Table 5: Health and Wellness Program Data.[60]

Area	Objective	Measures/Data	Collection Method	Data Sources	Area
Reaction & Satisfaction	• Accessibility • Effectiveness • Appropriate Delivery	• Perception • Willingness to Participate • Attitude towards programs	• Questionnaire/ Survey	• Participants	• End of session • End of program
Learning	• Comprehension • Retention	• Self-test scores • Session completion	• Quizzes	• Participants	• During session • End of session
Application & Implementation (behavioral change impact)	• Completion of programs • Review of program reports • Postprogram participation	• Goal setting and achievment • Program adherance	• Followup questionnaire • Observation of completed assignments	• Participants • Coordinators	• End of session • End of program • 6 months postprogram
Application & Implementation (behavioral change impact)	• Volunteers regularly working out • Increased endurance • Postprogram participation	• Goal setting and achievment • Program adherance	• Fitness screenings • Followup questionnaire • Observations	• Participants • Coordinators	• End of session • End of program • 6 months postprogram
Financial Impact	• Decreased claims • Decreased absences • Decreased disability	• Health care premiums • Total Hours (medical leave)	• Firefighter observation & attendance • Overtime costs	• Administration • Shift Leaders • Chiefs/Asst. Chiefs	• Monthly • Quarterly

Adapted from: The Human Resources Scorecard.

EVALUATING PROGRAM EFFECTIVENESS

This section has been adapted from the USFA's *Fire and Emergency Services Ergonomics - A Guide for Understanding and Implementing an Ergonomics Program in Your Department*, Chapter 10, "Evaluating Program Effectiveness."[61]

In many industries, management frequently assesses the success or failure of a program through economic measures:

- Increased net production (efficiency due to lower number of quality control rejects).
- Reduced incidence of days lost.
- Reduced medical insurance cost.
- Reduced worker's compensation cost.
- Increased esprit de corps.

As can be seen, all but the first of the items on the above list apply to firefighting and EMS. A successful program anywhere must show a measurable reduction in injuries, severity of injuries, and work time loss after the program is put into place.

Measuring the effectiveness of health and wellness programs in the fire service may require the development of new criteria. In the long term, the effectiveness of a health and wellness program may be measured mostly at the local level, regardless of the size of the department, by the criteria below.

Health Statistics

- reduced injury rate;
- reduced injury severity;
- reduced overhead costs;
- reduced medical/workers' compensation costs; and
- reduced time loss.

Program Statistics

- increasing participation by membership in all aspects of program;
- number of injuries or illnesses identified by screenings; and
- hours logged by membership in physical fitness.

General

- better fitness equipment developed/purchased;
- improved eating practices;
- regular health screenings and examinations; and
- regular educational events.

With the data collected and analyzed on a regular basis, department coordinators and leadership can make smart choices about the direction, funding level, and impact of the program. Every program is a work in progress, and a health and wellness program will be no different. The key to maintaining a robust health and wellness program is adapting to the needs of the volunteers who participate. Analysis of collected data and information is the key to the success of any program.

Appendix A:
Health and Wellness Resources

(All contacts listed alphabetically)

Program Development Contacts

American College of Sports Medicine
Phone: 317-637-9200
Email: publicinfo@acsm.org
www.acsm.org

IAFF/IAFC Fire Service Joint Labor Management Wellness-Fitness Initiative
http://www.iaff.org/hs/Well/wellness.html

IAFC Wellness Initiative
Vicki Lee, Program Manager, IAFC
Phone: 571-221-2813
Email: vlee@iafc.org

National Fire Protection Association
Phone: 617-770-3000
www.nfpa.org

National Volunteer Fire Council
Phone: 888-ASK-NVFC (275-6832)
Email: nvfcoffice@nvfc.org

FEMA Assistance to Firefighters Grant Program
Phone: 866-274-0960
Email: usfagrants@fema.gov

USFA Firefighter Fitness and Wellness Program
www.usfa.fema.gov/fire-service/health/health.shtm

Fire Department Contacts

Austin Fire Department
1621 Festival Beach Road
Austin, Texas 78702
Phone: 512-974-0200
www.ci.austin.tx.us/fire
(*Career*)

Bernalillo County Fire and Rescue
6840 2nd Street N.W.
Albuquerque, New Mexico 87107
Phone: 505-761-4225
www.bernco.gov/live/departments.asp?dept=2332
(*Combination*)

Brodhead Fire Department
1100 West 3rd Avenue
Brodhead, Wisconsin 53520
Phone: 608-897-2112
www.cityofbrodheadwi.us/Home.cfm?DepartmentID=2
(*Volunteer*)

Caldwell Fire and Rescue
310 South 7th Avenue
Caldwell, Idaho 83605
Phone: 208-455-3032
www.city.cityofcaldwell.com/index.v3page?p=32337
(*Volunteer*)

Calgary Fire Department
4124 11th Street, SE
Calgary, Alberta, Canada T2G 3H2
Phone: 403-287-4299
http://content.calgary.ca/CCA/City+Hall/Business+Units/Calgary+Fire+Department/index.htm
(*Career*)

Charlotte Fire Department
600 E. 4th Street
Charlotte, North Carolina 28202
Phone: 704-432-1654
www.charmeck.org/Departments/Fire/home.htm
(*Career*)

Chesterfield Fire and EMS
P.O. Box 40
Chesterfield, Virginia 23832-0040
Phone: 804-748-1360
www.co.chesterfield.va.us/PublicSafety/Fire/default.asp
(*Volunteer*)

Fairfax County Fire and Rescue Department
4100 Chain Bridge Road
Fairfax, Virginia 22030
Phone: 703-246-3970
www.fairfaxcounty.gov/fr/
(*Combination*)

Gates Fire District
2355 Chili Avenue
Gates, New York 14624
Phone: 585-426-2720
http://www.gatesfd.org/
(*Volunteer*)

Hartford Emergency Services
812 VA Cutoff Road
White River Jct., Vermont 05001
Phone: 802-295-3232
www.hartford.gov/EmergencyServices/default.htm
(Combination)

Los Angeles County Fire Department
464 W. 8th Street
Claremont, California 91711
Phone: 323-881-2371
www.fire.lacounty.gov/
(*Career*)

Miami-Dade County Fire and Rescue
9300 N.W. 41st Street
Miami, Florida 33178
Phone: 786-331-4278
www.miamidade.gov/MDFR/
(Combination)

New York City Fire Academy
Randall's Island
New York, New York 10035
Phone: 718-784-6510
www.nyc.gov/html/fdny/html/units/fire_academy/fa_index.shtml
(*Career*)

Phoenix Fire Department
10102 North 173rd Avenue
Waddell, Arizona 85355
Phone: 602-262-6297
http://phoenix.gov/FIRE/
(*Career*)

Seattle Fire Department
301 2nd Avenue, South
Seattle, Washington 98104
Phone: 206-386-1450
www.seattle.gov/fire/
(*Career*)

National Resources

DIET

American Dietetic Association
1-800-877-0877
www.eatright.org

Center for Nutrition Policy and Promotion
703-305-7600
www.cnpp.usda.gov

DISABILITIES/INJURIES

American Paralysis Association
1-800-225-0292
www.christopherreeve.org

American Medical Rehab Providers
1-800-368-3513
www.amrpa.org

American Speech-Language Hearing Association
1-800-638-8255
www.asha.org

Brain Injury Association
1-800-444-6443
www.biausa.org

National Easter Seal Society
1-800-221-6827
www.easterseals.com

DISEASE

Alcohol and Drug Hotline
1-800-821-4357
www.highlandridgehospital.com

American Cancer Society Response Line
1-800-227-2345
www.cancer.org

American Diabetes Association
1-800-232-3472
www.diabetes.org

American Liver Foundation Hepatitis Hotline
1-800-223-0179
www.liverfoundation.org

