

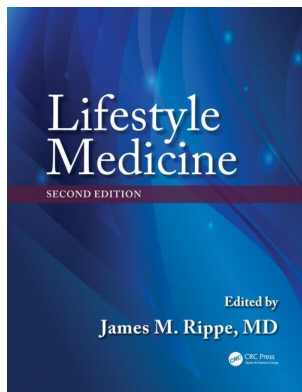
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# 3 Nutrition Interventions for Cardiovascular Disease

## *Behavioral and Educational Considerations*

Carol E. O'Neil, PhD, MPH, RD and Theresa A. Nicklas, DrPH

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### CARDIOVASCULAR DISEASES AND LIFESTYLE

Death rates from cardiovascular diseases (CVD), including coronary heart disease (CHD), stroke, and heart failure, have declined; however, they remain the major cause of mortality in the United States. In 2007, CHD caused 1 in 6 deaths in the United States; stroke accounted for 1 in 18 deaths; and 1 in 9 death certificates mentioned heart failure. Traditional risk factors for CVD remain prevalent. Approximately 76,400,000 (33.5%) of the U.S. adult population had hypertension (HTN); 23.1% of men and 18.3% of women smoked cigarettes, approximately 33,600,000 (15%) adults had total serum cholesterol levels  $\geq 240$  mg/dL; 18,300,000 (8%) adults had diagnosed diabetes; and approximately 149,300,000 (67.3%) were overweight or obese [1].

In the United States, there are ethnic disparities in the prevalence of CHD and HTN. Blacks (6.7%) had the

highest prevalence of CHD, followed by Whites (6.4%), Latinos (5.8%), American Indians or Alaska Natives (4.1%—figure considered unreliable), and Asians (3.9%). Blacks also had the highest prevalence of HTN (32.3%), followed by Whites (23.0%), American Indians or Alaska Natives (21.8%), and Asians (19.4%) [1]. Older and lower socioeconomic status individuals also have an increased prevalence of CVD and they are more likely to have risk factors associated with CVD, including sedentary behavior, overweight, and unhealthy dietary habits [2].

The American Heart Association has projected that direct and indirect costs of CVD in the United States will increase from \$252.5 and \$171.7 billion dollars in 2010 to \$818.1 and \$275.8 billion in 2030, respectively. These cost estimates do not include all costs related to obesity, diabetes mellitus, and tobacco use [3]—all major risk factors for CVD.

Although death rates from CVD have fallen, the prevalence and severity of risk factors associated with these diseases has increased [4]. Thus, reduction of incident cases of CVD is a primary public health goal. “To improve cardiovascular health and quality of life through prevention, detection, and treatment of risk factors for heart attack and stroke; early identification and treatment of heart attacks and strokes; and prevention of repeat cardiovascular events” is a goal for Healthy People 2020 (HP 2020) [5]. To meet this goal, HP 2020 has 24 specific objectives related to increasing the overall cardiovascular health in the U.S. population. These objectives include those related to lifestyle changes, including Heart Disease & Stroke goal (HDS-10): (Developmental): “Increase the proportion of adults with hypertension who meet the recommended guidelines” which includes reducing saturated fatty acid (SFA) and sodium intake, and moderating alcohol intake. Another goal related to reducing CVD using lifestyle changes is HDS-13 goal: (Developmental) “Increase the proportion of adults with elevated low-density lipoprotein cholesterol (LDL-C) who have been advised by a health care provider regarding cholesterol lowering management including lifestyle changes and, if indicated, medication.” Components of this goal include lowering serum cholesterol levels and weight control through diet.

The potential impact of diet and other lifestyle factors on the risk of CHD was shown by Ancel Keys in the Seven Countries study [6] and by a study that looked at heart disease in Japanese men living in Japan, Hawaii, and California [7]. Although these studies are older, and have been criticized for design and analyses issues, they provide an historical basis for the link between diet and CHD.

Modifiable risk factors for CVD accounted for 90% and 94% of the Population Attributable Risk (PAR) factors in males and females, respectively. Smoking and abnormal lipids were shown to be the most important risk factors, accounting for approximately two-thirds of the PAR of an acute myocardial infarction. These were followed by psychosocial factors, abdominal obesity, diabetes, and HTN [8]. The severity of dyslipidemia, abdominal obesity, diabetes, and HTN can be modified by lifestyle changes, including diet.

## RECOMMENDATIONS FOR “HEART HEALTHY DIETS”

Overall nutrient and food consumption patterns play a central role in the prevention of CHD in individuals and population [9,10]. A meta-analysis of dietary trials showed that lowering of serum cholesterol levels by diet produced as much CHD risk reduction as did lipid-lowering drugs—corresponding to their respective degree of cholesterol lowering [11]. Diets, and other lifestyle measures, designed for primary or secondary prevention of CHD, should be designed not only to reduce serum total cholesterol, LDL-C, and triglycerides in those individuals with dyslipidemia and to increase high-density lipoprotein cholesterol (HDL-C) but also to control other risk factors for CHD, including overweight/obesity, blood pressure, and blood glucose levels.

Dietary and physical activity recommendations for prevention and treatment of CHD, as well as other chronic diseases, including HTN, stroke, type 2 diabetes, cancer, are remarkably consistent [12–18]. Recommendations are for total healthy diet patterns, which are generally rich in whole grains, fruit and vegetables, low-fat dairy, and lean proteins; some agencies also recommend consumption of nuts. Nutrient recommendations include high intakes of poly-UFA (PUFA) and mono-unsaturated fatty acids (MUFA) and potassium, and low intakes of added sugars, SFA, *trans*-fats, and sodium.

