

Can Lifestyle Modifications Using Therapeutic Lifestyle Changes (TLC) Reduce Weight and the Risk for Chronic Disease?

Introduction:

Overweight and obesity are complex health problems that affect more than two-thirds of U.S. adults.¹



There are many health conditions associated with overweight and obesity including hypertension, coronary heart disease, and type 2 diabetes.² Therefore, it is likely that health care practitioners will be advising overweight or obese individuals who also have additional health conditions.

The challenge for many practitioners is choosing an appropriate weight management therapy that will simultaneously address these multiple health conditions. Fortunately, lifestyle changes including healthy eating patterns, increased physical activity, and weight management often improve the risk factors associated with obesity.

One such lifestyle approach, Therapeutic Lifestyle Changes (TLC) is recommended by various health organizations (American Diabetes Association, American Heart Association, and The Obesity Society, among others) as a sound therapeutic strategy for overweight or obese persons at risk for type 2 diabetes and/or coronary heart disease.^{3, 4}

TLC is an effective lifestyle therapy targeting low-density lipoprotein cholesterol (LDL), a risk factor for coronary heart disease.⁵ Fortunately, the health benefits of TLC do not stop there. Along with lowering LDL, TLC also improves risk factors associated with the metabolic syndrome and diabetes, including blood pressure, high-density lipoprotein cholesterol (HDL), serum triglycerides, blood glucose, and weight status (**Table 1**).⁶⁻¹⁰

Table 1. TLC—Summary of Physiological Effects

LDL	HDL	Triglycerides	Blood pressure	Glucose	Weight
↓	↔/↑	↓	↓	↓	↓

This research brief for the health care practitioner reviews TLC as an effective lifestyle therapy for improving the risk factors associated with an overweight status, coronary heart disease, and diabetes. This brief will begin with a review of the relationship between overweight and chronic disease, followed by a description of TLC and a scientific review of how the different TLC components work to promote weight management and reduce chronic disease risk. Finally, suggestions will be provided for practitioners to use when counseling individuals on how to begin using TLC as a healthy lifestyle approach.

An overview of the following topics is provided:

- ❖ What are the Health Risks Associated with Overweight and Obesity?
- ❖ What is TLC?



Research to Practice Series, No. 7

National Center for Chronic Disease Prevention and Health Promotion
Division of Nutrition, Physical Activity, and Obesity



- ❖ How Does the Current U.S. Dietary Fat and Cholesterol Consumption Compare to TLC Recommendations?
- ❖ Why Does TLC Recommend Reducing Intakes of Saturated Fat, Trans Fat, and Cholesterol while Increasing Consumption of Monounsaturated and Polyunsaturated Fats?
- ❖ What Other Dietary Options Can Help Reduce Coronary Heart Disease Risk?
- ❖ What are the Benefits of Increased Physical Activity and Weight Management?
- ❖ Research to Practice: Suggestions for Incorporating TLC into a Healthy Lifestyle.

What are the Health Risks Associated with Overweight and Obesity?

Overweight (BMI 25–29.9 kg/m²) and obesity (BMI ≥30 kg/m²) are independent risk factors for several chronic disease conditions including coronary heart disease, hypertension, elevated cholesterol, and diabetes.^{11–13} The prevalence of these conditions increases as BMI increases. Based on NHANES III data, hypertension, total cholesterol, and low HDL are positively associated with BMI (**Figure 1**).¹⁴ The risk for developing diabetes also increases with increasing weight.¹⁵ Compared to a healthy weight person, an overweight individual is 3 times more likely to develop diabetes within 10 years.¹⁶ This risk rises dramatically to 23 times the risk at the higher BMI levels (BMI ≥35 kg/m²).¹⁶ Individuals with diabetes are also at an increased risk of developing coronary heart disease.⁵ Coronary heart disease comprises more than 50% of all cardiovascular disease-related events in U.S. adults and is the leading cause of diabetes-related death.¹⁷

Of concern is the tendency for diabetes and coronary heart disease risk factors to co-occur in those who are overweight or obese, thus complicating treatment options. An estimated 64% and 72% of overweight and obese Americans, respectively, have hypertension, elevated cholesterol, or both.¹⁴ A study examining more than 1.9 million members of a large managed care program found hypertension, elevated total cholesterol, and/or diabetes to commonly co-occur in more than 40% of those diagnosed with one of these conditions.¹⁸

The metabolic syndrome—a clustering of multiple risk factors associated with overweight and obesity



It is now known that when certain chronic disease risk factors co-occur (abdominal obesity, low HDL, elevated fasting glucose, and elevated triglycerides), there is an increased risk for cardiovascular disease and diabetes. The metabolic syndrome is a defined cluster of three or more these chronic disease

risk factors (**Table 2**) that are often accompanied by insulin resistance.⁵

Metabolic syndrome increases the risk for coronary heart disease and diabetes 2- to 6-fold and 3.5-fold, respectively.^{19–21} Based on NHANES III data, an estimated one-fourth of U.S. adults have the metabolic syndrome.²² Furthermore, based on the National Cholesterol Education Program (NCEP) criteria listed in **Table 2** an estimated 86% of adults age 50 and older with type 2 diabetes have the metabolic syndrome.²³

The beneficial health effects of weight loss

A 10- to 20-pound weight loss often improves blood pressure, blood cholesterol, and triglyceride levels.^{24–27} Weight loss is also an effective therapy for reducing the risk of diabetes. A subanalysis of a Diabetes Prevention Program cohort comprised of adults with impaired glucose tolerance receiving an intensive lifestyle intervention, found a 16% reduction in risk for developing diabetes for every kilogram

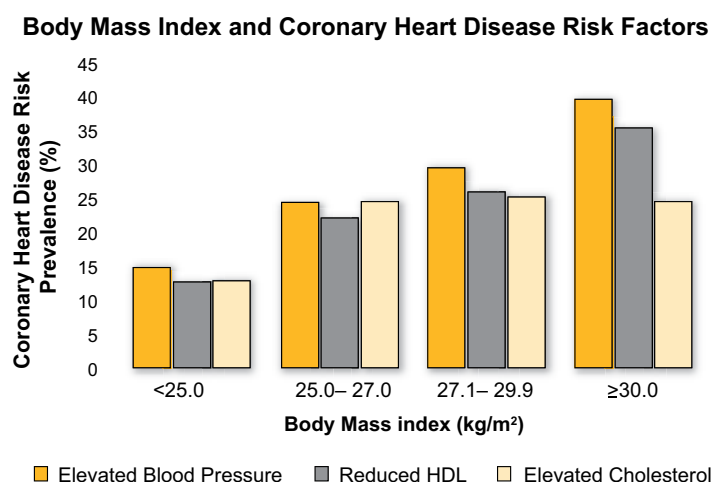


Figure 1. BMI and prevalence of coronary heart disease risk factors. Adapted from Brown et al., 2000.¹⁴

Table 2. NCEP Criteria for Metabolic Syndrome*

Risk Factor	Defining Level
Abdominal obesity	Waist Circumference
Men	≥40 in
Women	≥35 in
Triglycerides	≥150 mg/dL
HDL cholesterol	
Men	<40 mg/dL
Women	<50 mg/dL
Blood Pressure	≥130/85 mmHg
Fasting glucose	≥100 mg/dL

