higher temperatures. Lean meat, whether red meat or poultry, can be included in small amounts and both have lipid-lowering effects.¹⁶

Alcohol Alcohol consumption of up to one drink/day for women, is associated with lower incidence of both CHD and diabetes, by raising high-density lipoproteins blood levels, reducing inflammation, and improving insulin sensitivity.⁶ However, this benefit may be overestimated and irregular or binge drinking is more harmful than moderate consistent intake. While the non-alcoholic components, including resveratrol, are potentially beneficial, most studies have found more consistent benefit with the alcohol itself. Given that alcohol intake negatively affects overall mortality, it is not recommended as a population-based strategy nor should individuals be encouraged to increase their intake.¹⁴

Sodium Elevated BP is responsible for the majority of strokes and CHD events worldwide²⁵ and the DASH diet along with weight loss is recommended to reduce the risk. In addition, while there is some disagreement,²⁵ most evidence points to a direct relationship between sodium intake and elevated BP, as well as increased CVD risk.⁶ The AHA³ recommends sodium intake of <1,500 mg/day (3.8 g salt = 65 mmol/day sodium) for everyone, less than before and much lower than current intakes.^{4,25}

Intervention should focus on reducing consumption of processed foods, the source of most (>75%) dietary sodium.⁶ Limiting high intakes of processed foods and increasing fruits and vegetables will help lower both sodium and total calories and will likely increase potassium intakes, all important in BP control.

Sugar The AHA recommends no more than 100 cal/day from added sugars for women,²⁶ much lower than current intakes. Of particular concern are the liquid refined sugars, either natural or industrially-produced. Not only do they replace more healthful beverages, but liquid calories appear to be less satiating than those from solid foods and, therefore, contribute to weight gain.^{6,26} The sedentary lifestyle and extra calories from all sources

appear to be more important than the effect of high fructose corn syrup.²⁷

Supplements Dietary supplements have not been shown to be as protective as foods high in those nutrients.^{6,14} None of the following supplements are recommended^{3,6} for CVD prevention: vitamins E, C, beta-carotene, folic acid with or without vitamins B-6 and B-12, selenium, fiber, calcium, vitamin D, coenzyme Q10, resveratrol, L-arginine, and multivitamins. In addition, some, including beta-carotene, vitamin E, and calcium can be harmful.⁶ Research on vitamin D supplementation is ongoing.^{3,6,28}

Only in limited cases are fish oil supplements recommended^{3,5,8} and determining both optimal dosing and appropriate target populations requires further study.⁶

Plant stanols/sterols (2–3 g/day) can lower LDL levels by up to 15%^{5,13} and appear safe for most people.²⁹ While stanols/sterols are naturally found in foods, including nuts and oils,²⁴ fortified foods, including margarine spreads, juices, and dairy products, usually contain higher levels.¹³ While the food vehicle for fortification (ie, whether fat-containing or not) does not appear important, the stanols/sterols do appear to be more effective if taken multiple times/day rather than in one dose. Taking these fortified foods with lunch or dinner appears to be more effective than taking them with breakfast.

Many other nutritional components are still being evaluated.^{6,14} Updated recommendations from the NHLBI regarding CVD are expected in 2013. See Figure 2 for further information, as well as implementation resources.

OSTEOPOROSIS

Osteoporosis is a chronic disease of compromised bone strength that affects women more often than men, especially older persons, and places Mexican American adults at highest risk compared to non-Hispanic whites (median risk) and non-Hispanic black adults. Approximately half of adults had low bone mass, with 9% having osteoporosis according to data from 2005–2008.³⁰ The underlying cause of osteoporosis is related to an imbalance in the bone remodeling sequence, with more bone being resorbed than being formed. Bone mineral density is measured by dual-energy x-ray absorptiometry, with scores compared to a young adult standard.³¹

The worst consequence of osteoporosis is fracture, although the frequency of spontaneous fracture is low. Fractures typically occur in the spine, hip, and wrist after a fall. In addition, sections of the spinal vertebrae may collapse, or be crushed by the weight of standing or sitting. This will result in loss of height and if the sections are wedged instead of crushed horizontally, kyphosis can develop.³¹