It is also important that individuals balance energy intake with physical activity to maintain a healthy weight [16]. The Department of Health and Human Services recommends specifically that adults (18–64 years of age) should do 150 min of moderate-intensity weekly, or 75 min of vigorous-intensity, aerobic physical activity weekly, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity. Aerobic activity should be performed in episodes of at least 10 min, preferably spread throughout the week. Additional health benefits are seen from increasing physical activity to 300 min/week. Adults should also do muscle-strengthening activities that involve all major muscle groups performed on 2 or more days per week. Adults older than 64 years should follow these recommendations unless limited by chronic conditions, and if present, individuals should be as physically active as they can. Few Americans meet the recommendations for either diet or physical activity [18].

The U.S. Preventive Services Task Force (USPSTF) recommends intensive behavioral dietary counseling for adult patients with hyperlipidemia and other known risk factors for CVD and diet-related chronic disease [19]. Such secondary prevention of CVD can be conducted by a physician or a Registered Dietitian (RD) via nutrition education or counseling. The USPSTF, however, failed to find sufficient evidence to recommend for or against behavioral counseling for primary prevention of CVD in unselected patients [19]. A Cochrane Review found that education or counseling in the general population did lower risk factors modestly, but did not lower CHD events or total or CHD mortality and were not recommended. It did find that high risk patients could, however, benefit from these efforts [20].

Dietary recommendations for secondary prevention of CHD or HTN are similar to those for the general public, although they are somewhat more restrictive [11,21] (Table 3.1). For example, population-wide recommendations for SFA are <10% of energy, whereas the recommendation for those with dyslipidemia or who have had a coronary event is <7% of energy from SFA [11]. Dietary changes are recommended as the first-line treatment for mild to moderate dyslipidemia [22]. The principal goal of the National Cholesterol Education Program’s Adult Treatment Panel III’s goal is to lower serum LDL-C levels [11]. With the reduction in serum LDL-C levels comes a concomitant decrease in CHD mortality [23]. Dietary changes can reduce serum cholesterol levels by up to 30% [24]; however, in practice, reductions of 5%–15% are more common [25]. The principal dietary modifications to reduce serum LDL-C levels are to reduce the intake of SFA and increase the intake of PUFA and MUFA.

**TABLE 3.1**  
**Nutrient Recommendations for Primary and Secondary Prevention of CVD**

	Primary Prevention			Secondary Prevention	
	IOM <sup>a</sup>	2010 DGA	AHA	ATP III	DASH
Energy	Energy intake should be balanced with energy expenditure to achieve and maintain an appropriate weight				
Protein	10%–35% of energy	N/A	N/A	~15% of energy	18% of energy
Carbohydrates	45%–65% of energy	N/A	N/A	50%–60% of energy	55% of energy
Refined grains	N/A	No more than 3 oz eq <sup>b</sup>	“Choose whole grain foods”	N/A	N/A
Added sugar	<25% of energy <sup>c</sup>	Reduce Intake	<10% of energy	N/A	N/A
Fiber	38–21 g/day <sup>d</sup>	14 g/1000 kcal	N/A	20–30 g/day; 10–25 g/day viscous fiber	30 g/day
Total fat	20%–35% of energy	20%–35% of energy	25%–35% of energy	25%–35% of energy	27% of energy
SFA <sup>e</sup>	As low as possible	<10% of energy	<7% of energy	<7% of energy	6% of energy
trans-fat	As low as possible	As low as possible	<1% of energy	“Low intake”	N/A
Solid fat	N/A	Reduce intake	Minimize	N/A	N/A
MUFA	N/A	N/A	N/A	Up to 20% of energy	N/A
PUFA	N/A <sup>f</sup>	N/A	N/A	Up to 10% of energy	N/A
Cholesterol	As low as possible	<300 mg/day	<300 mg/day	<200 mg/day	150 mg/day
Potassium	4700 mg	4700 mg	N/A	90 mmol <sup>g</sup>	4700 mg
Sodium	19–50 years 1500 mg; 51–70 years 1300 mg; >70 years 1200 mg	<2300 mg <sup>h</sup>	Moderation	2400 mg <sup>g</sup>	2300 mg <sup>g</sup>
Magnesium	Males: 19–30 years 330 mg; ≥31 years 350 mg Females >19 years 265 mg	N/A	N/A	Enough for good health <sup>g</sup>	500 mg
Calcium	Males: 19–70 years 800 mg; ≥71 years 1000 mg Females: 19–50 years 800 mg; ≥51 years 1000 mg	N/A	N/A	Enough for good health <sup>g</sup>	1250 mg
Alcohol <sup>i</sup>	N/A	1 drink/day females; 2 drinks/day males	Moderation		Limit

Sources: IOM, *Dietary Reference Intakes (DRI)*, <http://www.iom.edu/Activities/Nutrition/SummaryDRIs/~media/Files/Activity%20Files/Nutrition/DRIs/New%20Material%20Values%20SummaryTables%202014.pdf>, accessed August 10, 2011; United States Department of Agriculture, *2010 Dietary Guidelines for Americans (DGA)*, <http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm>, accessed August 10, 2011; National Institutes of Health, National Heart, Lung, and Blood Institute, Detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III), <http://www.nhlbi.nih.gov/guidelines/cholesterol/atp3full.pdf>, accessed August 10, 2011; *DASH Eating Plan*, <http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new-dash.pdf>, accessed August 10, 2011.

N/A, no specific recommendation; however, this will revert to the DGA or the IOM's DRI values. American Heart Association (AHA): Lichtenstein, A.H. et al., *Arterioscler. Thromb. Vasc. Biol.*, 26, 2186, 2006; the AHA added sugars recommendation is from Van Horn, L. et al., *Circulation*, 122, 2470, 2010.