Adapted from National Cholesterol Education Program (NCEP), ATP III Final Report.⁵

*A diagnosis of metabolic syndrome is made when 3 or more of the risk factors are present.

of weight loss, independent of diet and physical activity.²⁸ Weight loss has a similar effect on the risk for developing hypertension. In another observational study, a Framingham Study cohort composed of overweight, middle-aged adults without hypertension, found that a moderate weight loss of 15 pounds or more reduced the long-term risk of developing hypertension by 28%.²⁹ Furthermore, in a clinical study of individuals with metabolic syndrome, weight reduction was shown to reduce elevated triglycerides, systolic and diastolic blood pressure, serum glucose, and total cholesterol.³⁰

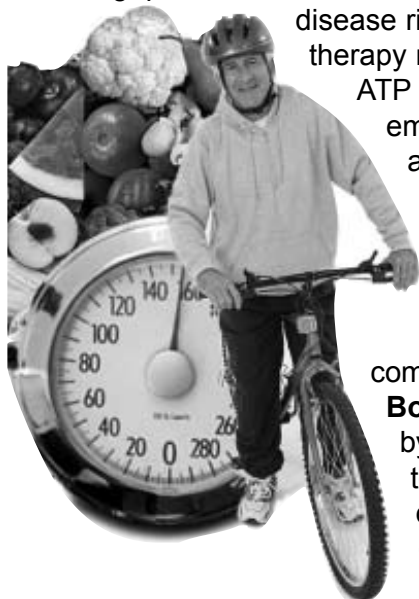
What is TLC?

TLC is the lifestyle component of the Third Report of the NCEP Adult Treatment Panel (ATP) III guidelines⁵ that focuses on diet, weight management, and increased physical activity (**Box 1**). The ATP III guidelines specifically target LDL because of its strong, positive correlation with coronary heart

disease risk.⁵ Although drug therapy may also be used,

ATP III places a major emphasis on TLC as an essential therapy for persons at risk for coronary heart disease.⁵ The cumulative effect of the TLC diet components listed in

Box 1 can reduce LDL by 25-30% compared to a typical U.S. diet—similar to the effect of drug therapy.⁵



Box 1. TLC Components:

- **Diet**

- Reduced intakes of saturated fats, *trans* fats, and cholesterol.
- Dietary options for maximizing LDL reduction and reducing coronary heart disease risk (plant stanols/sterols, increased soluble fiber, and fish).

- **Weight management**

- **Increased regular physical activity**

In addition to lowering LDL, a TLC-like eating plan has also been shown to positively affect blood pressure and serum triglyceride levels with little or no effect on HDL levels.⁶ These effects are further enhanced by weight reduction and increased physical activity in overweight individuals (**Table 1**).^{5, 31} This is especially important for those with diabetes and/or the metabolic syndrome.

TLC is a comprehensive lifestyle approach that includes specific dietary recommendations (TLC diet), weight management, and increased physical activity. The TLC diet component emphasizes reducing dietary cholesterol (<200 mg/day), saturated fats (<7% of total calories), and *trans* fats (lower intake) (**Table 3**). Total fat comprises 25–35%

Table 3. Dietary Recommendations for TLC Diet

Component	TLC Diet
Total fat	25-35% of total calories*
Saturated fat	<7% total calories
Polyunsaturated fat	Up to 10% of total calories
Monounsaturated fat	Up to 20% of total calories
<i>Trans fat</i>	Lower intake [†]
Carbohydrate**	50-60% of total calories
Dietary fiber	20-30 grams per day
Protein	15-25% of total calories
Cholesterol	<200 mg/day
Sodium	<2,300 mg/day
Dietary options	
Plant sterols/stanols	Add up to 2 grams per day
Soluble fiber	Increase 5-10 grams per day
Fish (fatty fish)	Include in weekly eating plan ^{††}

* ATP III allows an increase of total fat to 35% of total calories and a reduction of carbohydrate to 50% in persons with metabolic syndrome and/or at risk for type 2 diabetes.

^{††} Carbohydrate should derive predominantly from foods rich in complex carbohydrates including grains (especially whole grains) and fruits and vegetables.

of total calories, with up to 20% coming from monounsaturated fats and 10% from polyunsaturated fats. Finally, optional nutrient considerations for maximizing LDL reduction and reducing coronary heart disease risk include complementing the diet with stanols/sterols (2 g/day) and viscous (soluble) fibers (5–10 g/day), and including fish (especially oily fish such as salmon, tuna, and mackerel) as part of one's overall eating plan.

The following sections describe each of the TLC components (TLC diet, weight management, and increased physical activity) in detail and how each affects the risk factors associated with coronary heart disease, type 2 diabetes, and metabolic syndrome.

How Do the Current U.S. Dietary Fat and Cholesterol Intakes Compare to TLC Recommendations?

Fats play diverse roles in the body. Not only do fats insulate the body against the elements, but they also serve as an energy source for the body. In addition, fats are a crucial component of the cell membranes that surround each of the billions of cells in the body.

Because of the important roles dietary fats play in maintaining health, it is important to consume both the proper amount and types of fat. Fats are the most concentrated source of energy (calories) in the diet, providing nine calories per gram compared to four calories per gram for either protein or carbohydrates. As previously mentioned, TLC recommends that dietary fats make up 25–35% of a person's total daily calories.⁵ The minimum value protects against energy and nutrient deficiencies, elevated triglyceride levels, and lower HDL-C levels while the upper limit helps curb saturated fat intake and excess energy consumption.³² According to a



2004 report of the *Continuing Survey of Food Intakes of Individuals (CSFII)*, the latest estimated median intake of total dietary fats in the United States is approximately 33 percent of total calories.³³ While this number is within the TLC recommendations for total fat intake, TLC's second criterion for fat

intake—types of fats—is not being met. As shown in (**Table 4**), Americans are consuming more than the recommended amounts of saturated fat and cholesterol.³⁴

More about trans fats and dietary cholesterol

Trans fats have received much attention lately due to their negative effect on coronary heart disease risk.³⁶ Most trans fats in the United States diet are produced during the partial hydrogenation of vegetable oils.³² Hydrogenation is a food manufacturing process that turns liquid vegetable oils into the more solid margarines. This process also makes the fats more stable and less likely to turn rancid, which is an especially favorable characteristic for fats used in deep fat frying. Hydrogenation adds hydrogen atoms to a fat molecule. The more hydrogen atoms that are added to a fat molecule, the more “hydrogenated” and solid the fat becomes. Trans fats are produced when the fat molecule is not completely hydrogenated, or in other words “partially-hydrogenated.” Of note, although a small amount of naturally occurring trans fats are also found in dairy products and meats, these trans fats do not appear to negatively affect cholesterol levels to the same degree as those derived from partially-hydrogenated vegetable oils.³⁶

Cholesterol is a “fat-like” substance that also plays an integral role in cell membrane structure. In addition, cholesterol is required for the production of bile acids (used in fat digestion) and steroid hormones (e.g., estrogen and testosterone). The body is able to produce all of the cholesterol it needs on a daily basis.⁵ Therefore, unlike the daily requirement for dietary fats, cholesterol does not need to be acquired through the diet. The current



U.S. consumption for cholesterol (257 mg/day) is slightly higher than the maximal level of TLC guidelines (**Table 4**).