Arthritis Foundation Information Line
1-800-283-7800
www.arthritis.org

Asthma and Allergy Foundation of America
1-800-727-8462
www.aafa.org

CDC National AIDS Hotline
1-800-342-2437
www.cdc.gov/hiv

CDC National STD Hotline
1-800-227-8922
www.cdc.gov/STD

National Foundation for Depressive Illness
1-800-248-4344
www.depression.org

National Parkinson Foundation, Inc.
1-800-327-4545
www.parkinson.org

FITNESS

Aerobics and Fitness Association of America
1-800-233-4886
www.afaa.com

American College of Sports Medicine
1-800-445-4808
www.acsm.org

American Heart Association
1-800-AHA-USA-1
(800-242-8721)
www.americanheart.org

Healthier US
1-800-336-4797
www.healthierus.gov

FIRE AND EMERGENCY SERVICES

International Association of Fire Chiefs
703-273-0911
www.iafc.org

International Association of Fire Fighters
202-737-8484
www.iaff.org

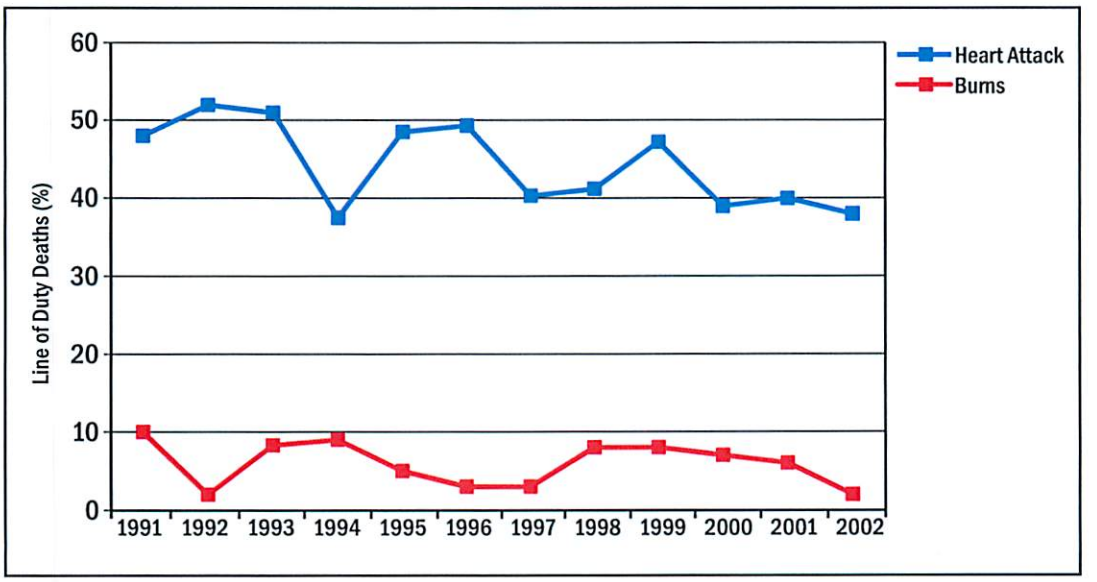
National Volunteer Fire Council
1-888-ASK-NVFC
(1-888-275-6832)
www.nvfc.org

United States Fire Administration
301-447-1000
www.usfa.dhs.gov

Appendix B:
Relationship Between Cardiovascular Risk Factors and Physical Fitness

Cardiovascular disease (CVD) is the leading cause of death in the United States, accounting for approximately 650,000 deaths per year.[62] CVD also exacts a considerable toll on the fire and emergency services. As seen in Figure B-1, approximately 40 to 45 percent of all line-of-duty deaths among firefighters, from 1991 to 2002, were due to heart attacks, whereas less than 10 percent are due to burn injuries.[63] The USFA and the NFPA record the number of deaths and disability of firefighters due to CVD, provided the cardiac event occurred while the individual was on duty.[64, 65] It is difficult to compare the incidence of CVD in the fire and emergency services with that of the general population. (There currently is epidemiological data that indicate rate of CVD deaths in the general population, but there is no information for firefighters because no agency collects data on firefighter deaths, unless they occur in the line of duty.)

FIGURE B-1: Line-of-Duty Death by Cause.[66, 67, 68]



Sources: USFA, "Firefighter Fatality Retrospective Study," April 2002. NFPA Firefighter Fatality Reports 2001 and 2002. NFPA Journal July/August 2002, 2003.

A goal of the NVFC and USFA is to make a drastic reduction in the number of firefighter deaths due to heart attacks. A commitment to health and safety also will require the fire and emergency services to continue to address line-of-duty deaths due to other causes (e.g., accidents, entrapment, thermal injuries) through training, the provision of adequate resources, and other measures.

Firefighters are most effective in their emergency response activities when they possess a thorough understanding of the nature of their profession. This appendix provides information to first responders about CVD and the risk factors associated with developing CVD. The appendix describes the prevalence and progression of CVD, including occlusion, atherosclerosis, atherosclerotic plaque and plaque rupture, and clot formation.

Finally, and perhaps most importantly, this appendix identifies the risk factors for CVD including smoking, hypertension (high blood pressure), hypercholesterolemia (high cholesterol levels), diabetes or impaired glucose tolerance, obesity, and physical activity. The more risk factors that an individual has, the greater the likelihood that he or she will suffer from CVD.

The Progression of Cardiovascular Disease

"Cardiovascular disease" refers collectively to a state of disease in the blood vessels. If blood vessels become narrowed (i.e., by the buildup of plaque) or obstructed (i.e., by a blood clot), then blood, and the oxygen and nutrients it carries, cannot be delivered to the vital organs of the body. If blood supply to the brain is impeded, a stroke occurs. If blood flow to the heart muscle is impeded, a heart attack occurs. The terms "coronary heart disease" (CHD) and "coronary artery disease" (CAD) describe specific forms of CVD in which the blood vessels supplying the heart muscle are blocked.

When there is an obstruction in a coronary vessel, the tissue below the blockage does not get adequate oxygen. If the lack of oxygen (called ischemia) is too severe, the heart tissue dies (called an infarction; a myocardial infarction means death of heart muscle tissue). Thus, a person who has suffered a myocardial infarction (also called a heart attack) has had a portion of the heart tissue destroyed. If the area supplied by the blood vessel is very small, the person may recover from the heart attack or may not even know that he or she has suffered a heart attack. However, if the area below the occlusion is too great, the heart cannot continue to function as an effective pump and death results.