<sup>a</sup> Unless otherwise noted, recommendations are for adults 19+ years; pregnant and lactating females excluded. Institute of Medicine (IOM) acceptable macronutrient distribution ranges are presented for protein, carbohydrates, and total fat.

<sup>b</sup> Based on a 2000 kcal diet.

<sup>c</sup> Acceptable macronutrient distribution range, not the recommended intake.

<sup>d</sup> Fiber recommendations are age- and gender-dependent: males 19–50 years 38 g/day, 51+ years 30 g/day; females 19–50 years 25 g/day, 51+ years 21 g/day.

<sup>e</sup> Saturated fatty acids (SFA) in the diet should be replaced by monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA).

<sup>f</sup> IOM acceptable macronutrient distribution range for *n*-6 polyunsaturated fatty acids (linoleic acid) is 5%–10% of energy and for *n*-3 polyunsaturated fatty acids ( $\alpha$ -linolenic acid) is 0.6%–1.2% of energy.

<sup>g</sup> Referenced from JNC VI.

<sup>h</sup> Intake should be reduced to 1500 mg among 51+ years, African Americans, or individuals with hypertension, diabetes, or chronic kidney disease.

<sup>i</sup> If alcohol is consumed, intake should be moderate, as defined earlier; this is not a specific recommendation for alcohol consumption.

When counseling patients to reduce SFA intake, it is important to consider this reduction in the context of the macronutrients that replace it. Replacement of SFA with PUFA or MUFA has shown to reduce both LDL-C and HDL-C and may lessen CHD risk. Generally, MUFA has a slight positive effect on HDL and

LDL levels and improves insulin sensitivity [26,27]. Olive oil, a MUFA, has also been shown to have a positive effect on lipid levels, but it is unclear if this is due to the fatty acid profile or to the polyphenolic content of the oil [28]. However, if the energy from SFA is replaced by carbohydrates, particularly refined

carbohydrates, this can increase triglycerides and small LDL-C particles, as well as reduce HDL-C. Other dietary interventions, as described later, can reduce the risk of CVD.

Nutrient recommendations may be difficult for the public to follow, so either the recommendations need to be in food, as they have been for MyPlate [29], the interpretation of the DGA for the consumer, or the DASH diet [21]. These are recommendations for whole diets rather than individual foods or nutrients. Health providers, including RDs, can help individuals make appropriate food and diet choices to reduce CVD risk (Table 3.2). Consumption of fruit and vegetables may lead to a reduced intake of SFA and dietary cholesterol. These foods also contribute dietary fiber, antioxidant vitamins, potassium, magnesium, and phytochemicals to the diet that may be cardio-protective [30]. Adults that consume fruit and vegetables tend to have a lower body weight than those that do not, although the association was weak [31]. Whole grains contribute dietary fiber, vitamin E, B vitamins, folate, and magnesium and may enhance satiety and displace refined carbohydrates in the body. Nuts provide unsaturated fatty acids (some [walnuts] are high in omega-3 fatty acids), phosphorus, magnesium, and phytochemicals; nut consumers also have lower body weights than nonconsumers. Fish, especially fatty fish, provide omega-3 fatty acids, selenium, magnesium, and vitamin D. Moderate alcohol intake is associated with some cardioprotective factors, notably elevating HDL-C levels, reducing systemic inflammation, and

improving insulin resistance. Heavy habitual alcohol intake, on the other hand, is associated with ventricular dysfunction and a higher risk of atrial fibrillation [30].

Additional therapeutic dietary options for individuals with dyslipidemia that cannot meet LDL-C goals, with or without lipid-lowering medication, include plant stanols/sterols (2 g/day) [11,32] and increased viscous (soluble) fiber (10–25 g/day) [11]. Other lifestyle variables that can be modified by behavioral interventions are increasing physical activity and smoking cessation. However, the efficacy and availability of statins and other cholesterol-lowering drugs has reduced enthusiasm for behavioral modifications.

## ENVIRONMENTAL AND INTERNAL FACTORS INFLUENCING FOOD BEHAVIORS

Despite the consistency of dietary recommendations across agencies and across time, the majority of Americans do not meet them [33]. On average, adults consume 11% of energy from SFA, 12%–13% of energy from MUFA, and 6%–8% of energy from PUFA [34]. Intake of whole grain [35], fruit and vegetables [36,37], and low-fat dairy [38] is also well below current recommendations.

Dietary behaviors are complex issues, and for interventions to be effective, they must not only be based on sound

**TABLE 3.2**  
**Food Recommendations (2000 kcal Diet) for Primary (MyPlate) and Secondary (DASH) Prevention of Cardiovascular Disease**

	MyPlate	DASH Diet	Components that Reduce CVD Risk Factors
Total grain/whole grain	6/3 oz	6–8 servings	Whole grains contribute dietary fiber, vitamin E, B vitamins, folate, and magnesium and may enhance satiety and displace refined carbohydrates in the body. Whole grains are generally low in total fat and saturated fatty acids and sodium; no cholesterol
Fruit	2 cups	4–5 servings	High in dietary fiber, antioxidant vitamins, potassium, magnesium, and phytochemicals; low in total fat and saturated fatty acids and sodium; no cholesterol
Vegetables	2.5 cups	4–5 servings	High in dietary fiber, antioxidant vitamins, potassium, magnesium, and phytochemicals; low in total fat and saturated fatty acids and sodium; no cholesterol
Low-fat dairy	3 cups	2–3 cups	High in vitamin D, calcium, and potassium; low in total and saturated fatty acids
Lean protein <sup>a</sup>	5.5 oz	≤6 oz	Low in total and saturated fatty acids; fatty fish are high in omega-3 fatty acids, selenium, magnesium, and vitamin D
Nuts, seeds, legumes <sup>b</sup>	N/A	4–5/week	Nuts and seeds provide unsaturated fatty acids (some [walnuts] are high in omega-3 fatty acids), phosphorus, magnesium, and phytochemicals; low in sodium. Legumes are high in dietary fiber, low in total fat and saturated fatty acids and sodium; no cholesterol
Oils	6 t	2–3 servings	High in monounsaturated fatty acids

Sources: United States Department of Agriculture, MyPlate, <http://www.choosemyplate.gov>, accessed August 10, 2011; National Institutes of Health, National Heart, Lung, and Blood Institute, *Your Guide to Lowering Your Blood Pressure with DASH*, [http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new\\_dash.pdf](http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf), accessed August 10, 2011.