Why Does TLC Recommend Reducing Intakes of Saturated Fat, Trans Fat, and Cholesterol while Increasing Consumption of Monounsaturated and Polyunsaturated Fats?

Saturated Fats. Saturated fat intake is believed to be the primary dietary factor known to raise LDL.⁵ It has been estimated that for every 1% increase in total calories from saturated fats, there is an associated 2% increase in LDL.⁵ Conversely, LDL is lowered by 2% for every 1% decrease in total calories from saturated fats. A recent weight loss study of obese adults found that a TLC-like diet deriving less than 7% of total calories from saturated fats reduced LDL levels an average of 8%.⁷

Trans Fats. In addition to lowering saturated fat intake, TLC also recommends trans fat intake be kept low. Trans fats raise LDL, although not to the

same degree as saturated fats.³⁷ Trans fats also lower HDL cholesterol when used instead of naturally occurring oils such as olive or canola oil.^{38, 39} This dual effect on cholesterol levels actually raises the total cholesterol to HDL ratio, which can increase the risk for coronary heart disease.^{36, 40, 41} Other than their impact on cholesterol levels, trans fats are also believed to increase other coronary heart disease risk factors, including elevated triglyceride levels and alterations to the inside lining of the blood vessels (endothelial dysfunction).^{39, 42} Due to these negative effects on coronary heart disease risk, TLC recommends that intakes of trans fats be kept low.

Monounsaturated Fatty Acids and Polyunsaturated Fatty Acids. Replacing saturated fats and trans fats with either monounsaturated fats or polyunsaturated fats has been shown to lower LDL.⁴³ Data from the 20 Years Follow-up of the Nurses' Health Study found that a higher polyunsaturated fat intake (approximately 7% versus 5% of total calories) in women is associated with a decreased risk of coronary heart disease.⁴⁴ In an earlier examination of the Nurses' Health Study

Table 4. Common Food Sources for Dietary Fats and Cholesterol			
Dietary Fat	Estimated Mean Daily Consumption Levels (U.S.) ^{34, 35}	TLC Recommendations	Food Sources
Saturated fats	11% total calories	<7% total calories	Animal-based foods, including whole-fat dairy products (milk, cream, butter, cheese), fatty meats such as beef and pork. Some vegetable-based foods such as coconut, palm, and palm kernel oils also contain relatively high levels of saturated fats.
Trans fats	6 grams/day	Lower intake	Foods containing or prepared with partially hydrogenated vegetable oils, including stick margarine, pastries, fried foods, french fries, and pastries. Naturally occurring trans fats are also found in milk, butter, and meats.
Monounsaturated fats	12% total calories	Up to 20% total calories	Oils including olive, canola, and peanut oil.
Polyunsaturated fats	6% total calories	Up to 10% total calories	The two primary types of polyunsaturated fats are omega-6 and omega-3 fats. Omega-6 fats are found in nuts, seeds, and vegetables oils such as sunflower, canola, safflower, corn, and soybean oils. Plant sources of omega-3 fats (-linolenic) include canola oil, soybean oil flaxseed, and English walnuts. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are omega-3 fats found in the oily fish such as salmon, tuna, and mackerel. The leaner fish such as cod, haddock, and catfish contain less EPA and DHA.
Cholesterol	257 mg/day	<200 mg/day	Foods of animal origin. Highest amounts are found in liver and egg yolks. Moderate amounts are found in full-fat dairy products, some seafood (shrimp and lobster), and fish (salmon and sardines)

group, monounsaturated fats were also shown to be inversely associated with the risk for coronary heart disease.⁴⁵ Thus, based on the heart-protective effects of monounsaturated and polyunsaturated fats, TLC recommends that most of the total daily dietary fat (25–35% of total calories) be comprised of monounsaturated fat and polyunsaturated fat with intakes ranging up to 20% and 10% of total calories, respectively. See **Table 4** for examples of foods containing these healthy fats.

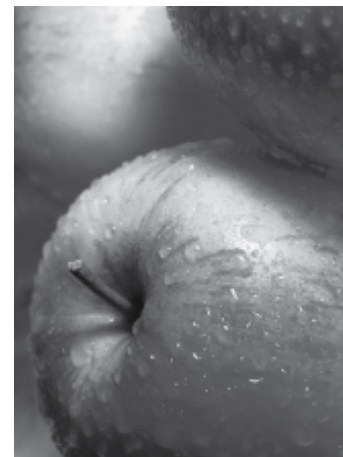
Other positive health effects of monounsaturated and polyunsaturated fats occur when these fats replace a portion of one's dietary carbohydrate intake. High intakes of carbohydrates (>60% of calories) in overweight/obese individuals can potentially elevate blood glucose and triglyceride levels and lower HDL cholesterol.⁵ Diets that replace a portion of the carbohydrates with monounsaturated fats and/or polyunsaturated fats can decrease serum triglyceride levels with little or no decrease in HDL levels.¹⁰ A recent study looking at the effect of various diet compositions on coronary heart disease risk found that a partial substitution of dietary carbohydrates with either protein (half from plant sources) or unsaturated fats (primarily monounsaturated) improved blood pressure, LDL, HDL, and triglyceride levels and reduced the risk of coronary heart disease.⁶ This is an important consideration for those with insulin resistance or diabetes that have elevated triglycerides and low HDL levels.⁵ For this reason, TLC recommends increasing total fat (primarily composed of monounsaturated and polyunsaturated fats) percentage up to 35% of total calories while reducing carbohydrate intake to approximately 50% and protein to 15% of total calories for individuals with the metabolic syndrome and/or at risk for diabetes.⁵

Dietary Cholesterol. On average, a 100 mg increase in dietary cholesterol increases total serum cholesterol levels by 2.2 mg/dL.⁴⁶ Interestingly, while egg consumption accounts for more than one-third of cholesterol consumption in the United States, prospective data from the Nurses' Health Study and the Health Professionals Study found no significant impact on frequency of egg consumption on coronary heart disease risk, except among diabetic women.⁴⁷ A more recent meta-analysis found that dietary cholesterol raises the total cholesterol to HDL cholesterol ratio—negatively affecting the cholesterol profile.⁴⁸ Therefore, due to the potential for dietary cholesterol to raise LDL, the TLC diet recommends consuming less than 200 mg/day of cholesterol.

What Other Dietary Options Can Help Reduce Coronary Heart Disease Risk?

Plant Stanols/Sterols.

Plant stanols and sterols (stanols/sterols) are typically derived from soybean and tall pine-tree oils. Processed stanols/sterols are easily dissolved in oils and margarine and are currently available in a wide variety of foods, drinks, margarines, and soft gel capsules. Once consumed, the stanols/sterols are digested and subsequently changed to a compound that blocks cholesterol absorption, which in turn can reduce LDL cholesterol.⁴⁹ Maximum dietary effects occur at plant stanol/sterol intakes of approximately 2 g/day.⁵ To sustain LDL reductions, stanol/sterol-containing products need to be consumed on daily basis.