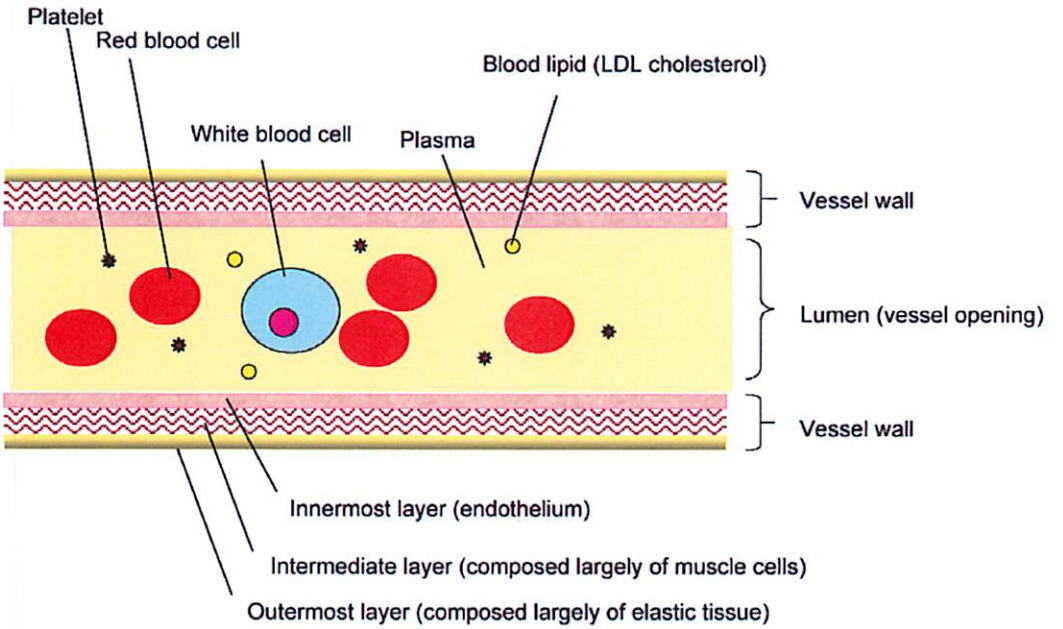
CAUSES OF OCCLUSION

When a coronary blood vessel (or any blood vessel) becomes blocked, tissue will be deprived of oxygen and die. The two primary causes of blockage are atherosclerosis (buildup of plaque) and a thrombus (blood clot). In reality, it appears that these causes interact; the buildup of plaque in an artery makes it more likely that a blood clot will develop. The initial buildup of plaque, which may begin in the late teens or early twenties, causes the arterial wall to become enlarged. Plaque buildup progressively decreases the size of the arterial opening until little or no blood can pass through the artery. Furthermore, the rupture of a plaque is likely to initiate the formation of a blood clot.

Atherosclerosis. Atherosclerosis refers to the disease condition in which plaque builds up in the arterial wall, which narrows the vessel opening. To fully understand how atherosclerosis develops, it is first necessary to understand the structure of an artery. Far from being a simple vessel through which blood flows, an artery is a complicated structure that plays an important role in blood clotting (or preventing blood clotting) and that constantly changes size to meet the demands of the tissue it supplies.

Figure B-2 is a schematic of a healthy artery. The vessel has three distinct layers. The innermost layer is composed primarily of a single layer of cells called the endothelium, and under normal conditions the endothelium plays a critical role in preventing blood clots.

FIGURE B-2: Structure of a Normal Artery and Components in the Blood.



The intermediate layer (tunica media) contains smooth muscle that permits the artery to change diameter to meet the needs of a tissue. For instance, when a firefighter is involved in strenuous fire suppression activities, smooth muscles around the arteries in muscles relax so that the vessel becomes larger and allows more blood to be supplied to the muscles. The outermost layer (adventia) contains connective tissue and nerves. Within the artery is the plasma (fluid portion of blood) that contains nutrients, oxygen, and blood lipids (including low-density lipoproteins). The blood vessel also contains red blood cells (RBCs), white blood cells (WBCs), and platelets.

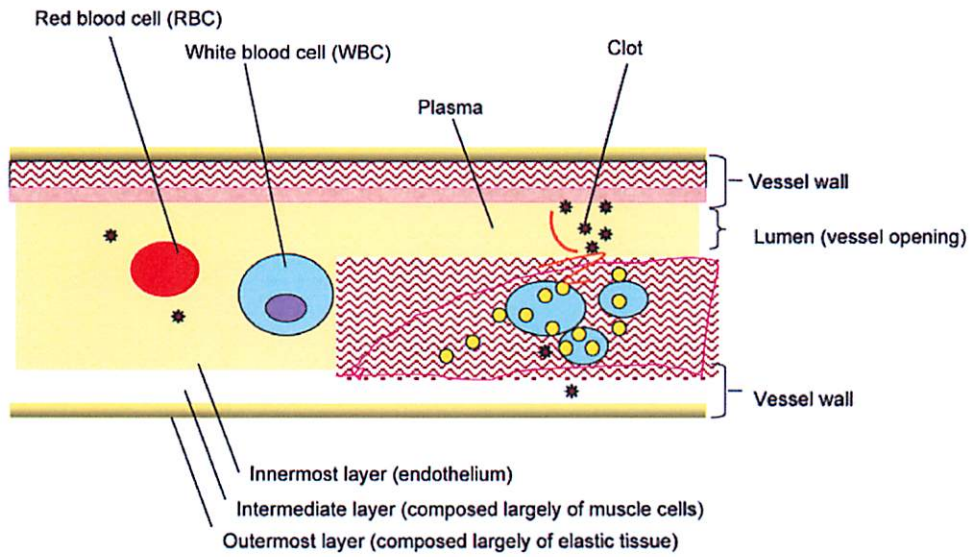
Development of Atherosclerotic Plaque. The initiation of atherosclerotic plaque buildup may begin quite early in life; there is strong evidence that it begins in the early twenties for many people in Western, developed countries. Therefore, it is important to think of CVD as a long-term disease that begins early in life, although symptoms often are delayed until middle or older age. Also, it must be stressed that CVD may become very advanced without symptoms. In many individuals, the first sign of CVD is a fatal heart attack, thus reinforcing the need for young first responders to take steps to avoid or delay atherosclerosis. It also suggests that those in their forties and fifties should begin to address the health issues of CVD seriously even if they are symptom free.

The plaque contains a lipid-rich core, composed largely of fat, and is covered by a fibrous cap. The events in the development of atherosclerotic plaque are very complex and are described only briefly below.

The first step in the initiation of atherosclerosis is damage to the endothelium, the smooth layer of cells that line the blood vessel and is in contact with the blood. Damage may occur due to high blood pressure, chemicals from inhaled cigarette smoke, or infection. Damage to the endothelium causes or allows cholesterol, specifically low-density lipoproteins (LDLs) to move into the wall of the blood vessel. The presence of LDLs in the arterial wall leads WBCs, especially macrophages, to move into the arterial wall. The macrophages ingest the LDLs and become known as foam cells. Foam cells release chemicals that stimulate smooth muscle to grow and divide in the arterial wall. The additional smooth muscle in the arterial wall causes other material to accumulate in the vessel wall, thus causing the atherosclerotic plaque to grow. In later stages, the plaque may become calcified. The end result is a fatty lesion that contains a core that is rich in lipids (LDL) and dead or dying cells and a fibrous cap.