All recommendations are per day except as noted. DASH servings of grain: 1 slice of bread, ½ cup cooked cereal, pasta, or rice, 1 oz ready-to-eat cereal; fruit: 1 piece of fruit, ½ cup cut fruit, ¼ cup dried, ½ cup juice; vegetables: 1 cup leafy green, ½ cup cooked; nuts: 1½ oz, 2 T peanut butter, ½ oz seeds, ½ cup legumes; oils: 1 t soft margarine, 1 t vegetable oil, 1 T mayonnaise, 2 T salad dressing. Sugars should be limited in both eating plans.

<sup>a</sup> Protein foods should be prepared using methods that minimize addition of added fats: baking, broiling, and grilling are recommended.

<sup>b</sup> MyPlate does not have a specific recommendation for nuts, seeds, or legumes; however, these are included in the category of protein foods.



theoretical theories and learning principles but be individualized to patients' specific environmental and behavioral factors influencing their food behaviors and food choices. Taste, cost, nutrition, convenience, and weight control have been shown to be the most important factors influencing food choice. Other contributing factors are socioeconomic status and level of education, interpersonal and cultural influences, and family influences.

Although it is assumed that individuals have the freedom to choose a healthy lifestyle, food choices are often constrained by economic factors which can lead to unhealthy dietary practices [39,40]. Grains, oils, and sugar have been shown to be cheaper than vegetables and fruit [41,42]. Overall, the cost of nutritious diets was higher than less nutritious diets [43]; cost or the perceived cost of healthy foods may limit individuals' ability to consume these foods [44]. Often the cheapest easiest to prepare "convenience" foods are high in SFA, added sugars, and sodium, which are nutrients to limit in a healthy diet [45]. Supermarket availability [45], food accessibility [45], and lack of nutrition knowledge and food preparation skills [44] also affect the ability of individuals to consume a healthful diet.

Nutrition knowledge, especially as it relates to diet-disease relationships, can help promote more healthful dietary choices. Declarative and procedural knowledge are both necessary components of a nutrition intervention program [46], but neither is sufficient without the motivation and support to elicit a behavioral change. An example of declarative knowledge would be knowing the number of grams of SFA in butter or olive oil, but not knowing how to incorporate olive oil (or other oils high in MUFA) into the diet. Procedural knowledge is needed to transform declarative knowledge into behavior. Important knowledge for individuals seeking to change dietary behaviors includes shopping skills, reading nutrition labels, and food preparation skills. Knowledge of food and food sources of nutrients is also needed [47] to help improve the diet.

Nutrition labels have been referred to as "a cost-effective population-level intervention with unparalleled reach." However, it is important to ensure that the information presented is accessible and understandable to all population. Although controversial [48], front of package labels may help those individuals with time constraints [49].

Other than understanding the potential link with dietary SFA and CVD, consumers appear confused about dietary fat and the health implications of consuming dietary fats [50,51]. Consumer education has been shown to increase the knowledge of some types of fat that may increase the risk of CVD; however, knowledge of food sources remained low [52]. The SFA and *trans*-fat content of foods are provided on the Nutrition Facts label and it is important for health professionals to help individuals understand how to read these labels and to know that foods low in these fats are not necessarily healthy foods. In a survey, American consumers were asked "which types of the following specific information that relate to heart health do you look for on food or beverage labels or packages?" Responses were sodium (60%), total fat (58%),

cholesterol (54%), *trans*-fat (53%), SFA (50%), and statements about heart health benefits (41%). These findings did not always translate into heart healthy behaviors; for example, only 37% of individuals surveyed used more healthful fats than *trans*-fats and only 27% reviewed information on *trans*-fats and SFA together before purchasing the product. Some consumers also substituted tropical oils for products with *trans*-fats or SFA [52].

Nutrition education has been shown to improve knowledge of the food label in a variety of populations [53,54]. Individuals with type 2 diabetes, hypertension, or hyperlipidemia who read food labels consumed less sugar and more fiber than those who did not. Also, individuals with these health problems read food labels more frequently than those without them [55]. Additional education is needed to help the general consumer and those with chronic nutrition-related diseases to read Nutrition Facts labels.

Meal structure and patterning is changing with more convenience and prepared foods consumed and fewer fresh foods used in meals. Although lack of time has been cited as a principal reason for this, use of convenience foods also depends on economic and social factors and lack of self-efficacy [47,56]. A lack of cooking or food preparation skills has also been associated with consumption of pre-prepared foods [57] where an individual has no control over the sodium content or the type or amount of fat used. Food preparation has been associated with a better diet quality and less frequent fast food intake; those who prepared food frequently were more likely to meet dietary recommendations for fat, calcium, fruit, vegetables, and whole grains than those who did not [58].

Dietary modifications for CVD can include highly restrictive and highly supervised programs, like the Pritikin Program or the Ornish Lifestyle Heart Diet or be those that are behaviorally driven, including meal replacement plans, and nutrition education, or counseling.