Genetic predisposition, increasing age, and being female are non-modifiable risk factors for osteoporosis. Women are particularly susceptible because of the rapid decline in estrogen that occurs at menopause. Several medical conditions and medications can contribute to low bone mass development. Modifiable risk factors include diet and physical activity.³¹

Nutrition Recommendations for Prevention of Osteoporosis

Protein Concern has been raised that high-protein diets may have a detrimental effect on bone health. However, often high and low protein amounts are not quantified by researchers and both extremes may affect bone health negatively, especially when combined with inadequate calcium intake. It is hypothesized that while dietary protein may increase acid load and thereby increase urinary calcium excretion, protein also may improve calcium absorption, increase growth factors, and possibly lean body mass, which, in turn, improve bone health.³²

Calcium and Vitamin D The mean calcium absorption for healthy men and non-pregnant women is about 25% to 30%.^{33,34} This fractional calcium absorption varies with intake, but is not strong enough to account for continued low intake.

Calcium is essential for bone health, but is not the only essential nutrient. In 2008 the Food and Drug Administration amended the regulations so that the products claiming that calcium-rich products are associated with a lower risk for osteoporosis must now also include vitamin D.³⁵ The decision was influenced by evidence that vitamin D plays a pivotal role in calcium uptake and therefore bone homeostasis. Calcium absorption is also regulated by parathyroid hormone and possibly estrogen.³⁶ Vitamin D deficiency has an influence on parathyroid hormone which can increase the likelihood of osteoporosis. Vitamin D may also have an effect on muscle health, and thereby have an indirect effect on fracture risk by increasing a propensity to fall.²⁸

Good dietary calcium sources include dairy and calcium-fortified foods, as well as dark green leafy vegetables, shellfish, and soybeans. There are limited dietary sources of vitamin D. They include fatty fish such as salmon, tuna, and mackerel, as well as fish liver oils and egg yolks. Most processed fluid milk is vitamin D-fortified and juices, cereals, yogurt, and margarine may also be fortified. Mushrooms exposed to sunlight or UV radiation can also be good sources of vitamin D.³⁷ Exposure of the skin to ultraviolet light promotes the conversion of 7-dehydrocholesterol to vitamin D-3 (cholecalciferol); however, this conversion lessens with age and is less efficient in those with darker skin

tones. Once present, cholecalciferol is further hydroxylated by the liver and then by the kidneys.³⁸

Sodium Excessive sodium intake can increase urinary calcium excretion. However, the predicted impact on bone density is complicated by possible compensatory increases in calcium fractional absorption, the dietary calcium adequacy, and other dietary, lifestyle, and genetic bone-related variables. While much remains to be investigated in this area, a lower sodium diet is generally healthy and may decrease urinary calcium loss.³⁹

Vegetables Vegetable intake contributes to an overall healthy bone diet, possibly due to the vitamin K and magnesium content of these foods. In addition to vitamin K's role in blood clotting, there are three vitamin K-dependent proteins found in bone. These proteins are osteocalcin, matrix gla protein, and protein S, although only osteocalcin is found exclusively in bone. The optimal level of vitamin K for bone health is unknown and continues to be investigated.⁴⁰ The bone is a reservoir for exchangeable magnesium when magnesium is needed in other tissues. Vegetables are also a source of carotenoids, which may have a positive effect on bone health as well, possibly related to the anti-oxidant and/or anti-inflammatory effects on bone.⁴¹

Body Weight Because thinness is a risk factor for osteoporosis, consuming calories to maintain a healthy weight is recommended, generally interpreted as a body mass index of 18.5–24.9. Although some data show that overweight can be protective for bone health, emerging evidence suggests that obesity can have a negative effect, possibly through an obesity-related inflammatory response.⁴²