Soluble Fiber. The two primary types of complex carbohydrates include fiber and starch. Starch is found in the seed of corn, wheat, rice, oats, and legumes. The body is able to digest starch and use it for energy. Unlike starch, only a small amount of dietary fiber can be digested and used for energy. This is because humans lack the enzyme required to digest fiber. Although not a primary energy source for the body, fiber plays an important role in maintaining the health of the digestive system and is typically classified by its ability to absorb water:

- Soluble fiber absorbs water (soluble in water) and turns into a gel-like substance in the intestines that helps block cholesterol and fats from being absorbed through the intestinal wall into the blood system. Soluble fiber can be found in foods such as apples, oats, kidney beans, and barley.
- Insoluble fiber does not absorb water (insoluble in water) and essentially moves through the intestines undissolved. For this reason, insoluble fiber is also referred to as “roughage.” Insoluble fiber helps maintain the function of the digestive system by promoting the proper movement of food through the intestines. This form of dietary fiber is primarily found in whole grains such as whole wheat and popcorn and vegetables such as cauliflower, broccoli, and green beans.

Soluble forms of dietary fiber can reduce LDL, whereas insoluble fibers have not been shown to

significantly reduce LDL levels.⁵ A meta-analysis of trials related to soluble fibers found consuming 2-10 g/day produced a small, yet significant reduction in LDL.⁵⁰ Therefore, to further optimize the LDL-lowering effects of the TLC diet, TLC recommends including fiber-rich foods that add at least 5-10 grams of soluble fibers to the daily fiber intake (e.g., apples, bananas, oatmeal, legumes, and barley).

Fish Consumption. Omega-3 fats are a specific type of polyunsaturated fat known to reduce the risk for sudden death and death from coronary heart disease.^{51, 52} Although omega-3 fats are found in plants (α -linolenic acid) and fish (**Table 4**), the omega-3 fats found in fish, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), appear to be more effective in reducing coronary heart disease risk.⁵² The beneficial effects of fish consumption have been observed at levels of one to two ounces per day, with further reductions in coronary heart disease risk occurring in a dose-dependent manner up to about 5 servings per week.⁵³ Therefore, TLC guidelines support the American Heart Association's recommendations³⁷ that at least two 4-ounce servings of fish (especially oily fish such as salmon, tuna, and mackerel) be consumed each week.

Dietary Salt. Based on NHANES data, approximately 65 million U.S. adults have high blood pressure, an independent risk factor for cardiovascular disease.⁵⁴ Although there are numerous factors that can elevate blood pressure, increases in dietary salt (sodium chloride) intake are associated with increased blood pressure.⁵⁵ Conversely, a reduced salt intake can lower blood pressure and prevent hypertension. There have been many studies that have looked at the effects of dietary salt restriction in reducing blood pressure in individuals with high blood pressure.^{56, 57} These studies have consistently shown modest blood pressure reductions associated with salt-restricted diets. Similar studies assessing people with high-normal blood pressure (prehypertension) also showed a reduction in blood pressure with reduced salt intake.^{58, 59} A recent observational follow-up study from the Trials of Hypertension Prevention (TOHP) found that a 25% to 35% reduction in dietary salt intake reduced the risk of cardiovascular disease (defined as myocardial infarction, stroke, revascularization, or cardiovascular death) by 25% compared to those with no sodium reduction.⁶⁰ Based on these cumulative findings, TLC recommends limiting sodium intake to less than 2,300 mg per day.⁵

What are the Benefits of Increased Physical Activity and Weight Management?



Because an overweight status and physical inactivity are highly correlated with the metabolic syndrome; weight reduction and increased physical activity using TLC are recommended for those who are overweight or obese and at risk for type 2 diabetes and/or coronary heart disease.³⁻⁵ Lifestyle interventions are effective therapies in promoting weight loss and improving coronary heart disease and diabetes risk factors.^{31, 61-65} Specifically, TLC-like interventions have been shown to promote weight loss while improving coronary heart disease and diabetes risk factors.^{7, 9, 10}

Reduced-Calorie TLC Diet for Weight Loss

Achieving energy balance (calories consumed = calories expended) is key to maintaining a healthy weight. Weight loss occurs when calories expended exceed calories consumed. Optimally, this is achieved by reducing caloric intake while increasing daily physical activity levels.

An important consideration of any reduced-calorie diet plan is whether it provides the appropriate balance of nutrients at the lower calorie levels. For example, a particular diet may provide the proper balance of carbohydrates, protein, fats, and other nutrients at a 2,000 calorie level, but not provide adequate amounts of fat, protein, and/or other nutrients when the daily calories are reduced to 1,200 calories.

Overall, the TLC diet is low in saturated fats, dietary cholesterol, and sodium, while emphasizing adequate levels of monounsaturated and polyunsaturated fats. These nutrient levels remain constant at the reduced calorie levels, making it a high quality/balanced diet for weight reduction.⁶⁶ In addition, along with

providing the recommended amounts and types of dietary fats, a reduced-calorie TLC diet plan also maintains a healthy balance between carbohydrate, protein, and total fat intake.⁶⁶

Increasing Physical Activity

Weight reduction that incorporates increased physical activity has beneficial effects on several metabolic risk factors including insulin resistance, blood pressure, serum triglycerides, LDL, and HDL levels.⁵

⁶⁷⁻⁷⁰ In a recent weight loss study of overweight and obese women with metabolic syndrome, the addition of physical activity to a reduced-calorie diet improved metabolic syndrome risk factors approximately 3.5-fold as compared to diet alone.⁷¹

Thus, because of its positive effects on coronary heart disease, diabetes, and metabolic syndrome risk factors, TLC suggests physical activity levels based on the *2005 Dietary Guidelines for Americans* recommendations:^{5, 32, 72}

- “To reduce the risk of chronic disease in adulthood: Engage in at least 30 minutes of moderate-intensity physical activity, above usual activity, at work or home on most days of the week.
- For most people, greater health benefits can be obtained by engaging in physical activity of more vigorous intensity or longer duration.
- To help manage body weight and prevent gradual, unhealthy body weight gain in adulthood: Engage in approximately 60 minutes of moderate- to vigorous-intensity activity on most days of the week while not exceeding caloric intake requirements.
- To sustain weight loss in adulthood: Participate in at least 60 to 90 minutes of daily moderate-intensity physical activity while not exceeding caloric intake requirements. Some people may need to consult with a healthcare provider before participating in this level of activity.”



Summary

Because of the high prevalence of overweight/obesity and associated chronic disease risk in the United States, it is likely that health care practitioners will be required to treat overweight or obese individuals with multiple chronic disease risk factors. TLC is an effective lifestyle therapy in the treatment of both elevated LDL cholesterol levels and hypertension. Because it also promotes weight loss while improving coronary heart disease risk factors associated with the metabolic syndrome, TLC can also be an important therapeutic strategy in the prevention of type 2 diabetes.