## THE PRITIKIN PROGRAM AND THE ORNISH LIFESTYLE HEART DIET

Making successful small, stepwise changes to improve diet and physical activity can increase the confidence and motivation of most individuals. Other individuals become frustrated and lose motivation if the results of their changes are minimal. The alternative for them may be to begin with a highly restrictive diet, such as the Pritikin Program [59,60] or the Ornish Lifestyle Heart Diet [23]. The Pritikin Program is provided in a physician's office and incorporates diet (10%–15% of energy from fat, 15%–20% from protein, 65%–75% from carbohydrates), exercise, and counseling lasting 21–26 days; there is an optional residential component available for participants. The Ornish lifestyle change approach incorporates comprehensive lifestyle modifications, including exercise, a very low-fat diet (10% energy from fat), smoking cessation, stress management, and group support which is available at several centers in the United States. The Ornish Program has been demonstrated to reverse coronary atherosclerosis and reduce the number of coronary events when compared with more traditional diets [23].

Diets that focus on macronutrient content, such as the Pritikin and Ornish diets, may be deficient in micronutrients and it is important that counselors also focus on helping individuals obtain nutrient adequacy. A recent study showed that after 8 weeks on the Ornish diet, intakes of >25% of females were below the Estimated Average Requirement for vitamins A, E, and B12, magnesium, and zinc [60].

In August 2010, the Centers for Medicare and Medicaid Services approved both programs for inclusion in the list of approved intensive cardiac rehabilitation programs for Medicaid and Medicare reimbursement. To qualify for reimbursement, these programs had to demonstrate through peer-reviewed, published research that they improved patients' CVD through specific outcomes and that they significantly influenced one or more of these elements: (1) positively affected the progression of CHD, (2) reduced the need for coronary bypass surgery, and (3) reduced the need for percutaneous coronary interventions. Finally, the programs had to demonstrate significant reductions (from baseline) in five or more of the following measures: (1) LDL-C, (2) triglycerides, (3) body mass index (BMI), (4) systolic blood pressure, (5) diastolic blood pressure, and (6) the need for cholesterol, blood pressure, and diabetes medications. Intensive cardiac rehabilitation sessions are limited to 72 one hour sessions, up to 6 sessions/day, over a period of up to 18 weeks [61]. It should be noted that, per patient, the Ornish Program costs four times as much as some traditional cardiac rehabilitation programs [62], thus may not be a suitable option for all patients.

## MEAL REPLACEMENT OR STRUCTURED MEAL PLANS

These are considered as nutrition counseling strategies since meal replacements help participants control food portions while attempting to modify their eating patterns. Meal replacements include over-the-counter shakes, bars, or portion-controlled frozen meals; they can be purchased in a supermarket or can be ordered by mail. They have the advantage of simplifying food choice, reducing the time planning or preparing food, reducing the temptation to overeat, and controlling portion sizes [63]. The disadvantage is that using them does not teach the patient/client meal planning or food selection or preparation skills.

Meal replacements are most commonly used for weight loss, blood sugar control in conjunction with weight loss in individuals with diabetes, or reducing dietary fat. Short-term studies have shown that prepared meal plans have shown improved cardiovascular risk factors, quality of life, dietary compliance, and nutritional adequacy [64]. One study that compared meal replacements with a self-selected diet accompanied by nutrition education information and the ability of participants to follow the National Cholesterol Education Step Diets showed a higher prevalence of those receiving meal replacements

were able to meet recommendations for both Step 1 and Step 2 diets\* [65].

## BEHAVIORAL CHANGE THEORIES

It is important to consider the personal and environmental factors that affect consumer choices; however, these factors do not explain how patients make decisions to change behaviors. Behavioral change is based on the assumption that behavior is learned, and can be unlearned and replaced by other behaviors. Behavioral change theories and models have been proposed that account for how individuals make decisions and should be used when designing and implementing nutrition counseling programs. Three variables have been identified as key determinants of behavior [66–68]: (1) the person has committed to performing the behavior; (2) there are no environmental constraints making it impossible for the behavioral change to occur; and (3) the person has the necessary skills to make the behavioral change. These variables are common to behavioral change theories. Other factors that influence the strength and direction of the intention of the behavior include the person's attitude that the advantages of performing the behavior outweigh the disadvantages and that the person believes that he or she has the capability to perform the behavior under a variety of circumstances (self-efficacy).

Interventions that are based on a behavioral theory are more likely to be successful than those that are not and strategies that combine multiple theories are more likely to have a larger effect [2,69]. The three principal behavioral change theories used in nutritional counseling are the cognitive behavioral theory (CBT) [70–72], the transtheoretical theory [73], and the social cognitive theory (SCT) [74].

## COGNITIVE BEHAVIORAL THEORY

This theory assumes that behavior is learned and can, therefore, be unlearned through cognitive and behavioral strategies taught to patients. The CBT focuses on external factors (environmental and reinforcement) and internal factors (thoughts) [63]. The CBT uses strategies to promote dietary change that may include goal setting, self-monitoring, problem solving, cognitive restructuring, social support, relapse prevention, and contingency management [75].

## SOCIAL COGNITIVE THEORY

The basis of the SCT is that behavior is the result of the complex interaction of personal and behavioral factors, and environmental influences; the theory also acknowledges

\* Step diets were the previously recommended dietary programs to reduce serum LDL-C levels and reduce the risk of CHD. They have been replaced by the Therapeutic Lifestyle Change (TLC) diet recommended by the Adult Treatment Panel III. Step 2 diets were more restrictive than Step 1 diets and were employed if patients were unable to meet their LDL-C goals on a Step 1 diet.

the ability of the individuals to alter and construct their environments to fit their needs [69]. A basic premise of SCT is that people learn not only through their own experiences but also by observing the actions of others and the results of those actions [74]. Key constructs of SCT that are relevant to health behavioral change interventions include observational learning (acquiring behaviors by watching others), reinforcement (responses to the behavior that can increase or decrease the likelihood of repeating the behavior), self-control (personal regulation of behavior), and self-efficacy (the personal confidence in the ability to perform a behavior and overcome barriers to that behavior under any circumstance) [69].

