James L. Holly, M.D.

Effects of Exercise and Diet on Chronic Disease Part II
Coronary Artery Disease (CAD)
By James L. Holly, MD
Your Life Your Health
The Examiner
July 27, 2006

Atherosclerotic disease (ASCVD) is the leading cause of death in developed countries, with coronary artery disease (CAD) being the number one killer of both men and women. In fact, every year since 1919, cardiovascular diseases have ranked as the number one killer in the United States. In 2001, cardiovascular diseases accounted for approximately 39% of all deaths (931,108 deaths). Despite estimates that death rates from cardiovascular diseases declined 17% from 1990 to 2000, secondary to improvements in disease diagnostics, surgical procedures, and drug therapy, the number of deaths increased 2.5% during this period.

The association between lifestyle, diet, and CAD has been investigated since the early 1900s. In the latter half of the 20th century, with feeding studies demonstrating that saturated fat and dietary cholesterol increased serum cholesterol, dietary fat emerged as a determinant of serum cholesterol. Studies established a link between dietary saturated fat, dietary cholesterol, serum cholesterol, and CAD mortality.

The average population intake of saturated fat, and changes in average serum cholesterol levels were strongly related to CAD death [rates]. The Framingham Heart Study emphasized the relationship between serum cholesterol, especially LDL-cholesterol (LDL-C), and CAD. It is now well established that LDL-C levels are increased by saturated fatty acids (red meat and animal fat other than fish) and by trans-fatty acids (abnormal fats created by the processing of foods to increase their shelf life).

The type of carbohydrate also affects CAD risk. Refined carbohydrates are highly processed, resulting in removal of fiber, vitamins, minerals, phytonutrients, and essential fatty acids. In the process of refinement, 21 nutrients are removed from the wheat kernel. Typical seven to eleven nutrients are added back and the breas is called, “enriched bread)

Consumption of refined carbohydrates – such as white bread, white rice, refined sugar, etc. -- compared with whole grains increases the risk of CAD, resulting, in part, from the increased glycemic load of these types of carbohydrates. (for more information on glycemic load, see Your Life Your Health at www.setma.com).

As fiber consumption goes up, CAD goes down, as does death from all causes. High-fiber foods lower LDL-C levels and improve insulin sensitivity (for more information on

insulin sensitivity and insulin resistance, see Your Life Your Health at www.setma.com). The large Women's Health Study showed an inverse relation between dietary fiber intake and the risk of CAD events. This may be attributed in part to increased consumption of fruits and vegetables, which have been documented in numerous studies to decrease CAD risk.

Additionally, moderate consumption of protein is associated with a reduced risk of CAD, whereas substitution of red meat with poultry and fish also decreases risk. As a consequence of this research, diet has gone to the forefront as a regulator of CAD progression.

Physical activity also plays a critical role in the pathogenesis of CAD. The Adult Treatment Panel III summary concluded that physical inactivity is a major risk factor for CAD. Total physical activity and vigorous activities associate inversely and strongly with CAD risk. There is an inverse association between cardiorespiratory fitness and both all-cause and CAD mortality in over 13,000 individuals. The relative risk of CAD has been estimated to be about twofold higher for inactive subjects compared with physically active persons.

In the Women's Health Initiative Observational Study and the Nurses' Health Study, 30–40% of CAD was prevented by simply walking briskly more than 2.5 h/wk, compared with less than this amount of physical activity. Additionally, in the Harvard alumni study, mortality risk, primarily from cardiovascular diseases, varied inversely with calories expended. In a study of 4,276 men, the relative risk of death from CAD was about threefold higher for unfit individuals independent of conventional coronary risk factors, and several additional studies have documented that physical activity is comparable to conventional risk factors in the ability to predict risk.

Several studies have assessed the combined effects of a healthy lifestyle on CAD. In the Nurses' Health Study cohort, in which 84,129 women aged 30–55 yr were enrolled and followed up for 14 yr, a healthy lifestyle was defined as:

- not smoking,
- consuming at least half a drink of alcoholic beverage per day,
- engaging in moderate to vigorous physical activity for >30 min/day, and
- a BMI <25 kg/m^2.

A healthy diet included components such as:

- cereal fiber,
- marine n-3 fatty acids,
- folate,
- low trans-fatty acids, and
- low glycemic load.

Adherence to these factors correlated inversely with 14-year CAD incidence. In one study, 82% of CAD events could be prevented by a combination of physical activity and diet, providing additional evidence for a combined effect. When comparing dietary intake, consumption of vegetables, fruit, legumes, whole grains, fish, and poultry was associated with a decreased risk of CAD, whereas typical Westernized diet patterns high in red and processed meats, refined grains, sweets/desserts, and high-fat dairy products was associated with increased risk independent of other lifestyle factors.