Research to Practice: Suggestions for Incorporating TLC into a Healthy Lifestyle

This research review has detailed how a healthy diet and increased physical activity using a TLC-like approach can help with weight management while decreasing the risk for chronic disease. Even though the primary focus of the TLC “diet plan” is reducing dietary cholesterol and replacing saturated and trans fats with the more heart-healthy fats, the TLC diet

also features a sound eating plan that includes many lower energy density foods including fruits, vegetables, whole grains, lean meats, poultry, seafood, legumes, and low-fat dairy products. Furthermore, TLC helps balance calories consumed with calories expended (energy balance) by combining increased daily physical activity levels with an appropriate calorie level for weight management.⁶⁶

The remaining sections are written specifically for the client/patient. Practitioners can use the following tips to help get their clients started on the road to a healthier lifestyle with TLC. When adopting a TLC-like approach, the client may need to seek the advice of a registered dietitian or other health professional.



Begin with Determining Calorie Needs

When it comes to maintaining your current weight, the key is achieving energy balance—balancing the number of calories you consume with the amount of calories your body requires to support its daily energy needs. In contrast, if you want to lose weight, it means taking in less calories than your body needs on a daily basis (energy deficit). The first step for any healthy eating plan is to determine a daily calorie level based on whether you want to maintain or lose weight.

For weight loss, the National Heart, Lung, and Blood Institute (NHLBI)¹¹ recommends decreasing a person's intake approximately 500–1,000 calories per day, which will result in an approximate 1 to 2 pound weight loss per week and an average 8% weight loss after 6 months.⁴ A simplified approach for determining an appropriate calorie level for weight loss in individuals who are overweight is based on a person's initial body weight (**Table 5**).⁴ The calorie levels shown in **Table 5** will generate a daily energy deficit similar to the 500–1,000 cal/day deficit recommended by the NHLBI.⁴

Table 5. Estimating Daily Calorie Needs for Weight Loss

Starting body weight (pounds)	Suggested calorie levels (calories/day)
150–199	1,200
200–249	1,200–1,500
250–299	1,500–1,800
300–349	1,800–2,000
>350	2,000

Adapted from 2004 ADA, NAASO, and ASCN joint position statement on lifestyle modification in the prevention and management of type 2 diabetes.⁴

Focus on the Healthy Fats

Fats, as long as they come from the right sources can be part of a healthy diet. A balanced diet deriving approximately one-third of its total calories from monounsaturated and polyunsaturated fats has many health benefits. The key is choosing foods that contain these health-supporting fats while limiting those foods that contain the less healthy saturated and trans fats.

A good rule of thumb is to focus on fats that come from plant sources such as vegetable oils, nuts, and seeds and reduce the saturated fats typically found

in animal products. Foods high in saturated fats include fatty meats, whole milk, cheeses, ice cream, and butter. Second, minimize your intake of fried fast foods and food products containing “partially hydrogenated” ingredients. Trans fats are typically found in fried restaurant foods, harder margarines, and foods made with partially hydrogenated vegetable oils.

Following are some tips for reducing your saturated and trans fat intake:

- Switch from whole-milk products to either low-fat or nonfat products.
- Choose foods that have less than 1 gram of saturated fat per serving.
- When preparing your meats and poultry, trim all excess fat and remove skin before eating.
- Try substituting red meat with a fatty fish such as salmon, tuna, and mackerel twice a week—you will decrease your saturated fat consumption while increasing your intake of the heart-healthy omega-3 (polyunsaturated) fatty acids.
- Dietary trans fats can be reduced by limiting your intake of fried restaurant foods (e.g., French fries, breaded chicken nuggets, and breaded fish) and substituting liquid vegetable oils, soft margarine, and trans fat-free margarines for butter, stick margarine, and shortening.
- Another tip for reducing your trans fat intake is to review a food product's ingredient list for “hydrogenated,” “partially hydrogenated vegetable oil,” and “vegetable shortening,” and choose a similar product without these ingredients—especially for those foods you consume more frequently (e.g., microwave popcorn, crackers, biscuits, and muffins).



Fill up on Fruits and Vegetables—Increase Your Fiber Intake While Eating Fewer Calories

One of the many pleasures of a healthy diet is selecting from the wide variety of fresh fruits and vegetables available from your local farmers and supermarkets. Along with adding a spectrum of flavors and texture to your meals, a diet high in fruits and vegetables also provides an array of complex carbohydrates (including soluble and insoluble fiber), vitamins, minerals, and other substances crucial to health. Because fruits and vegetables have a higher water and fiber content, they are low in energy density (calories per gram of food) and thus, they will fill you up while providing fewer calories. Unfortunately, many Americans eat less than their recommended daily servings of fruits and vegetables.⁷³ To find out how many fruits and vegetable servings are right for you, visit <http://www.fruitsandveggiesmatter.gov/>.



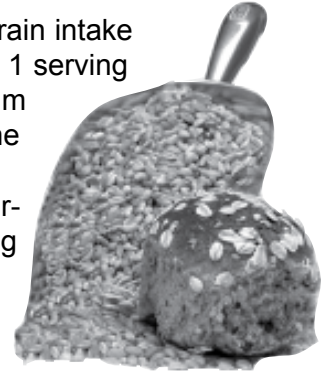
Following are some basic tips for getting plenty of fruits and vegetables into your daily diet:

- Choose dark-green leafy and yellow vegetables daily.
- Eat legumes, peas, and lentils often. Try adding legumes such as chickpeas and pinto beans to your soups and salads.
- Choose citrus fruits or juices, melons, and/or berries daily. Try adding fresh fruit to your next cup of yogurt or bowl of cereal.
- Eat raw vegetables and fruit as between-meal snacks.
- To increase your soluble fiber intake while increasing your fruits and vegetables, eat more fruits and vegetables such as: apples, bananas, berries, citrus fruits, nectarines, peaches, pears, plums, prunes, broccoli, brussels sprouts, carrots, dry beans, peas, and soy products such as tofu and miso.

Be adventurous and try a new fruit or vegetable you haven't eaten before—you'll be surprised just how many new foods there are to try.

Target the Whole Grains to Increase Your Daily Soluble and Insoluble Fiber Intake

The current estimated whole grain intake among U.S. adults is less than 1 serving per day, well below the minimum 3 servings recommended by the 2005 Dietary Guidelines for Americans.³² Examples of fiber-rich foods that contain 1 serving (16 grams) of whole grain include the following



- ½ cup oatmeal cooked (also a good source of soluble fiber)
- 1 slice whole grain bread
- ½ whole grain English muffin
- 2 cups popped popcorn
- 4 whole grain crackers
- 1/3 cup whole wheat pasta cooked
- 1/3 cup brown rice, bulgur, sorghum, or barley cooked (also good source of soluble fiber)

Look for whole grain-containing products that include “whole,” “whole grain,” or “whole wheat” in the first ingredient—bread labeled as “wheat bread” doesn't always mean that it contains “whole” wheat. Be aware that “multi-grain” only means that a food product contains a variety of grains—not that these grains are whole grains.

Increasing the whole grains in your diet does not have to be a “tasteless” process. In fact, whole grain-containing foods can be quite flavorful and easy to prepare.