Dietary Supplements Achieving the Recommended Dietary Allowances for calcium and vitamin D may be difficult for many women, especially if they do not regularly consume vitamin D fortified cow or soy milk. The most common calcium supplements are calcium carbonate and calcium citrate. Calcium carbonate is the least expensive, but requires an acidic environment for absorption. While taking the supplement with a meal usually supplies adequate gastric acidity, for older women who may have achlorhydria, or women of any age taking medications for gastric reflux, proton pump inhibitors, or H2 blockers, calcium citrate is recommended.⁴³ Calcium supplementation absorption is optimal when taken as individual doses of 500 mg or less because of fractional calcium absorption rates. The Tolerable Upper Intake Level of safety for total calcium intake is 2,500 mg for women under 50 and 2,000 mg for those over 50 years of age.³⁴

Supplemental vitamin D is found in two comparable forms, vitamin D-2 (ergocalciferol) and vitamin D-3 (cholecalciferol).⁴⁴ Over-the-counter supplements of

cholecalciferol contain 400–2,000 IU or more per tablet. Supplements of vitamin D up to 2,000 IU can be sold without a prescription.⁴⁵ The Tolerable Upper Intake Level for vitamin D is 4,000 IU.³⁴

Following the Dietary Guidelines for Americans⁷ is recommended for optimal bone health (see Figure 1). Nutrition interventions should address intake of any deficient nutrients. See Figure 2 for further information.

BREAST CANCER

Over 230,000 women are diagnosed with breast cancer annually in the United States; making it the most common cancer diagnosis in females.⁴⁶ Early detection enhanced by the rise in mammogram rates over the past 3 decades, as well as more targeted therapeutic agents, has resulted in highly favorable survival rates, ranging for early stage disease from as high as 98% during the first 5 years post-diagnosis to 77% at 15 years.⁴⁶ Incidence rates are higher in non-Hispanic whites than Hispanics and African Americans, but survival rates are lower for minority women.⁴⁶ Age is the leading non-modifiable risk factor for invasive breast cancer; other generally non-modifiable risks include family or personal history of breast cancer, hyperplasia (found on breast biopsy), high breast density, Ashkenazi Jewish heritage, estrogen/progesterone exposure related to early menarche or late menopause, and nulliparity. However, modifiable risk factors do exist. These include the reduction in cancer-promotional factors such as high endogenous estrogen (obesity, post-menopause and adult weight gain), hormone therapy use (estrogen plus progesterone), alcohol consumption, as well as cancer-protective factors such as lactation, and plant-based, low-fat diets.⁴⁶

Of note, advancements in the understanding of the tumor-specific characteristics in relation to hormone receptor sensitivity (eg, estrogen and progesterone) as well as proliferation indices (eg, Ki67 protein) and molecular characteristics (eg, human epidermal growth factor receptor protein or 2-HER2/neu expression) has prompted research into the variability in risk factors by tumor subtype. This approach offers the potential to develop more tailored approaches to prevent and treat breast cancer.⁴⁶

Nutrition Recommendations for Prevention of Breast Cancer

In 2012, the American Cancer Society (ACS) updated guidance for diet and cancer prevention.⁹ These guidelines are based on currently available evidence and were developed by a panel of investigators actively engaged in diet and cancer research. While not specific to breast cancer, the guidelines are relevant to breast cancer risk reduction and likely support a reduced risk for CVD as well. See Figure 1

for a summary. Much of the evidence evaluating the role of nutrients, foods, and/or eating patterns and breast cancer prevention is based on epidemiological association studies, including numerous large, prospective cohort studies, rather than randomized controlled intervention trials. This is because primary prevention trials would require an extremely large sample for study as well as long-term follow-up in order to identify sufficient breast cancer events to test dietary intervention effects. Epidemiological studies are therefore much more cost and time efficient, but are limited to the identification of associations rather than true causal relationships. In addition, dietary factors are one of numerous exposures (eg, smoking) that may influence cancer risk. As such, most association studies that have identified protective or cancer-promoting diet exposures tend to demonstrate only modest risk variance, generally below 30%. Commonly, the associations will be inconsistent given the heterogeneity in populations studied and the large number of confounding factors. Overall, however, data suggest diet is associated with at least 30% of all cancers and may be particularly relevant for breast cancer.⁴⁷ Below is a summary of the available data for the more commonly studied dietary factors: alcohol, fiber, soy, fruit, vegetables, and fats, as well as body weight.