Plaque Rupture and Clot Formation. The body has a highly complicated mechanism that balances the need to keep blood in the liquid state under normal conditions with the need to produce blood clots quickly when faced with a damaged blood vessel. It appears that most cases of acute heart attack are "triggered" when an atherosclerotic plaque is disrupted, causing the development of a clot (thrombus). As depicted in Figure B-3, the clot occurs because the disruption of the plaque exposes platelet and blood coagulatory factors to underlying tissue, such as the smooth muscle and connective tissue in the vessel walls that do not possess the anticlotting factors that intact endothelium does. Exposure of the blood to underlying tissue causes the platelets to adhere to one another and form a platelet plug. The platelet plug is then reinforced by strands of thrombin to form a clot. A clot may be small enough that it does not occlude an artery, in which case the person may or may not exhibit symptoms. Conversely, the clot may be large enough to block an artery, causing a heart attack. When a plaque ruptures, it may also release a "fatty embolism," meaning a traveling fat clot that occludes an artery.

FIGURE B-3: Rupture of Atherosclerotic Plaque and Clot Formation.



Risk Factors for Developing Cardiovascular Disease

Although it is useful to understand how CVD develops, it is more important to understand what predisposes an individual to develop CVD, and what measures can be taken to reduce the risk of developing CVD. A risk factor is a characteristic that is present early in life and is associated with an increased risk of developing future disease. A modifiable risk factor is a risk factor that can be minimized by diet, exercise, or personal habits. Table B-1 presents several risk factors for CVD, both nonmodifiable and modifiable risks. Men are more likely to suffer CVD at a younger age than females; thus, being over 45 years is considered a risk factor for males and being over 55 years is a risk factor for females. Family history is defined as the premature death (before 55 years for males or before 65 years for females) of a parent or sibling from CVD.

TABLE B-1: Risk Factors for Developing Cardiovascular Disease.

Risk Factors That Cannot be Modified	Risk Factors That Can be Modified
• Age • Heredity • Race • Gender	• Cholesterol-lipid fractions • Cigarette smoking • Diabetes mellitus • Hypertension • Obesity • Physical inactivity

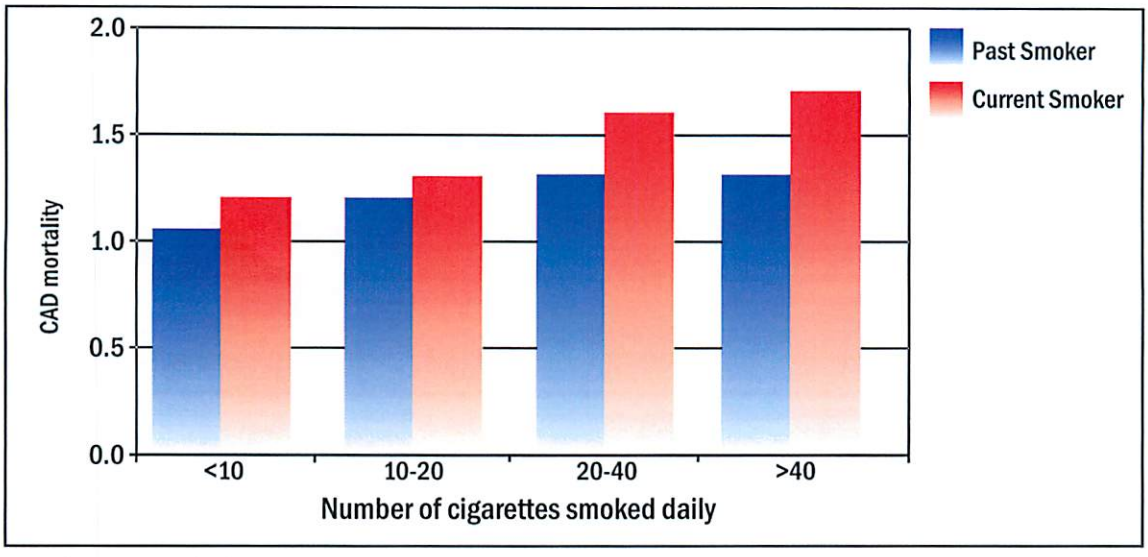
Modifiable risk factors deserve a great deal of attention because it is through altering these risk factors that a person can influence his or her likelihood of developing CVD. There are six major modifiable risk factors: smoking, hypertension (high blood pressure), hypercholesterolemia (high cholesterol levels), diabetes or impaired glucose tolerance, obesity, and physical activity. The more risk factors an individual has, the greater the likelihood that he or she will suffer from CVD. The good news is that armed with information and supported by coworkers and family, most firefighters can reduce their risk for CVD by following reasonable guidelines for healthy living.

RISK ASSOCIATED WITH SMOKING

Approximately 21 percent of the adult population in the United States smokes, and approximately 4,000 young people begin to smoke each day.[69] Cigarette smoking accounts for an estimated 438,000 deaths per year in the United States, more than 20 percent of them due to CVD.[70] In fact, as early as 1983, the Surgeon General had established smoking as the leading avoidable cause of CVD. Thus, the cessation of cigarette smoking is one of the single most important interventions that can be undertaken to decrease the risk of premature death due to CVD. Smoking increases the risk for sudden cardiac death, aortic aneurysm, peripheral vascular disease, and stroke. Smoking one pack of cigarettes per day doubles the risk of CVD compared to not smoking, and smoking more than one pack triples the risk.[71,72] Chemicals in cigarettes stimulate the sympathetic nervous system, causing an increase in heart rate and blood pressure. Carbon monoxide binds to hemoglobin, thus reducing hemoglobin's ability to carry oxygen.

As seen in Figure B-4, as the number of cigarettes smoked increases, so does the risk of coronary artery disease and stroke. "CAD Mortality," as depicted on the Y-axis in the figure, represents coronary artery disease (or coronary heart disease) mortality. A CAD mortality of 1.0 implies the same death rate as a nonsmoker.

FIGURE B-4: Coronary Artery Disease and Stroke Versus Cigarette Smoking in Current and Past Smokers.[73]



Source: "The Health Benefits of Smoking Cessation: A Report from the Surgeon General," 1990.

Smoking accelerates the process of plaque development by damaging the endothelium, enhancing lipid accumulation in the arterial wall, increasing inflammation in the arterial wall, and enhancing the movement of white blood cells (especially macrophages) into the arterial wall. Simultaneously, smoking increases the likelihood of developing a blood clot by increasing platelet activation and making them more likely to adhere to each other and form a clot.

Benefits of Smoking Cessation. The good news is that much of the damage done by smoking is reversible. Smoking cessation is the single most important intervention for preventing cardiovascular death. Encouragingly, smoking cessation reduces the risk of the first heart attack by 65 percent.[74]

Strategies for Smoking Cessation. The strategies to reduce the risk of CVD associated with smoking are straightforward:

- Quit smoking, and encourage fellow first responders to quit smoking. Individuals wanting to quit smoking should consider attending a smoking cessation program, nicotine replacement therapy (nicotine chewing gum), or discuss medication options with their physician. There are over-the-counter and prescription medications available to help overcome the smoking addiction.
- Fire and emergency service departments should aggressively promote smoking cessation programs available through local hospitals and other health agencies and consider sponsoring programs for their employees.
- Departments should consider policies that ban smoking among first responders.
- Departments should have regulations that protect first reponders from secondhand smoke.