- Start your day with a whole grain cereal (dry or cooked).
- Next time you fix rice, spend an extra 15 minutes and cook brown rice instead of quick-cooking white rice.
- Try oatmeal topped with blueberries instead of a bagel and cream cheese for your next breakfast.
- When food shopping, select comparable foods containing higher fiber content such as breads and pastas.

Watch Out for Added Salt

On average, Americans consume 1½ to 2 times the maximum recommended 2,300 mg of sodium per day.⁷⁴ Approximately 75% of sodium in the U.S. diet comes from processed foods, with the remaining sources coming from the naturally occurring sodium in food, foods eaten away from home, and salt added

during cooking or at the table.⁷⁵ One teaspoon of salt equals 2,000 mg sodium, close to the maximum recommended daily sodium intake.

A quick and simple way to determine the amount of sodium in a processed food is to use the Nutrition Facts Label located on the food product. Look for foods that are low in sodium that contain less than 140 mg of sodium per serving or 5% of the % Daily Value. For more information on how to better understand and use the Nutrition Facts Label, visit <http://www.cfsan.fda.gov/~dms/foodlab.html>.

Because your taste for salt is a developed taste, you can “re-sensitize” your taste buds such that your taste for salt will decline.⁶⁶ This is not something that will happen overnight, but in time you will start to enjoy the natural flavor of food without the excess salt. Herbs and spices are typically sodium-free and are an excellent substitute for seasoning foods. Following are some tips for reducing sodium intake:



- Taste your food before picking up the saltshaker—taste before you shake.
- Avoid adding salt to homemade dishes.
- Choose fresh, frozen, or canned foods without added salts.
- If you use canned foods such as beans or vegetables, rinse before using.
- Choose low-sodium or sodium-free broths or soups.
- When dining out, request preparation of your dish without salt.
- Keep plenty of herbs and spices on hand to flavor your dishes.
- Choose the low-sodium version of processed foods such as sauces, condiments, salad dressings, lunch meats, and TV dinners.

Pick up the Pace

Based on Behavioral Risk Factor Surveillance System (BRFSS) data from 2003, the majority (54.1%) of U.S. adults are not meeting the minimum recommendation of 30 minutes moderate-intensity exercise most days of the week.⁷⁶ As with making positive changes in the diet, increasing your physical activity level has many far-reaching health

advantages. Daily physical activity not only helps you reach and maintain your desired body weight, but will also reduce the risk for chronic disease and enhance your psychological, cognitive, and emotional well-being.¹¹

The *2005 Dietary Guidelines for Americans* recommends a minimum of 30 minutes of moderate-intensity physical activity most days of the week to reduce chronic disease risk.³² For most individuals, greater health benefits are achieved by engaging in more vigorous activities or by performing a moderate-level activity for a longer duration. For example, if your goal is to maintain your current weight, it is recommended to increase your moderate-intensity activity levels to 60 minutes per day. Finally, if you are trying to sustain a recent weight loss, you may need to increase this value to 90 minutes of daily moderate-intensity physical activity.³² You may need to consult with your healthcare provider before increasing your physical activity levels activity.

The question for many of us is—What exactly is a “moderate” or “vigorous” intensity activity? To help address this question, **Table 6** lists activities based on their intensity levels.

Table 6. Estimated Calories/Hour Expended in Common Physical Activities	
Moderate Physical Activity	Approximate Calories/Hr for a 154 lb Person*
Hiking	370
Light gardening/yard work	330
Dancing	330
Golf (walking and carrying clubs)	330
Bicycling (<10 mph)	290
Walking (3.5 mph)	280
Weight lifting (general light workout)	220
Stretching	180
Vigorous Physical Activity	Approximate Calories/Hr for a 154 lb Person*
Running/jogging (5 mph)	590
Bicycling (>10 mph)	590
Swimming (slow freestyle laps)	510
Aerobics	480
Walking (4.5 mph)	460
Heavy yard work (chopping wood)	440
Weight lifting (vigorous effort)	440
Basketball (vigorous)	440
*Calories burned per hour will be higher for persons who weigh more than 154 lbs (70 kg) and lower for persons who weigh less. Source: Adapted from the 2005 Dietary Guidelines for Americans. ³²	

If you have not already, begin some type of physical activity today—it is never too late to start.

Following are some tips for increasing your daily physical activity:

- Walking is a great place to start—if you have been fairly inactive and want to start increasing your physical activity, start slowly and build to 30 minutes of brisk walking most days of the week.
- Find one or two physical activity partners. Sharing an activity is not only fun, it may also get you out on those days when you are making excuses not to increase your physical activity.
- Increasing your daily physical activity levels to at least 30 minutes per day does not mean that you have to do an activity all at once. You can gain the same benefits by breaking your physical activity up into 10-minute or 15-minute intervals.

In conclusion, by focusing on achieving your energy balance (or energy deficit for weight loss), eating the healthy fats, consuming more fruits and vegetables, choosing whole grain-containing foods, decreasing your salt intake, and increasing your daily physical activity, you will be well on the way to adopting a healthy lifestyle and reducing your risk for chronic disease.



References:

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the united states, 1999-2004. *JAMA*. 2006;295(13):1549-1555.
2. Pi-Sunyer FX. Medical hazards of obesity. *Ann Intern Med*. 1993;119(7_Part_2):655-660.
3. Buse JB, Ginsberg HN, Bakris GL, Clark NG, Costa F, Eckel R, et al. Primary prevention of cardiovascular diseases in people with diabetes mellitus: A scientific statement from the American Heart Association and the American Diabetes Association. *Circulation*. 2007;115(1):114-126.
4. Klein S, Sheard NF, Pi-Sunyer X, Daly A, Wylie-Rosett J, Kulkarni K, et al. Weight management through lifestyle modification for the prevention and management of type 2 diabetes: Rationale and strategies: A statement of the American Diabetes Association, the North American Association for the Study of Obesity, and the American Society for Clinical Nutrition. *Diabetes Care*. 2004;27(8):2067-2073.
5. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Final report. *Circulation*. 2002;106(25):3143-3421.
6. Appel LJ, Sacks FM, Carey VJ, Obarzanek E, Swain JF, Miller ER, III, et al. Effects of protein, monounsaturated fat, and carbohydrate intake on blood pressure and serum lipids: Results of the Omniheart Randomized Trial. *JAMA*. 2005;294(19):2455-2464.
7. Graffagnino CL, Falko JM, La Londe M, Schaumburg J, Hyek MF, Shaffer LET, et al. Effect of a community-based weight management program on weight loss and cardiovascular disease risk factors. *Obesity*. 2006;14(2):280-288.
8. Jenkins DJA, Kendall CWC, Faulkner DA, Nguyen T, Kemp T, Marchie A, et al. Assessment of the longer-term effects of a dietary portfolio of cholesterol-lowering foods in hypercholesterolemia. *Am J Clin Nutr*. 2006;83(3):582-591.
9. Nowson CA, Worsley A, Margerison C, Jorna MK, Godfrey SJ, Booth A. Blood pressure change with weight loss is affected by diet type in men. *Am J Clin Nutr*. 2005;81(5):983-989.
10. Wister AP, Loewen NMD, Kennedy-Symonds HM, McGowan BMD, McCoy BMA, Singer JP. One-year follow-up of a therapeutic lifestyle intervention targeting cardiovascular disease risk. *CMAJ*. 2007;177(8):859-865.
11. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. *Obesity Research*. 1998;6(suppl 2):51S-209S.
12. Wilson PWF, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: The Framingham Experience. *Arch Intern Med*. 2002;162(16):1867-1872.
13. Wannamethee SG, Shaper AG, Walker M. Overweight and obesity and weight change in middle aged men: Impact on cardiovascular disease and diabetes. *J Epidemiol Community Health*. 2005;59(2):134-139.
14. Brown CD, Higgins M, Donato KA, Rohde FC, Garrison R, Obarzanek E, et al. Body mass index and the prevalence of hypertension and dyslipidemia. *Obesity Res*. 2000;8(9):605-619.
15. National Task Force on the Prevention and Treatment of Obesity. Overweight, obesity, and health risk. *Arch Intern Med*. 2000;160(7):898-904.
16. Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz WH, et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Intern Med*. 2001;161(13):1581-1586.