Alcohol There is compelling evidence from epidemiological studies that alcohol intake increases a woman's risk for breast cancer, but whether modest amounts (< 1 drink/day), significantly increase risk remains somewhat controversial.⁴⁸ Earlier evidence suggested that alcohol intake of greater than 1 serving/day increased risk, but this risk was attenuated by increased folate intake. More recent studies, including a re-analysis of over 105,000 participants in the Nurses' Health Study found an increase in risk with intake of 3 to 6 drinks/wk, particularly in post-menopausal women, independent of folate intake.⁴⁸ In fact, in this analysis, risk increased by approximately 15% regardless of alcohol source – beer, wine, or spirits.⁴⁸ Certainly, alcohol consumption should be addressed as a risk factor with all women at risk of or previously treated for breast cancer and the nutrition care plan should be adapted for the individual circumstance.

Fiber and Soy Fiber and soy alter circulating estrogen levels and there is a well-characterized association between estrogen and breast cancer owing to the fact that an estimated 72% of breast cancers are hormone responsive.⁴⁶ Meta-analyses suggest that higher fiber intake was inversely associated with estrogen-receptor positive disease⁴⁹ and that soy intake was associated with a 12% risk reduction for breast cancer.⁵⁰ Despite the mechanistic evidence supporting a reduction in risk for these dietary components, the current data are insufficient to provide clear recommendations. Of note, the inconsistency in associations across studies in the United States versus Asian countries may be largely driven by the

overall lower intake of fiber and soy in the United States as compared to Japan. Higher, regular, and life-long intakes may be important to establishing a protective association for these dietary factors.

Fruit and Vegetables There are several proposed mechanisms by which fruits and vegetables may reduce breast cancer risk, including anti-oxidation, anti-inflammation, immune modulation, and repair of damaged DNA, but the evidence to date does not support a significant protective association. Again, this may reflect both insufficient quantity as well as sub-optimal quality (in terms of protective bioactive food constituents) of fruits and vegetables to modify risk, particularly for U.S. study populations. As noted in the ACS guidelines, a plant-based diet that is rich in fruits and vegetables is recommended to reduce overall cancer risk.⁹ Similar support, particularly for estrogen receptor negative breast cancer, was seen in a recent pooled analysis.⁵¹

Dietary Fat Among the more compelling of dietary factors associated with breast cancer is dietary fat. Several epidemiological studies over the past several decades have suggested an increase in breast cancer risk in relation to higher overall fat intake. Mechanistic studies suggest fat may increase oxidative stress and inflammation, as well as circulating estradiol concentrations, thus contributing to breast cancer risk.⁵²⁻⁵⁴ Dietary fat intake has been tested in relation to breast cancer risk reduction in the Women's Health Initiative (WHI) Dietary Modification Trial, a study of 48,835 postmenopausal women randomized to either a low-fat diet or usual diet with a mean follow-up of 8.1 years. Dietary intervention was delivered primarily in a group counseling setting and included behavioral approaches to achieve a dietary goal of <20% total energy intake as fat; no weight loss component was included. No overall difference in breast cancer rates between the study groups was demonstrated.⁵⁵ In a subgroup analysis, breast cancer rates were 22% lower for women who entered the trial with higher self-reported dietary fat intake (>36.8% of total energy consumed) and randomized to the low-fat diet arm of the study,⁵⁵ suggesting that the dose of fat reduction likely influences disease risk. In addition, an analysis of energy intake for which self-reported intake was calibrated with true intake based on doubly-labeled water measurements, suggested that greater total energy intake also increases breast cancer risk, independent of change in body weight or baseline body mass index.