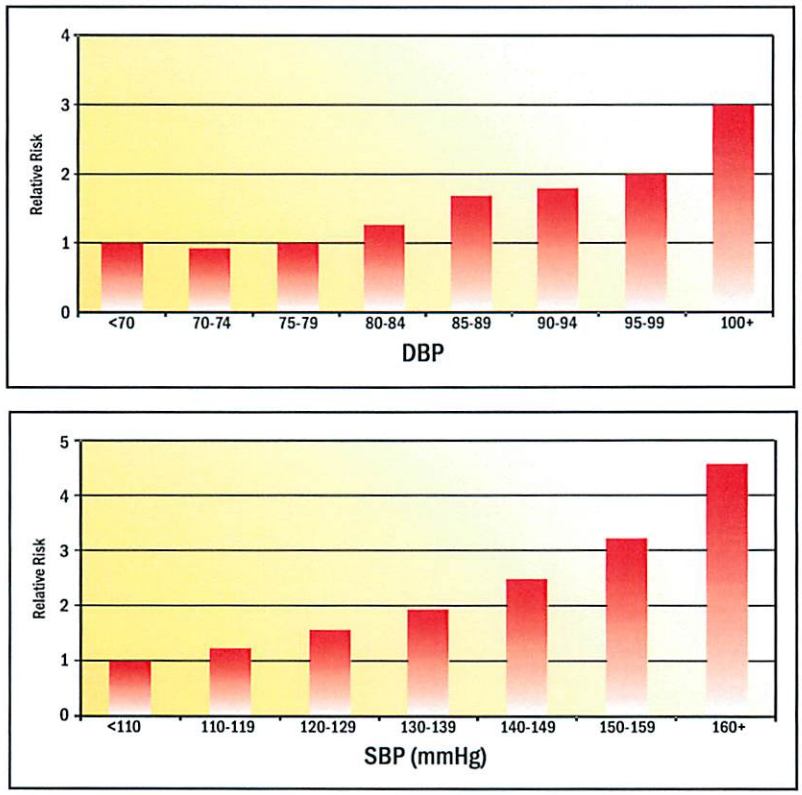
RISK ASSOCIATED WITH HYPERTENSION

Hypertension refers to a chronic, persistent elevation of blood pressure. Hypertension is actually defined as the level of blood pressure that is associated with a twofold increase in long-term risk of mortality.[75] Table B-2 presents various blood pressure categories. Epidemiological data show that the risk of death doubles with a systolic blood pressure greater than or equal to 140 mmHg and a diastolic blood pressure of greater than or equal to 90; and a blood pressure above 140/90 is defined as hypertension. However, as seen in Figure B-5, the risk of developing CVD increases directly with increasing levels of both systolic and diastolic blood pressure.

TABLE B-2: Classification of Blood Pressure—Adults (Not on Blood Pressure Medications).

Category	Blood Pressure (mmHg)		
	Systolic		Diastolic
Optimal	<120	and	<80
Normal	<130	and	<85
High-Normal	130-139	and	<85
Hypertension			
Stage 1	140-159	or	90-99
Stage 2	160-179	or	100-109
Stage 3	≥180	or	≥100

FIGURE B-5: Relative Risk of Cardiovascular Disease Versus Blood Pressure.[76]



Source: National Blood Pressure Education Program Working Group. Arch. Intern Med., 1993.

Role of Hypertension in Cardiovascular Disease. Hypertension accelerates the atherosclerotic progress by damaging the lining of the blood vessels (endothelium). If untreated, approximately 50 percent of patients with hypertension die from coronary heart disease or congestive heart failure, another 33 percent die from stroke, and 10 to 15 percent die due to renal failure.

Reducing blood pressure levels decreases the risk of CVD. In fact, a 5- to 6-mmHg reduction in diastolic blood pressure or a 10-mmHg reduction in systolic blood pressure decreases the risk of cardiovascular disease by as much as 40 percent.[77]

Hypertension could be slowed, and possibly prevented, by preventing obesity, moderate reduction in salt intake, higher levels of physical activity, and avoidance of excessive alcohol consumption.[78]

Strategies for Controlling Hypertension. The strategies to reduce the risk of CVD associated with hypertension are varied and often overlapping. Furthermore, the degree of risk and the appropriate interventions depend upon the degree of hypertension and the presence of additional risk factors. If you have elevated blood pressure, or even high-normal blood pressure, you should consult with your physician. Make sure he or she knows the types of job stresses you encounter as you discuss controlling your blood pressure. Table B-3 presents recommendations for treatment based on the level of blood pressure and the presence of additional risk factors. This table should serve as a basis for discussions with your physician regarding how to best control your blood pressure given your overall medical condition. Although your physician may recommend drug therapy to treat hypertension, lifestyle modifications should be used in conjunction with medication. Furthermore, lifestyle modifications may be sufficient to avoid medication or to prevent the need for medication. If, however, your physician has prescribed a medication, you should take it faithfully.

TABLE B-3: General Guidelines for Strategies to Reduce or Treat Blood Pressure Based on Blood Pressure Readings and Presence of Additional Risk Factors.

Blood Pressure Category	No Other Risk Category	At Least One Other Risk Factor (Not Including Diabetes)	Diabetes and Clinical Evidence of Heart Disease
High-normal	Lifestyle modification	Lifestyle modification	Drug therapy
Stage 1	Lifestyle modification	Lifestyle modification	Drug therapy
Stages 2 and 3	Drug therapy	Drug therapy	Drug therapy

Lifestyle Modifications. The primary lifestyle modifications to help reduce hypertension include smoking cessation, diet, and exercise, with the overall goals of losing weight, increasing physical activity levels, and decreasing salt intake. Lifestyle modifications also may be appropriate for those who are currently in the normal range because blood pressure tends to increase with age. Therefore, it is prudent to take steps to control blood pressure before it becomes a problem. The benefits of lifestyle modifications are readily apparent when one realizes that even modest reductions in blood pressure translate into significant reductions in the risk of cardiovascular disease.

Diet. A decrease in total caloric intake is important in weight reduction. A loss of excess body fat is associated with decreased blood pressure. A two-pound reduction in body weight is associated with a 1.6 mmHg reduction in systolic blood pressure and a 1.3 mmHg reduction in diastolic blood pressure.[79]

A reduction in salt intake is beneficial for individuals with elevated blood pressure. Sodium restriction is associated with a decrease in blood pressure in most people.[80] Salt restriction can be achieved by avoidance of salty foods (i.e., potato chips, olives, etc.), by not using additional salt while cooking or seasoning foods, and by avoiding processed food.

Other recommended dietary changes include a decrease in alcohol and caffeine consumption, and an increase in fruits, vegetables, and fish in the diet.

Types of Lipids

Blood lipids are comprised primarily of triglycerides and cholesterol. Triglycerides are composed primarily of fatty acids and are the type of fat ingested in food. Cholesterol also is ingested in food, but in much smaller amounts than triglycerides. Cholesterol is important for cell membranes and hormone synthesis, but when present in excessive amounts, it can have negative health outcomes. Cholesterol and triglycerides are carried in the blood by a lipoprotein molecule. Low-density lipoproteins (LDLs), also known as "bad cholesterol", and high-density lipoproteins (HDLs), also known as "good cholesterol", vary in their densities and in the way they transport cholesterol.

An analysis of blood lipids that includes LDLs and HDLs provides important information (in addition to total cholesterol) regarding an individual's risk for cardiovascular disease. As seen in Table B-4, elevated levels of triglycerides, cholesterol, and LDL-cholesterol are associated with increased risk of CVD. On the other hand, increased levels of HDL-cholesterol are associated with a decreased risk of cardiovascular disease. Therefore, elevated levels of HDL are desirable. In fact, high HDL levels represent a lowered risk of cardiovascular disease.

TABLE B-4: Description of Various Lipids and Their Relationship to Cardiovascular Disease.