17. American Heart Association. *Heart disease and stroke statistics—2006 update*. Dallas, Texas: American Heart Association; 2006.
18. Selby JV, Tiffany P, Karter AJ, Alexander M, Sidney S, Lian J, et al. High rates of co-occurrence of hypertension, elevated low-density lipoprotein cholesterol, and diabetes mellitus in a large managed care population. *The American Journal of Managed Care*. 2004;10(pt 2):163–170.
19. Lorenzo C, Okoloise M, Williams K, Stern MP, Haffner SM. The metabolic syndrome as predictor of type 2 diabetes: The San Antonio Heart Study. *Diabetes Care*. 2003;26(11):3153–3159.
20. Maisson P, Byrne CD, Hales CN, Day NE, Wareham NJ. Do different dimensions of the metabolic syndrome change together over time?: Evidence supporting obesity as the central feature. *Diabetes Care*. 2001;24(10):1758–1763.
21. Wilson PWF, Kannel WB, Silbershatz H, D'Agostino RB. Clustering of metabolic factors and coronary heart disease. *Arch Intern Med*. 1999;159(10):1104–1109.
22. Jacobson TA, Case CC, Roberts S, Buckley A, Murtaugh KM, Sung JC, et al. Characteristics of US adults with the metabolic syndrome and therapeutic implications. *Diabetes Obes Metab*. 2004;6(5):353–362.
23. Alexander CM, Landsman PB, Teutsch SM, Haffner SM. NCEP-defined metabolic syndrome, diabetes, and prevalence of coronary heart disease among NHANES III participants age 50 years and older. *Diabetes*. 2003;52(5):1210–1214.
24. Anderson JW, Konz EC. Obesity and disease management: Effects of weight loss on comorbid conditions. *Obesity Res*. 2001;9(Supplement 4):326S–334.
25. Dattilo AM, Kris-Etherton PM. Effects of weight reduction on blood lipids and lipoproteins: a meta-analysis. *Am J Clin Nutr*. 1992;56(2):320–328.
26. Metz JA, Stern JS, Kris-Etherton P, Reusser ME, Morris CD, Hatton DC, et al. A randomized trial of improved weight loss with a prepared meal plan in overweight and obese patients: Impact on cardiovascular risk reduction. *Arch Intern Med*. 2000;160(14):2150–2158.
27. Stevens VJ, Obarzanek E, Cook NR, Lee IM, Appel LJ, West DS, et al. Long-term weight loss and changes in blood pressure: Results of the trials of hypertension. *Annals of Internal Medicine*. 2001;134(1):1–11.
28. Hamman RF, Wing RR, Edelstein SL, Lachin JM, Bray GA, Delahanty L, et al. Effect of weight loss with lifestyle intervention on risk of diabetes. *Diabetes Care*. 2006;29(9):2102–2107.
29. Moore LL, Vioni AJ, Qureshi MM, Bradlee ML, Ellison RC, D'Agostino R. Weight loss in overweight adults and the long-term risk of hypertension: The Framingham Study. *Arch Intern Med*. 2005;165(11):1298–1303.
30. Case CC, Jones PH, Nelson K, O'Brian Smith E, Ballantyne CM. Impact of weight loss on the metabolic syndrome. *Diabetes, Obesity and Metabolism*. 2002;4(6):407–414.
31. Villareal DT, Miller BV, III, Banks M, Fontana L, Sinacore DR, Klein S. Effect of lifestyle intervention on metabolic coronary heart disease risk factors in obese older adults. *Am J Clin Nutr*. 2006;84(6):1317–1323.
32. US Department of Health and Human Services and US Department of Agriculture. *Dietary Guidelines for Americans*, 2005. Available at <http://www.healthierus.gov/dietaryguidelines/>. (Accessed March 11, 2008.)
33. Trends in intake of energy and macronutrients—United States, 1971–2000. *MMWR*. Centers for Disease Control and Prevention. 2004;53(04):80–82.
34. U.S. Department of Agriculture, Agricultural Research Service. Continuing Survey of Food Intakes of Individuals (CFSII) 1994–1996. Available at <http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/Fatty96.PDF>. (Accessed March 11, 2008.)
35. Food and Drug Administration. Trans fatty acids in nutrition labeling, nutrient content claims, and health claims. *Federal Register*. 2003;68(133):41433–41506.
36. Mozaffarian D, Katan MB, Ascherio A, Stampfer MJ, Willett WC. Trans fatty acids and cardiovascular disease. *N Engl J Med*. 2006;354(15):1601–1613.
37. Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006;114(1):82–96.
38. Stampfer MJ, Sacks FM, Salvini S, Willett WC, Hennekens CH. A prospective study of cholesterol, apolipoproteins, and the risk of myocardial infarction. *N Engl J Med*. 1991;325(6):373–381.
39. Willett WC. The Mediterranean diet: science and practice. *Public Health Nutrition*. 2006;9:105–110.
40. Natarajan S, Glick H, Criqui M, Horowitz D, Lipsitz SR, Kinorian B. Cholesterol measures to identify and treat individuals at risk for coronary heart disease. *American Journal of Preventive Medicine*. 2003;25(1):50–57.
41. Lichtenstein AH, Ausman LM, Jalbert SM, Schaefer EJ. Effects of different forms of dietary hydrogenated fats on serum lipoprotein cholesterol levels. *N Engl J Med*. 1999;340(25):1933–1940.
42. Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. *JAMA*. 2002;288(20):2569–2578.
43. Sacks FM, Katan M. Randomized clinical trials on the effects of dietary fat and carbohydrate on plasma lipoproteins and cardiovascular disease. *The American Journal of Medicine*. 2002;113(9, Supplement 2):13–24.
44. Oh K, Hu FB, Manson JE, Stampfer MJ, Willett WC. Dietary fat intake and risk of coronary heart disease in women: 20 years of follow-up of the Nurses' Health Study. *Am. J. Epidemiol*. 2005;161(7):672–679.
45. Hu FB, Stampfer MJ, Manson JE, Rimm E, Colditz GA, Rosner BA, et al. Dietary fat intake and the risk of coronary heart disease in women. *N Engl J Med*. 1997;337(21):1491–1499.
46. McNamara DJ. The impact of egg limitations on coronary heart disease risk: Do the numbers add up? *J Am Coll Nutr*. 2000;19(5 Suppl):540S–548S.
47. Hu FB, Stampfer MJ, Rimm EB, Manson JE, Ascherio A, Colditz GA, et al. A prospective study of egg consumption and risk of cardiovascular disease in men and women. *JAMA*. 1999;281(15):1387–1394.
48. Weggemans RM, Zock PL, Katan MB. Dietary cholesterol from eggs increases the ratio of total cholesterol to high-density lipoprotein cholesterol in humans: a meta-analysis. *Am J Clin Nutr*. 2001;73(5):885–891.
49. Grundy SM. Stanol esters as a component of maximal dietary therapy in the National Cholesterol Education Program Adult Treatment Panel III Report. *The American Journal of Cardiology*. 2005;96(1, Supplement 1):47–50.
50. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. *Am J Clin Nutr*. 1999;69(1):30–42.
51. Kris-Etherton PM, Harris WS, Appel LJ, Nutrition Committee. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation*. 2002;106(21):2747–2757.
52. Wang C, Harris WS, Chung M, Lichtenstein AH, Balk EM, Kupelnick B, et al. N-3 fatty acids from fish or fish-oil supplements, but not {alpha}-linolenic acid, benefit cardiovascular disease outcomes in primary- and secondary-prevention studies: A systematic review. *Am J Clin Nutr*. 2006;84(1):5–17.
53. Psota TL, Gebauer SK, Kris-Etherton P. Dietary omega-3 fatty acid intake and cardiovascular risk. *Am J Cardiol*. 2006;98(4A):3i–18i.