Self-efficacy can facilitate or hinder behavioral change since individuals are more likely to engage in behaviors they believe they can successfully perform and avoid behaviors in which they believe that they will be unsuccessful. Nutrition counseling strategies can strengthen patient's self-efficacy by setting goals, using demonstrations and modeling, developing skills, and providing social support and reinforcements—including self-monitoring records [63,69]. Because of its broad appeal, the concept of self-efficacy has been incorporated in several other behavioral change models, including health belief model, theory of planned behavior, and transtheoretical model [76].

### TRANSTHEORETICAL THEORY (STAGES OF CHANGE)

Introduced in 1981 to explain smoking cessation behaviors, the transtheoretical model of health behavioral change has also been used to guide a wide variety of health behavioral changes, including dietary changes. The model's core concept includes five stages of change that people pass through over time with change most likely to occur when individuals engage in the right activities for the right stage [77]. The early stages of behavioral change are pre-contemplation (unaware a change is needed or not planning to make any changes) and contemplation (thinking about making a change within the next 6 months). In preparation, individuals are planning to take action in the near future (within 30 days) and are taking steps to change behaviors. In the action stage, individuals have made overt change and in maintenance (usually defined as 6 months), the behavior is sustained. Individuals usually do not progress linearly through these changes of change and relapses are common depending on the motivation and self-efficacy of the patient.

It is important that clinicians working with patients tailor their message to the specific stage [78], since determining the readiness to change is a key element of effecting dietary change. This should be a standard element of nutritional counseling [78,79]; unfortunately, few clinicians do this. Patients can be categorized into a specific stage by asking questions and listening to the replies. Statements in pre-contemplation that a patient may make could include "I don't need to change the way I eat" or "I tried eating more fruit and vegetables, but I just can't." In contemplation, they

might say "I've been thinking about eating healthy for awhile now." In preparation, the statement might be "I bought a new cookbook on low-fat cooking." In action, "I'm using my new cookbook and including more fruit and vegetables in the family's meals. It wasn't as hard as I thought it would be." For the patient to be in maintenance, they would need to say something like "I've been eating healthy for about 6 months, and it's become my standard now." Understanding a patient's stage of change can also help to understand barriers and enablers to dietary change.

### HEALTH BELIEF MODEL

This model is widely used in nutrition education and counseling. This model is based on the theory that patients have choices and can make appropriate decisions regarding health behaviors. In the health belief model, patients must perceive themselves as susceptible to a health threat or disease that has the potential to impact them or their lifestyle. They must also perceive that the benefits to making changes outweigh the effort of making behavioral changes. Internal and external cues motivate patients to take action and patients have the self-efficacy to accomplish these actions [80].

### COMPONENTS OF SUCCESSFUL BEHAVIORAL CHANGE

Many of the behavioral theories outlined earlier have common components including goal setting, problem solving, self-monitoring, and feedback.

#### GOAL SETTING

Goal setting is appropriate for patients ready to make a change or in action or maintenance stages. Measurable goals that focus on a behavior (e.g., increasing fruit and vegetable intake) rather than a physiological target (e.g., improving LDL-C levels) are preferable since behaviors, not outcomes, are under an individual's control [2]. Setting a challenging goal, but one that can be achieved, is better than setting one that cannot be reached or is so easy that it does not provide a sense of accomplishment when it is achieved [2]. Goals should be defined in terms of a measureable outcome. Goal setting will only work if the person accepts the challenge and has the experience, self-efficacy, and necessary feedback to accomplish the behavioral changes [81]. One to three goals, depending on the needs and skills of the patient, should be set, so as not to overwhelm an individual [80]. Ideally, goals should be established jointly by the health care provider and patient; however, goals set by either can elicit the desired outcomes [2].

Common to the success of any intervention is setting reasonable and achievable specific goals rather than having either vague goals or no goals at all. An example of an appropriate goal for the end result of lowering serum cholesterol levels would be: eat oatmeal for breakfast three times a week, not increase dietary fiber [80]. As much as possible, approach



goal setting as what the client can have, not what they cannot have. Regular feedback on goal attainment is important to reinforce self-efficacy. The need for feedback typically diminishes as the patient's skills improve.

### PROBLEM SOLVING

Problem-solving skills provided to and practiced by the patient should address specific barriers to behavioral change related to chronic illness. It is especially important part of self-management for patients with diabetes. Glasgow et al. [82] described a specific technique for analyzing problems and developing solutions: “S—specify the problem; T—think of options; O—opt for the best solution; and P—put the solution into action.” It is also suggested that patients look beyond the obvious solution and brainstorm to find multiple solutions to barriers to behavioral change [75].

### SELF-MONITORING

Self-monitoring is associated with improved treatment outcomes. It increases awareness of behaviors and helps to identify barriers to change; self-monitoring also identifies behavioral patterns and facilitates recognition of program progress made toward achieving a goal [2]. This entails keeping a detailed record of behaviors that influence diet or physical activity. The record may include what foods were eaten and where they were eaten; frequency, duration, and intensity of physical activity; any physical measurements, for example glucose levels; and thoughts associated with the behavior. Self-monitoring strategies can reflect the patient's self-response or external prompts, such as e-mail reminders or personal digital assistant programs can be used to help motivate patients.