Despite the abundance of evidence that lifestyle modification can mitigate the burden of cardiovascular diseases, they are still the major cause of death in developing nations. Several clinical trials and intervention studies have been conducted, unequivocally documenting the benefits of regular physical activity and diet for CAD risk reduction, mediated by changes in:

- plasma lipids,
- blood pressure,
- inflammation,
- insulin sensitivity,
- coronary blood flow,
- endothelial function, and
- oxidative stress,
- among others.

One intervention that has been studied extensively is the Pritikin residential lifestyle intervention, designed to achieve changes in lifestyle that are very extensive in each subject. Participants undergo a complete medical history and physical examination, before a 26-day (more recently 21-day or 11-day) physical activity and diet intervention.

Meals are served buffet style, and all participants are allowed unrestricted eating except for the meals when 3 oz. of fish or fowl are provided. Prepared meals contain:

- 10–15% of calories from fat,
- 15–20% of calories from protein, and
- 65–75% of calories from carbohydrates, primarily unrefined, according to analysis by computer dietary analysis software.

Carbohydrates are in the form of high-fiber whole grains (≥5 servings/day), vegetables (≥ 4 servings/day), and fruits (≥3 servings/day). Protein is primarily derived from plant sources with small amounts of nonfat dairy (up to 2 servings/day) and fish or chicken. The diet contains <100 mg of cholesterol, and alcohol, tobacco, and caffeinated beverages are not served during the program.

The exercise regimen consists of daily treadmill walking at the training heart rate for 45–60 min. The training heart rate is defined as 70–85% of the maximal heart rate attained during the treadmill test. Additionally, the subjects perform flexibility and resistance exercise.

Early studies documented that this combined physical activity and diet intervention decreased all serum lipids and angina in patients, the majority of whom had a prior myocardial infarction and/or multiple vessel disease and all of whom had been recommended for bypass surgery. The majority were taken off cardiac and/or blood pressure-lowering drug therapy. The durability of the changes were evidenced by a 5-yr follow-up, which documented that adherence to the program resulted in maintenance of the changes and dramatically reduced the need for bypass surgery.

The 4,587 men and women who completed the 26-day physical activity and diet intervention from 1977 to 1988 revealed an average Total-C reduction of 23%, from 234 to 180 mg/dl. LDL-C decreased by 23%, from 151 to 116 mg/dl, with male subjects exhibiting a greater reduction in Total-C (24 vs. 21%) and LDL-C (25 vs. 19%) compared with female subjects. HDL-C was reduced by 16%, but the ratio of Total-C to HDL-C was reduced by 11%. Serum TG decreased 33%, from 200 to 135 mg/dl, with male subjects showing a greater reduction than female subjects (38% vs. 23%).

Physical activity and/or dietary intervention can also reduce the risk for CAD by other mechanisms. Attention has recently focused on the involvement of inflammation in CAD, with multiple studies suggesting that elevated C-reactive protein (CRP) is a sensitive predictor of myocardial infarction, stroke, peripheral arterial disease, and sudden cardiac death. When considered in conjunction with plasma Total-Cholesterol, CRP:

- serves as a better predictor of CAD risk than Total-Cholesterol alone,
- may be a stronger predictor of cardiovascular events than LDL-C, and
- adds prognostic information at all levels of the metabolic syndrome.

These data suggest that blood clotting in arteries, in addition to being a disease of lipid accumulation, also represents a chronic inflammatory process. In postmenopausal women on hormone replacement therapy with risk factors for CAD, the Pritikin combined physical activity and diet intervention significantly decreased three markers of inflammation:

- CRP by 45%,
- serum amyloid A by 37%, and
- soluble ICAM-1

The mechanisms for the benefits of physical activity in reducing CAD risk are numerous and include effects on:

- plasma lipids
- endothelial function
- insulin sensitivity
- inflammation
- blood pressure.

The benefits of physical activity and diet modification may be accrued independent of significant weight loss. Just as risk factors for heart disease can be affected by changes in lifestyle independent of changes in body weight, the actual disease itself can be as well. Men who improve their diets showed no new fatty deposits in their coronary vessels, determined by coronary angiography. However, men who failed to make significant dietary changes all showed evidence of new lesions. Neither group lost any weight during a 2-yr study, suggesting that the appearance of new lesions can be influenced without weight change.

Summary

Physical inactivity and dietary factors both contribute vitally to atherosclerosis and consequent CAD. Studies indicate that inactivity may be as predictive of CAD risk as conventional risk factors, exercise training may improve endothelial function and is superior to percutaneous angioplasty for short-term survival. Additionally, several dietary factors such as fiber, fat (amount and type), glycemic load, and fruit and vegetable consumption appear to significantly modulate CAD risk. Combined exercise and diet interventions mitigate atherosclerosis progression and may in fact induce plaque regression and/or improve myocardial flow reserve. These benefits are, at least in part, due to reductions in plasma lipids, lipid oxidation, and inflammation. Improvements in risk factors with diet may, in some instances, be as great as with statin therapy, and lifestyle interventions combined with statin therapy possess additive effects on lipid lowering. Moreover, although obesity contributes to CAD, risk can be modified independent of large changes in weight.

Remember, it is your life and it is your health.