Type of Lipid	Description	Relationship to CVD
Triglyceride	Simple fat, found in food	Positive relationship. As LDL levels increase, so does the risk of CVD.
Cholesterol	A derived fat that is essential for cell function and hormone production but is detrimental in excessive amounts	Positive relationship. As LDL levels increase, so does the risk of CVD.
Low-density lipoprotein (LDL cholesterol)	"Bad cholesterol." These lipoproteins transport concentrated amounts of cholesterol to the arterial wall where it contributes to plaque buildup. These lipoproteins contain a large portion of cholesterol.	Positive relationship. As LDL levels increase, so does the risk of CVD.
High-density lipoprotein (HDL cholesterol)	"Good cholesterol." These lipoproteins pick up cholesterol in the bloodstream and transport it from the arteries to the liver, where it is metabolized. These lipoproteins contain a small portion of cholesterol.	Negative relationship. As HDL levels increase, the risk of CVD decreases, making high HDLs a negative risk factor

Because high levels of some lipids (triglycerides, total cholesterol, or LDL-cholesterol) are undesirable and low levels of other lipids (HDL-cholesterol) are undesirable, the term hyperlipidemia (high lipid levels) is not always appropriate. Instead, medical professionals prefer the term dyslipidemia (altered or dysfunctional levels of lipids in the blood) to describe lipid disorders that may include values that are too high (for triglycerides, total cholesterol, or LDL-cholesterol) or too low (for HDL-cholesterol).

CHOLESTEROL

High cholesterol levels (hypercholesterolemia) increase the risk of CVD. Elevated levels of cholesterol in young adults greatly increase their risk of coronary heart disease later in life. In fact, young men who are in the upper quartile (highest 25 percent for cholesterol levels) have a ninefold increase in risk of heart attack compared to men in the lowest quartile (lowest 25 percent).[81]

As seen in Table B-5, desirable levels of cholesterol are less than 200 mg/dL, whereas high cholesterol is defined as total cholesterol above 240 mg/dL of blood. There is a twofold increase in risk of cardiovascular mortality when cholesterol levels are elevated to 240 mg/dL versus 200 mg/dL. Unfortunately, approximately half of American adults have cholesterol values greater than 200 mg/dL, and about 20 percent have values above 240 mg/dL.[82] The increase in risk of CVD increases progressively with increasing levels of cholesterol; there is a 20- to 30-percent increase in risk for coronary heart disease for every 10 mg/dL increase in cholesterol.[83] Although values above 240 mg/dL are defined as high, it is important to note that the risk of coronary heart disease increases in a curvilinear fashion with increasing levels of total cholesterol. The 10-year risk of coronary heart disease increases as the total cholesterol level increases.[84] The risk of coronary heart disease associated with increasing total cholesterol levels is affected by the presence of other risk factors.

TABLE B-5: Classification of Lipid Levels.[85]

Lipid (classification)	Value (mg/dL)
Total cholesterol	
Desirable	<200
Borderline	200-239
High	>240
LDL-cholesterol	
Optimal	<100
Near optimal	100-129
Borderline High	130-159
High	160-189
Very High	>190
HDL-cholesterol	
Low	<40
High	>60
Triglyceride level	
Normal	<150
Borderline High	150-199
High	200-499

LOW-DENSITY LIPOPROTEINS

LDLs are considered the bad form of cholesterol because elevated levels of LDL are associated with greater risk of CVD. LDLs transport highly concentrated amounts of cholesterol to the arterial wall where the cholesterol participates in plaque formation. Because LDLs are the primary plaque-causing lipoprotein, they are the focus of cholesterol/lipid-lowering efforts.

HIGH-DENSITY LIPOPROTEINS

HDL-cholesterol is an independent predictor of coronary heart disease. As the level of HDL increases, the incidence of CVD decreases and visa versa. For every 1-mg/dL decrease in HDL, there is a 3- to 4-percent increase in coronary artery disease.[86]

As HDL-cholesterol decreases (from 60 to 41 to 37), the risk for coronary heart disease increases at all levels of total cholesterol. Additionally, the presence of diabetes or smoking greatly affects the risk associated with a given level of total cholesterol. Hence, a nondiabetic smoker with elevated blood pressure (134/86); an HDL of 41, and a total cholesterol level of 240 to 79 mg/dL has an approximate 20-percent risk of coronary heart disease within 10 years. On the other hand, a diabetic smoker with the same total cholesterol level (240 to 279 mg/dL) but with higher blood pressure (146/94) and a lower HDL-cholesterol has an approximate 45-percent risk of coronary heart disease in the same time period.[87]

Benefits of Improved Lipid Profiles. The risk of CVD decreases when cholesterol levels are reduced. A lowering of total cholesterol by 10 percent reduces the risk of coronary heart disease by 15 percent, and a lowering of LDL-cholesterol by 10 percent reduces the risk of coronary heart disease by approximately 20 percent.[88] Furthermore, treatment that is continued for more than 5 years results in a 25-percent reduction in coronary heart disease events.

Thus, it is critically important that individuals with high cholesterol aggressively pursue treatment (including lifestyle modifications and prescription medications) and that they continue with the treatment plan. It is difficult to overstate the importance of this last point, as too many individuals are tempted to discontinue treatment because the benefits are not obvious to them in the way they feel. That is to say, they may not feel differently when they are on or off medication. Nonetheless, left untreated high cholesterol (especially elevated LDL-cholesterol) is associated with significantly greater rates of death from CVD.

Strategies for Improving Lipid Profiles. The lifetime risk of coronary heart disease can be reduced by 50 percent or more if blood cholesterol levels are reduced before age 40, and 30 percent if reduction in blood cholesterol occurs before 50.[89] The strategies to reduce the risk of CVD associated with dyslipidemia are varied and often overlapping. Furthermore, the degree of risk, and the appropriate interventions, depends on the specific lipid abnormality and the magnitude of the abnormality. In general, the strategies for managing lipid/cholesterol levels fall into two categories: life-style modification and drug therapy. If you have elevated cholesterol, LDLs, or triglycerides, or if you have low HDL levels you should consult a physician to see which combination of strategies is right for you.

Lifestyle Modifications. The primary lifestyle modifications to treat dyslipidemia involve diet and exercise:

- *Diet.* An appropriate diet is an important factor in the prevention and management of dyslipidemia. In general, there are three primary objectives of diet modification for attaining healthy lipid profiles:
  1. Attaining ideal body weight.
  2. Obtaining a well-balanced diet high in fruits and vegetables.
  3. Restricting saturated fats and simple, refined carbohydrates (sugars).[90]
- *Less* than 30 percent of calories should be from fats (with <10 percent of calories coming from saturated fats). Cholesterol intake should be less than 300 mg day. Additionally, there is growing evidence that Omega-3 fatty acids protect against cardiovascular disease, and for that reason it is now recommended commonly that individuals try to eat fish one or two times per week.