### FEEDBACK

Feedback is effective in reinforcing positive behavioral changes and increasing self-efficacy [80]. Those at high risk for CVD are more likely to respond to feedback than those not receiving it [83].

### MOTIVATIONAL INTERVIEWING

Lack of motivation is a major reason for backsliding on the readiness to change continuum outlined earlier in the transtheoretical model and can result in a lack of long-term behavioral change. Motivational interviewing was shown to be a highly effective strategy, especially when coupled with CBT. Goal setting, problem solving, and self-monitoring were effective strategies in helping individuals maintain behavioral changes. Motivational interviewing is a technique used by counselors to help individuals build motivation. It has been described as “a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence” [84]. Motivational interviewing is

used to identify and resolve discrepancies between desired and actual behaviors and to increase the motivation to change behaviors. It is client-centered and adheres to the concept that behavioral change is a shared responsibility of the client and practitioner and practitioners can enhance motivation to change or contribute to resistance [85].

The principles of motivational interviewing include expressing empathy, which suggests an acceptance and understanding of the client's perspective and situation; developing discrepancy, which emphasizes the discrepancy between present behavior and goals can facilitate change; avoiding escalating resistance from the client and, if present, changing strategies to assist change; rolling with resistance or provide a comfortable atmosphere for change; and supporting self-efficacy since confidence in the ability to make changes or achieve goals is a powerful motivator [80,84].

Motivational interviewing is an evidence-based counseling strategy that builds on several behavioral theory models, including the transtheoretical model of change, and is best applied to individuals who are not ready to change behaviors (pre-contemplation, contemplation, or preparation) or are unwilling or are ambivalent about changing diet or lifestyle. Reflective listening, eliciting self-motivational statements, and asking open-ended questions to elicit self-motivational statements are specific strategies that can be used [80]. Although developed originally for individuals with substance abuse, motivational interviewing has been used effectively to reduce energy [86] and sodium [87] intake and to increase intake of fruit and vegetables [88]—all of which would be important in counseling patients with CVD. It is less clear if behavioral changes can be sustained over time and what the overall effect on health is. Motivational interviewing and health-promoting behaviors have been recently reviewed [89].

### MULTICULTURAL COUNSELING

The majority of conventional theories that guide behavioral change strategies were developed by white males of European descent; they may have gender and cultural limitations and may not consider the influence the family has on the patient. Although all counseling occurs in a cultural context, counseling is only considered multicultural or cross-cultural when the counselor is of a different racial/ethnic group than the individual receiving the counseling. Effective multicultural counseling requires flexible techniques and training in cultural sensitivity and cultural norms [80]. This issue becomes more complex when individuals identify with more than one culture. As the United States moves to a racial/ethnic plurality, it is critical that more individuals be competent in cross-cultural counseling and that more individuals from different races/ethnicities become health professionals.

It is vital to develop cultural strategies to address the needs of specific groups. It is also important to consider all patients as individuals. For example, Latinos in the United States come primarily from Mexico, but they also come from all Central and South American countries and the countries of the Caribbean. Knowledge, attitudes, and beliefs, as well

as food, the role of the family in food and health norms, and languages spoken and understood may be different. The level of literacy, including health literacy, and acculturation, or the process by which immigrants adopt the attitudes, beliefs, and dietary practices of the host country, must be considered and how complete any acculturation is [90].

Latinos are the largest ethnic minority in the United States; they are at high risk for developing diet-related chronic diseases, including CVD. A recent review suggested that there was no relationship between intake of dietary fat and percent energy from fat and that less acculturated individuals consumed more fruit, rice, beans, and whole milk and less sugar, sugar-sweetened beverages, snacks, and added fats [91]. Dietary acculturation may have a negative effect on the diet and health of immigrants and places them at higher risk for developing diet-related chronic diseases [90–92]. Although it is important for counselors to develop cultural sensitivity, this was not sufficient for a successful intervention and it needed to be combined with behavioral change strategies and awareness of the individuals' socioeconomic status [90].

### ROLE OF HEALTH CARE PROVIDERS IN DIETARY INTERVENTIONS

The majority of individuals seeking to change dietary behaviors to reduce the risk of CVD do not choose either highly restrictive programs or meal replacement programs. Many of those interested in dietary change rely on group or individual education or counseling by health professionals, including physicians and RDs.

Healthy People 2020 [5] has as a goal to “Increase the proportion of physician office visits made by patients with a diagnosis of cardiovascular disease, diabetes, or hyperlipidemia that include counseling or education related to diet and nutrition” from 20.8% to 22.9% (+10%). Physician advice is highly valued by patients [93], presenting an ideal opportunity to provide counseling to patients about reducing risk factors of CVD. Those receiving advice about dietary change from a physician were more likely to report a healthy diet than those not receiving this advice [94].

Family physicians and general internal medicine physicians screen for CVD risk factors and may provide initial advice on lifestyle changes to patients who present with risk factors, such as high LDL-C or low HDL-C levels. Sixty-one percent of individuals surveyed by the Academy of Nutrition and Dietetics (AND) [95] cited physicians as very credible sources on nutrition. Paradoxically, the same survey showed that only 10% of respondents used physicians as a source of nutrition information—physicians ranked lower on this question than the Internet (~25%) or family and friends (~20%).

The link between nutrition and chronic disease is widely understood by physicians and they can be effective counselors for patients with CVD [96]. However, many physicians do not feel prepared to do nutrition counseling with their patients [97] or do not believe that nutrition counseling is one of their responsibilities [98]. Most physicians have not been

trained in nutrition counseling, and barriers to physician counseling for CVD and CVD risk factors include lack of time and compensation [98], nutrition knowledge [97,98], low self-efficacy [97], lack of knowledge of the guidelines [99], ineffective communication between doctors and patients [99], and “clinical inertia” [100].