54. Hajjar I, Kotchen JM, Kotchen TA. Hypertension: trends in prevalence, incidence, and control. *Annual Review of Public Health*. 2006;27(1):465–490.
55. Khaw K-T, Bingham S, Welch A, Luben R, O'Brien E, Wareham N, et al. Blood pressure and urinary sodium in men and women: The Norfolk Cohort of the European Prospective Investigation into Cancer (EPIC-Norfolk). *Am J Clin Nutr*. 2004;80(5):1397–1403.
56. Geleijnse JM, Kok FJ, Grobbee DE. Blood pressure response to changes in sodium and potassium intake: A metaregression analysis of randomised trials. *J Hum Hypertens*. 2003;17(7):471–480.
57. He FJ, Markandu ND, MacGregor GA. Modest salt reduction lowers blood pressure in isolated systolic hypertension and combined hypertension. *Hypertension*. 2005;46(1):66–70.
58. The effects of nonpharmacologic interventions on blood pressure of persons with high normal levels. Results of the Trials of Hypertension Prevention, Phase I *JAMA*. 1992;267(9):1213–1220.
59. Effects of weight loss and sodium reduction intervention on blood pressure and hypertension incidence in overweight people with high-normal blood pressure. The Trials of Hypertension Prevention, Phase II. The Trials of Hypertension Prevention Collaborative Research Group. *Arch Intern Med*. 1997;157(6):657–667.
60. Cook NR, Cutler JA, Obarzanek E, Buring JE, Rexrode KM, Kumanyika SK, et al. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: Observational follow-up of the Trials of Hypertension Prevention (TOHP). *BMJ*. 2007;334(7599):885.
61. Expert Panel on Detection Evaluation, and Treatment of High Blood Pressure in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA*. 2001;285(19):2486–2497.
62. Lindstrom J, Ilanne-Parikka P, Peltonen M, Aunola S, Eriksson JG, Hemio K, et al. Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention: Follow-up of the Finnish Diabetes Prevention Study. *Lancet*. 2006;368(9548):1673–1679.
63. Nicklas BJ, Dennis KE, Berman DM, Sorkin J, Ryan AS, Goldberg AP. Lifestyle intervention of hypocaloric dieting and walking reduces abdominal obesity and improves coronary heart disease risk factors in obese, postmenopausal, African-American and Caucasian women. *J Gerontol A Biol Sci Med Sci*. 2003;58(2):M181–189.
64. Orchard TJ, Temprosa M, Goldberg R, Haffner S, Ratner R, Marcovina S, et al. The effect of metformin and intensive lifestyle intervention on the metabolic syndrome: The Diabetes Prevention Program Randomized Trial. *Ann Intern Med*. 2005;142(8):611–619.
65. Wadden TA, Berkowitz RI, Womble LG, Sarwer DB, Phelan S, Cato RK, et al. Randomized trial of lifestyle modification and pharmacotherapy for obesity. *N Engl J Med*. 2005;353(20):2111–2120.
66. National institutes of health. *Your Guide to Lowering Cholesterol with Therapeutic Lifestyle Changes (TLC)*. Available at <http://email.nhlbi.nih.gov/product2.asp?source=&sku=06-5235>. (Accessed March 11, 2008.)
67. Durstine JL, Grandjean PW, Davis PG, Ferguson MA, Alderson NL, DuBose KD. Blood lipid and lipoprotein adaptations to exercise: a quantitative analysis. *Sports Med*. 2001;31(15):1033–1062.
68. Houmard JA, Tanner CJ, Slentz CA, Duscha BD, McCartney JS, Kraus WE. Effect of the volume and intensity of exercise training on insulin sensitivity. *J Appl Physiol*. 2004;96(1):101–106.
69. Leon AS, Sanchez OA. Response of blood lipids to exercise training alone or combined with dietary intervention. *Med Sci Sports Exerc*. 2001;33(6 Suppl):S502–515; discussion S528–509.
70. Ross R, Janssen I, Dawson J, Kungl A-M, Kuk JL, Wong SL, et al. Exercise-induced reduction in obesity and insulin resistance in women: a randomized controlled trial. *Obesity Res*. 2004;12(5):789–798.
71. Okura T, Nakata Y, Ohkawara K, Numao S, Katayama Y, Matsuo T, et al. Effects of aerobic exercise on metabolic syndrome improvement in response to weight reduction. *Obesity*. 2007;15(10):2478–2484.
72. *Physical Activity and Health: A report of the Surgeon General* Atlanta: US Department of Health and Human Services; Centers for Disease Control and Prevention. 1996.
73. Fruit and vegetable consumption among adults—United States, 2005. *MMWR*. Centers for Disease Control and Prevention. 2007;56(10):213–217.
74. Zhou BF, Stamler J, Dennis B, Moag-Stahlberg A, Okuda N, Robertson C, et al. Nutrient intakes of middle-aged men and women in China, Japan, United Kingdom, and United States in the late 1990s: The Intermap Study. *J Hum Hypertens*. 2003;17(9):623–630.
75. Mattes RD, Donnelly D. Relative contributions of dietary sodium sources. *J Am Coll Nutr*. 1991;10(4):383–393.
76. Adult participation in recommended levels of physical activity—United States, 2001 and 2003. *MMWR*. Centers for Disease Control and Prevention. 2005;54(47):1208–1212.