The type of dietary fat may also influence breast cancer risk. A systematic review of 57 studies including 26 cohort studies, suggested that polyunsaturated fats increased risk for invasive breast cancer by 9% overall. In postmenopausal women, total and polyunsaturated fat increased breast cancer risk by 4% and 22%, respectively.⁵³

Monounsaturated fats showed no association. Association studies have suggested a lower risk for breast cancer in relation to higher intake of n-3 fatty acids,⁵⁶ although evidence is mixed.⁵⁷

Dietary Patterns of Intake In addition to single nutrients and/or food items, dietary patterns of intake have also been explored in relation to breast cancer risk. Findings are inconsistent in identifying significant associations, although there is some limited evidence that the Mediterranean dietary pattern may reduce breast cancer risk. Among breast cancer type 1 susceptibility protein (BRCA1 or 2) breast cancer gene mutation carriers, higher dietary quality scores, including diet during adolescence, have been associated with a reduced odds for developing breast cancer,⁵⁸ suggesting diet practices in early life are an additional modifiable risk factor.

Body Weight Obesity has been associated with greater risk for postmenopausal breast cancer, but not consistently associated with premenopausal disease. In addition, adult weight gain is commonly reported in women diagnosed with breast cancer and may increase risk by increasing estrogen exposure. Evidence also suggests that obesity increases risk for several tumor subtypes including luminal tumors and possibly triple negative tumors. Mechanistically the differential association by menopausal status may be partially explained by the fact that body fat provides a significant proportion of total circulating estrogen in the post-, but not pre-menopausal women. Furthermore, after menopause fat deposits more centrally and this visceral deposition has been associated with greater circulating insulin and insulin-like growth factors that have been associated with greater risk for breast cancer.⁵⁹ No large randomized trials of weight loss in the primary prevention of breast cancer have been conducted to determine if such efforts would reduce risk; however, reducing the inflammation and insulin resistance through weight loss has been demonstrated and theoretically should be translated to lower risk.⁶⁰

Recommendations include achieving and maintaining a healthy weight throughout life without being underweight;⁹ even small amounts of weight loss have health benefits. To support weight control, patients should limit high-calorie foods and beverages and adopt a physically active lifestyle with reduced sedentary time.

Dietary Supplements There are generally no data that currently support the use of dietary supplements for breast cancer prevention. An analysis of the WHI study on this topic showed no association between multivitamin use and cancer, including specifically breast cancer.⁶¹ The U.S. Preventive Services Task Force reviewed evidence from randomized controlled clinical trials, including the vitamin D and calcium supplementation trial within the WHI, and

found no association between supplementation with these nutrients and breast cancer risk.⁶² Of note, populations at risk for vitamin D insufficiency should have their vitamin D status evaluated and be supplemented as indicated by these circulating measures since low circulating vitamin D concentrations have been associated with higher breast cancer risk.⁶³

Diet and Breast Cancer Survival

Given the higher rates of breast cancer as compared to other cancers in women, as well as the increasing survival rates for early stage breast cancer, the population of breast cancer survivors now approaches 3 million.⁴⁶ The ACS has recently updated guidelines for diet and physical activity in survivors.¹⁰ In the clinical setting, RDNs commonly consult with survivors (those previously diagnosed with cancer) more so than intervening in the primary prevention setting. Thus, understanding the relationship between diet and health outcomes in the survival setting becomes an important aspect of nutritional therapy. Prior breast cancer places women at greater risk for recurrent disease, thus, a few randomized, controlled trials have evaluated diet and risk of breast cancer recurrence. The first large trial was the Women's Intervention Nutrition Study, a trial of over 2,500 postmenopausal women previously treated for breast cancer. Results showed a 24% lower recurrence rate in women randomized to the low-fat (15% of energy) arm of the trial;⁶⁴ results primarily driven by reduced rates of estrogen receptor negative disease. A second study of 3,088 pre- and post-menopausal survivors followed for 7.2 years, the Women's Healthy Eating and Living study, evaluated the role of a post-diagnosis, plant-based, low-fat, high-fiber diet versus National Cancer Institute guidelines for diet. No differential benefit of diet was demonstrated.⁶⁵ However, higher plasma carotenoid concentrations were associated with lower recurrence rates,⁶⁶ higher fruit and vegetable intake combined with regular physical activity was associated with lower overall mortality,⁶⁷ and higher n-3 fatty acid intake was associated with a lower rate of recurrent or new breast cancer.⁶⁸ These trials, among others, in survivors suggest feasibility is well documented. Larger interventions that include weight control are currently planned or underway.