During an office visit, a patient spends only about 10 min with a physician [101], suggesting that time is a principal barrier to effective nutrition counseling. Referral of patients with dyslipidemia, CHD, or hypertension to an RD can expand the time available for a counselor to spend with a patient. Implementing the nutrition care process [102], the RD can provide quality theory-driven interventions and provide patients with effective nutrition interventions to reduce CVD risk [103]. Overall, however, providing nutrition information is a shared responsibility among physicians, RDs, and other health professionals [11].

### EFFECTIVENESS OF NUTRITION INTERVENTIONS: THE EVIDENCE

The AND's Evidence Analysis Library (EAL) Nutrition Counseling Workgroup recently conducted a systematic review of the literature related to behavioral change theories and strategies used in nutrition counseling [63]. They found that there was strong evidence to support the use of a combination of behavioral theory and CBT in facilitating behavioral change targeted to dietary habits, weight, and cardiovascular risk factors. The evidence was fair that problem-solving strategies were effective for diet management and weight loss, but the EAL noted that the studies available were small and limited to women. The effectiveness of client self-selected behavioral goal setting and goal attainment intervention was also validated. There was little evidence that cognitive restructuring was effective in patients without eating disorders and there was no evidence that stress management or stimulus control were effective strategies in eliciting behavioral change. The EAL also found that the evidence was fair that group counseling was more effective than individual counseling and that short-term CBT (less than 6 months) could result in long-term behavioral changes.

### NUTRITION CARE PROCESS

In 2003, the AND published the Nutrition Care Process, which they termed “a road map to quality care and outcomes management” [102]. The four steps of the nutrition care process are (1) nutrition assessment, (2) nutrition diagnosis, (3) nutrition intervention, and (4) nutrition monitoring and evaluation. Nutrition assessment has five domains: food/nutrition-related history; anthropometric measurements; biochemical data, medical testing, and procedures; nutrition-focused physical findings; and client history. It is essential that a counselor understands these components for effective counseling and to be able to help the client/patient be able to set the behavior goals that will help

them meet the ultimate health outcome goals, such as weight loss or lowering LDL-C levels. Nutrition diagnosis has three domains within which the problems fall: intake, clinical, and behavioral/environmental. From the standpoint of behavioral counseling, understanding behavioral/environmental aspects of the client, their family, and their living situation will help the client address potential barriers and find unique solutions to these barriers. There are four domains of nutrition intervention: food or nutrient delivery, nutrition education, nutrition counseling, and the coordination of nutrition care. Nutrition monitoring and evaluation terms are coupled with the first four domains of nutrition assessment [102,104].

The nutrition education domain is further divided into content with instruction intended to lead to nutrition knowledge, and application, with “training intended to lead to nutrition-related result interpretation or skills.” Nutrition counseling, on the other hand, is defined as “a supportive process, characterized by a collaborative counselor-patient/client relationship, to set priorities, establish goals, and create individualized action plans that acknowledge and foster responsibility for self-care to treat an existing condition and promote health.” This domain is divided into a theoretical basis approach and strategies [104]. Nutrition education or counseling is critical to elicit long-term dietary change.

#### CLIENT/PATIENT AND HEALTH CARE PROFESSIONAL CONTACT

Nutrition counseling can be provided to individuals or groups and in single or multiple sessions. The advantage to group counseling is that individuals can learn from each other and provide support to group members. The disadvantage is that less time is available to address individual problems. Group counseling tends to be more effective than individual counseling [63].

Multiple sessions tend to be more effective than single sessions since frequent contact helps to establish trust between the patient and provider, which is especially important among racial/ethnic minorities. Continued contact can also help patients progress through stages of change, provide patients with multiple skills, and allow for follow-up that can reinforce positive behavioral change. Ongoing contact can be face-to-face, via the telephone, e-mail, or the Internet. As contact decreases, new behaviors may wane and actually cease if contact stops. The majority of interventions that induce long-term behavioral changes involved multiple contacts [2].

#### LONG-TERM DIETARY CHANGE

Despite consistent health messages, the general public may not make dietary changes to improve their health; thus, nutrition interventions are critical, especially for those with chronic disease or risk factors for chronic disease [105]. To be effective in reducing CVD risk factors, nutrition interventions need to influence behaviors that are sustainable. When patients and health professionals are setting goals, it is important to consider short-term, as well as long-term goals. For most patients that follow a diet to reduce CVD risk factors, significant reductions have

been shown within 4–6 weeks and cholesterol reduction goals can be met within 3 to 6 months [106]. With a well-designed intervention, highly motivated individuals can sustain reduced fat intake and increased intake of fruit, vegetables, and fiber for 12 months, but for most, sustaining changes over longer periods was less successful [105].

It is clear, however, that long-term dietary changes to reduce CVD risk factors can be made by population and by individuals. Perhaps the most dramatic example of a population change was the 80% decline in coronary mortality in Finland. This reflects principally the “great” reduction in risk factors, including declines in serum cholesterol levels, blood pressure, and smoking prevalence. The greatest change in health behaviors was diet—including the type and amount of fat consumed and the intake of fresh fruit and vegetables. These changes were associated with long-term chronic disease prevention and health promotion interventions. It is unclear why the change in risk factors among the Finns is so much better than in other population, although it may be related to the collaboration among health services, nongovernmental organizations, and industry [107].

#### CONCLUSION

Facilitating dietary changes that reduce the risk of CVD can reduce the disease and cost burden to the United States. Dietary changes should be theory driven and individuals should be provided with the knowledge and skills to facilitate and maintain these changes. Self-efficacy and sustained motivation must compliment the knowledge and skills provided to the patient.

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