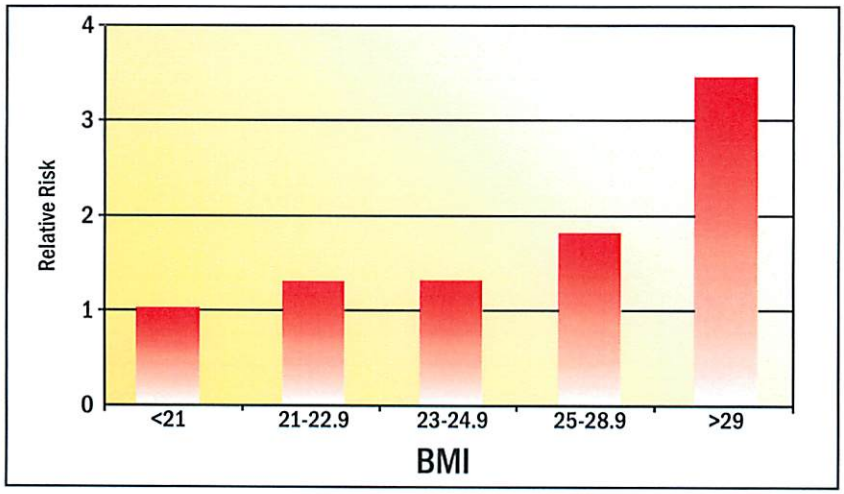
- Exercise. Exercise is an important component of any weight loss program and weight loss is associated with positive changes in lipid profiles. Furthermore, regular aerobic exercise is associated with decreased triglyceride levels and increased HDL levels.
- Drug therapy. Drug therapy may be necessary for individuals who are at high risk for cardiovascular disease (LDLs >160 mg/dL and other risk factors). In all cases, drug therapy should occur in conjunction with dietary therapy and increased physical activity. Prescription drugs are available to treat different lipid disorders (elevated cholesterol, elevated LDLs, low HDLs). In many instances, drug treatment for cholesterol/lipid levels is a long-term treatment strategy, and it is imperative that individuals continue to take their medication. Very often individuals will not "feel better" when they are taking the medication, but the cardiovascular system is "working better." If you have high cholesterol/lipid levels you should follow the diet and exercise guidelines detailed above, take your medicine religiously, and consult with your physician regularly.

RISK ASSOCIATED WITH OBESITY

Despite what seems to be an obsession with thinness and dieting, approximately 33 percent of the adult population in the United States is obese and another 30 to 35 percent of the population is overweight.[91] The trend in both the adult and the child population toward obesity is increasing. Obesity is associated with a number of diseases, including CVD (high blood pressure, dyslipidemia), diabetes, gallbladder disease, and cancer. Obesity is associated with several other risk factors, but it also exerts an independent influence on the risk of CVD.

As excess body weight (Body Mass Index (BMI)) increases, so does the risk of CVD (Figure B-6).

FIGURE B-6: Relationship Between BMI and Relative Risk of CVD.[92]



Source: Manson et al. *A Prospective Study of Obesity and Risk of Coronary Heart Disease in Women.* New England Journal of Medicine. 322:882-889, 1990.

This relationship is sometimes referred to as a J-shaped curve because, although there is little or no change in mortality at the lower end of the BMI range, as BMI increases above 25, risk begins to increase and does so in a nonlinear fashion. Thus, each incremental pound gained is associated with additional risk for the person who is overweight.

Not only is excess body weight an important risk factor for CVD, but where the weight is carried (fat distribution) is also predictive of heart disease. Abdominal fat increases one's risk of heart disease. This risk can be assessed easily by measuring waist circumference: values greater than 40 inches for males and greater than 35 inches for females indicate an increased risk of heart disease.

Obesity is associated with an increased amount of lipids and cholesterol in the blood. Thus, the LDLs are more likely to invade the arterial wall and initiate plaque development. Obesity also is associated with an inability to utilize carbohydrates causing blood sugar levels to increase. The increased blood glucose levels (and accompanying high levels of insulin) interfere with the ability of the artery to change size (vasodilate) when the heart needs additional blood flow.

The extent of body fatness can be measured in several ways; the most precise laboratory methods involve sophisticated equipment such as underwater weighing tanks or whole body scanning. More commonly, percent body fat is estimated by measuring skinfold thickness at various sites and calculating percent body fat based on the known relationship between skinfold thickness and total body fat. The easiest way, however, to gain a sense of body fatness is through the calculation of BMI (Figure B-7).

FIGURE B-7: Calculation of Body Mass Index (BMI).

- BMI = $Wt(kg)/Ht(m)^2$
- Assume: Wt = 220 lb, Ht = 5'10"
- Steps
    1. Convert wt to kg by dividing by 2.2 (1 kg = 2.2 lb)
       220/2.2 = 100 kg
    2. Convert height to meters by:
        a. Convert inches to centimeters by multiplying by 2.54
           (1" = 2.54 cm)
           70 x 2.54 = 177 cm
        b. Convert cm to m by dividing by 100 (1 m = 100 cm)
           177 cm = 1.77 m

Plug numbers into formula BMI = $100/1.77^2 = 100/3.13 = 31.9$

This method requires only that height and weight (in meters and kilograms, respectively) be known. Because of its simplicity, the BMI is often used in large-scale studies where hundreds or thousands of people are studied. This simple calculation, however, may overestimate the fatness of some individuals, especially those who are very muscular. Those individuals with a high BMI who do not believe they are overweight or obese, might consult a fitness expert to have percent body fat measured more accurately.

Even modest weight loss can have an important impact on several health parameters, including improvements in blood pressure, lipid profiles, and glucose tolerance.

Strategies for Weight Loss. The strategies to reduce the risk of CVD associated with obesity may seem straightforward: you need to increase the number of calories expended by physical activity (exercise program) and/or you need to decrease the number of calories consumed. Despite what may seem like simple logic, millions of people fail at weight loss attempts each year. In general it is healthful and most likely to be successful if your weight loss program includes a moderate increase in activity and a moderate decrease in caloric intake. Furthermore, you should recognize that your excess weight was not gained in a few weeks or months, and hence you should not try to lose the excess fat in a few weeks or months. Rather, commit yourself to a lifestyle change that you can sustain.

Diet. An appropriate diet is essential to appropriate weight loss. There is considerable controversy over what type of diet is best. In general, it is best to avoid fad diets and stick to proven and healthy diets (i.e., the American Heart Association diet). Your goals should be to:

- attain a healthy body weight;
- eat a well-balanced diet high in fruits and vegetables;
- restrict saturated fats and simple, refined carbohydrates (sugars); and
- eat approximately 250 to 500 calories fewer than you expend each day.

Most experts agree that you should limit your fat intake to less than 30 percent of total calories (with <10 percent of calories coming from saturated fats). Cholesterol intake should be less than 300 mg/day. Additionally, there is growing evidence that Omega-3 fatty acids are protective against CVD, and for that reason, it is now commonly recommended that you try to eat fish one or two times per week.

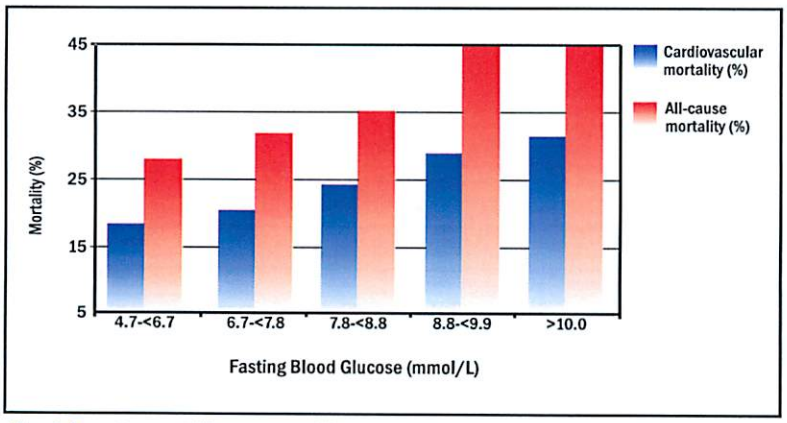
Exercise is a key part of any weight-loss program. Studies have shown consistently that exercise is particularly effective in maintaining weight loss. Additionally, exercise is the best way to lose fat and maintain muscle mass. When a person loses weight through exercise alone he/she loses fat and muscle. It is the fat that is detrimental to health. In fact, for a firefighter the loss of muscle mass may affect performance negatively because of the high strength demands of the job.