In addition, large breast cancer cohorts have been developed to study longitudinally the role of diet in modifying outcomes after breast cancer. These include, but are not limited to, the Life After Cancer Epidemiology (LACE) study, the Healthy Eating Activity and Lifestyle (HEAL) cohort, and the 4-Corners Breast cancer cohort. Data from these and other cohorts suggest that higher diet quality scores are associated with lower breast cancer-specific⁶⁹ or overall mortality.⁷⁰ In relation to alcohol intake the data are mixed, with no increase in risk demonstrated in the Women's Healthy Eating

and Living study population,⁷¹ possibly because of the low intake overall and the preference for red wine, which has demonstrated aromatase inhibitory activity.

Epidemiological studies evaluating body weight and risk for recurrent disease provide inconsistent findings. Intervention trials to promote weight control among overweight and obese survivors have shown efficacy in improving health-related indices of diabetes and/or cardiovascular risk.⁷² Well-designed weight-loss studies of sufficient size and duration are necessary before clear conclusions can be drawn regarding the effect of weight loss on cancer recurrence. Furthermore, physical activity should be considered an important component of weight control efforts in breast cancer survivors.⁷³

ROLE AND RESPONSIBILITIES OF THE RDN AND DTR

As an RDN or DTR working with women to promote optimal nutritional health, it is important to address the following roles and responsibilities:

- Understand that sex differences exist in chronic disease risk, particularly for CVD, osteoporosis, and breast cancer.
- Develop and adhere to screening programs and policies that address the unique chronic disease health risks of women.
- As a member of the health care team, RDNs will engage in assessment of health status in women that includes regular evaluation of diet and related health factors for cardiovascular, bone, and breast health.
- RDNs will provide evidence-based medical nutrition therapy (MNT) to promote a reduction in risk or optimal health outcomes after cardiovascular, bone, or breast cancer diagnoses.

SUMMARY

Over half of the U.S. population is female. Women represent a unique group in relation to common health problems and diagnoses. CVD, which was once thought to be a male disease, is increasing in women, a reality that is driven by both the aging of our population and the rising obesity rates. Osteoporosis, a disease that affects women at a higher rate than men, has significant implications in relation to morbidity and mortality as well as quality of life as women age. Breast cancer affects over 230,000 women in the United States annually, but survival after treatment for early disease approaches 98%.⁴⁶ Most women treated for breast cancer will experience morbidity and perhaps mortality from other causes, including CVD and osteoporosis.

The RDN and DTR are well positioned to provide education in both clinical and community settings targeted

at preventing each of these medical conditions. The DTR is also qualified to screen people for increased risk and the RDN is uniquely qualified to provide MNT for individuals with these conditions. While health guidelines are similar for all three conditions, there are differences and individual adaptations must be made when balancing interventions for multiple issues. Research continues to evolve, and the RDN and DTR are encouraged to supplement their knowledge through review of relevant published literature (see Figure 2).

MNT for CVD, osteoporosis, and breast cancer has several components in common (see Figure 1). All strongly recommend a woman achieve and maintain a healthy body weight with a particular emphasis on the avoidance of excess visceral adiposity. Furthermore, an emphasis on the nutrient density of the diet in relation to select micronutrients (calcium, vitamin D, n-3 fatty acids, antioxidants) is also central to effective MNT. While the current focus is on obtaining the nutrients and bioactive compounds for health through a variety of foods because of the likely synergistic effects of multiple components, osteoporosis is one of the diagnoses for which the RDN's working knowledge of the therapeutic role of dietary supplementation is central to care. Together, these common approaches for the provision of MNT in women's health will lead to reduced illness and improved health outcomes for women.

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