RISK ASSOCIATED WITH TYPE II DIABETES

Diabetes is a metabolic disorder characterized by the inability to use sugar (glucose) effectively. In nondiabetic individuals, blood glucose levels increase following the ingestion of carbohydrates (complex sugars) or simple sugar. Increased levels of glucose cause the body to release insulin (a pancreatic hormone), which helps transport glucose from the blood stream into the cells of the body where the glucose is used to make energy or is stored as fuel for later use. Individuals with Type II diabetes tend to have high insulin levels because their cells are resistant to the effects of insulin (a condition known as insulin resistance). Thus the pancreas continues to produce insulin in an attempt to move glucose into the cell. Since insulin is not effective, however, diabetics cannot effectively transport glucose from the blood stream into the cells of the body. Thus, diabetics have high glucose levels in the blood (hyperglycemia).

People with diabetes are twice as likely to experience cardiac events as other individuals. Furthermore, 65 percent of all deaths among diabetic patients are from CVD.[93] As seen in Figure B-8, the degree of cardiovascular risk (and risk of death from all-cause mortality) is directly related to fasting blood glucose levels.[94] Additionally, individuals who have diabetes along with other risk factors are at a much higher risk than nondiabetic individuals with the same number of risk factors.

FIGURE B-8: Fasting Blood Glucose Levels and Cardiovascular Mortality in Type II Diabetes Patients.



Adapted from: Nesto & Libby. In: Braunwald, Zipes, & Libby. Heart Disease: A Textbook of Cardiovascular Medicine. 6th Ed. Volume 2. Page 2138.

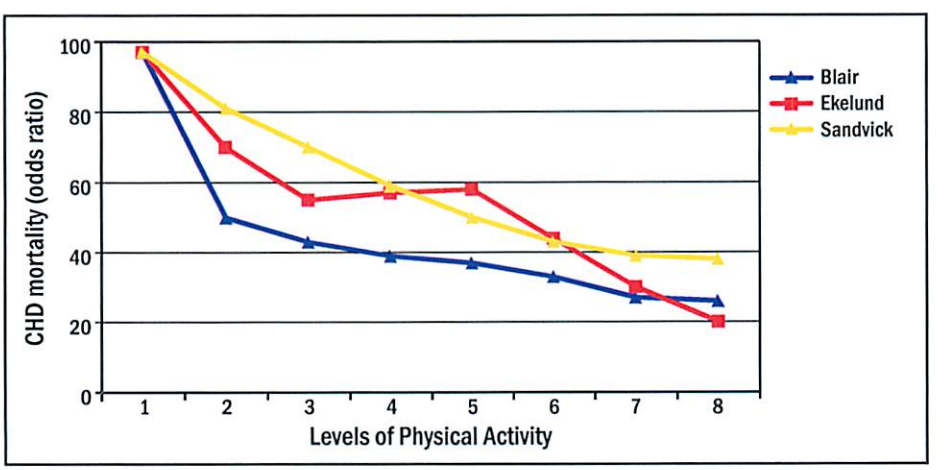
High blood glucose levels (hyperglycemia) are associated with damage to the smallest blood vessels (such as those in the retina of the eye) and enhanced atherosclerosis. High insulin levels also are associated with enhanced blood clotting.[95]

Strategies for Decreasing Blood Glucose Levels. Diabetes often coexists with other risk factors for CVD. In fact, the cluster of risk factors has been termed *metabolic syndrome X*, and includes abdominal obesity, hypertension, dyslipidemia, and an inability to use glucose effectively (diabetes). Therefore, it is important that a person with diabetes very aggressively control other risk factors. A diabetic should lose excess body weight, exercise regularly, and eat a diet low in simple sugars and carbohydrates. Because of the complexity of the disease, its relationship to heart disease, and the difficulty controlling blood glucose levels, a diabetic person should consult regularly with his/her physician about a diet and exercise program and the need for medication.

RISK ASSOCIATED WITH PHYSICAL INACTIVITY

Physical inactivity is related to several of the risk factors discussed previously. A lack of exercise increases an individual's risk of obesity, hypertension, dyslipidemia, and diabetes. However, physical inactivity is also an independent risk factor for cardiovascular disease. The risk of CVD in inactive people is about twice that of physically active individuals—approximately the same as for hypertension and dyslipidemia.[96] In fact, physical inactivity is responsible for approximately 200,000 deaths per year in the United States.[97] As seen in Figure B-9, several studies have shown that CVD mortality is inversely related to level of physical activity or fitness.[98]

FIGURE B-9: Relationship Between Physical Activity and Cardiovascular Mortality.[99]



Adapted from: Haskell, et al. Medicine and Science in Sports and Exercise. 26(6), 649-660.

Increased physical activity improves work capacity, increases strength, decreases injury rates, and improves heat tolerance. Exercise training also has a positive impact on several other CVD risk factors; it decreases blood pressure, increases HDL, improves glucose tolerance, and causes loss of fat weight. In addition to these substantial benefits, exercise also strengthens the heart muscle, enhances the blood-dissolving capacity of the blood (making unwanted clots less likely), and stabilizes the electrical activity of the heart.

Decreasing Cardiovascular Disease Risk Factors

CVD is a major threat to the health and safety of firefighters. In order to stay healthy, and address the risk factors for developing CVD, a firefighter should adopt a few healthy lifestyle habits. In short, to reduce the risk of suffering a heart attack or stroke, it is imperative that firefighters:

- do not smoke/stop smoking;
- follow a regimen of moderate aerobic exercise; and
- eat a balanced diet, avoiding excess saturated fats, excess simple sugars, and maintaining normal body weight.

Table B-6 summarizes these recommendations and indicates the risk factors that are influenced by each recommendation. Of particular note is the benefit of physical activity in eliminating or favorably affecting five of the six modifiable risk factors.

TABLE B-6: Recommendations for Decreasing CVD Risk Factors.

Recommendations	Description
Exercise Moderately	• Decreased blood pressure • Improved lipid (cholesterol) profile • Decreased body fat • Improved glucose tolerance • Eliminates physical inactivity
Eat a Balanced Diet	• Improved lipid (cholesterol) profile • Decreased body weight • Improved glucose tolerance • May decrease blood pressure
Do not Smoke	• Decreased artery blockage • Increased lung health; capacity

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National Volunteer Fire Council
Mission Statement

To provide a unified voice for volunteer Fire/EMS organizations.

This Mission will be accomplished by:

- *Representing the interests of the volunteer Fire/EMS organizations at the U.S. Congress and Federal agencies.*
- *Promoting the interests of the State and local organizations at the national level.*
- *Promoting and providing education and training for the volunteer Fire/EMS organizations.*
- *Providing representation on national standards setting committees and projects.*
- *Gathering information from and disseminating information to the volunteer Fire/EMS organizations.*

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