

Areas of Focus for Firefighters

to

Reduce Cardiac Disease and Cardiac Events

Regional Wellness Committee

2017

Sudden Cardiac Events are responsible for approximately 50% of annual Line of Duty Deaths among Fire Fighters. Data also shows an annual average between 800 and 900 non-fatal, yet high impact, Sudden Cardiac Events among Fire Fighters which is believed to be a dramatically underreported number. The median age of a first heart attack in the general population is 66 years of age, whereas this occurs at 49 years of age for Fire Fighters. Clearly, as a subset of the general population, Fire Fighters are experiencing a greater incidence of cardiac complications that increase mortality and morbidity.

Cardiovascular disease risk factors have been identified through various medical journals and peer reviewed research studies including the National Fire Protection Agency. These risk factors include biometric screening parameters, fitness levels, obesity, alcohol use, nutrition, hypertension, left ventricular hypertrophy, hydration levels, and heat stress. These risk factors tend to overlap one another and synergistically increase the risk of cardiovascular disease. Fortunately, many of the associated risk factors are modifiable through regular exercise and proper nutrition.

The Department of Environmental Health at the University of Cincinnati published a study revealing that despite the occupational exposures and risks firefighters face, only lifestyle factors were found to significantly predict cardiovascular disease and related health issues (Adrienne Eastlake, 2013).

The information and recommendations below are not all inclusive, but rather highlight some of the most impactful changes intended to reduce Fire Fighter risk factors and overall incidence of Sudden Cardiac Events.

Contributing Departments:

Mesa Fire / Medical, Superstition Springs Fire & Medical, Scottsdale Fire, Chandler Fire Health and Medical, Sun City Fire and Medical, Gilbert Fire and Rescue, Glendale Fire

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The following is an overview of the covered topics and areas of focus. Further information is detailed on subsequent pages.

1) Biometric Screening

1. Participate in an annual medical exam, at a minimum.
2. Ensure physician is compliant with NFPA standards for medically evaluating firefighters

2) Fitness and Obesity

1. Maintain or work to reach a healthy weight.
2. Perform regular, moderate-intensity aerobic activity to develop and maintain an MVO2 at or above 42 / at or above 12 METs.
3. Work with local health and wellness resources to develop a specific cardio and or weight management plan.

3) Alcohol and Tobacco Use

1. Reduce overall alcohol consumption, and avoid “heavy” and “binge” drinking
2. Utilize appropriate resources offered as needed to manage alcohol consumption, including EAP, Fire Strong, Peer Support Team, Chaplain, etc.
3. Promote a tobacco free workplace and encourage tobacco cessation

4) Nutrition

1. Strong evidence suggests Firefighters need to shift their nutrition, as much as possible, toward natural, whole foods and away from processed carbohydrates and sugar
2. 10 specific areas to focus on are listed in the later nutrition section

5) Hypertension & Left Ventricular Hypertrophy

1. Routinely monitor blood pressure and control hypertension if present in coordination with your physician through diet and NFPA 1581 preferred medications
2. Maintain or take actions to reach a healthy weight
3. Avoid tobacco use
4. Perform regular aerobic exercise

6) Hydration

1. Try to consume at least half of your body weight in ounces of water; a 200lb individual should drink at least 100 oz. throughout the day
2. If no water was consumed during exercise (fireground operations), aggressively rehydrate at a rate of 16 oz. of fluid every 15–20 minutes

7) Heat Stress

1. Utilize Full Rehab Sector after each work cycle per NFPA 1584
2. Participate in Passive and Active Cooling
3. Perform regular drilling and exercise that replicate working conditions, especially in turnouts to produce effective heat acclimation

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1) Biometric Screening

Cardiovascular disease develops over time and includes modifiable risk factors. NFPA developed a specific protocol within 1582 indicating the need for echocardiogram evaluation. Many of the risk factors listed can be improved upon leading to an individual level of control over the development of cardiovascular disease. Some of these risk factors are identified specifically in following sections.

Members should participate in a medical exam on a yearly basis at a minimum. The cardiovascular disease risk factors below indicate further evaluation is needed via stress echocardiogram. All testing and evaluation should be performed in conjunction with a physician familiar with the demands and needs of the Fire Fighter population based on NFPA 1582.

Recommendations:

1. Participate in annual medical exam.
2. Ensure physician is compliant with NFPA standards for medically evaluating firefighters and uses below risk factors to further determine need for stress echocardiogram evaluation.

Over the age of 45 (men) and 55 (women) with one or more of the following risk factors

- i. Total Cholesterol >240mg/dl
- ii. Hypertension (systolic >140 or diastolic >90)
- iii. Diabetes
- iv. Smoker
- v. Family History of premature CAD
- vi. Framingham risk score > 10

Metabolic Syndrome (meets 3 or more of the risk factors below)

- i. Abdomen Obesity (waist circumference > 40 in men, > 35 in women)
- ii. Triglycerides > 150mg/dl
- iii. HDL cholesterol < 40mg/dl for men, < 50 mg/dl for women
- iv. Blood pressure > 135/85mm/hg
- v. Fasting glucose > 110mg/dl

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2) Fitness and Obesity

Physical fitness and obesity are directly related to the overall risk associated with cardiovascular disease. According to a retrospective case control study, there was a five-fold increase in risk of sudden cardiac death for those with cardiomegaly which is significantly prevalent in obese individuals (Justin Yang, 2013). Overall cardiorespiratory fitness measured by maximal aerobic capacity in metabolic equivalents shows a substantially lower rate of mortality and coronary heart disease / cardiovascular disease in subjects with a maximal aerobic capacity of 7.9 METs or higher with each additional MET of improved fitness correlating to a 15% reduction in cardiovascular events (Kodama, 2009). NFPA 1582 clarifies a higher standard of an MVO₂ at 42 or 12 METs as the break over point. An individual who scores lower than this, according to NFPA, should be classified as having a Category A medical condition which would preclude the person from performing as a member in a training or emergency operational environment by presenting significant risk to the safety and health of the person and others (NFPA 1582).

Recommendations:

1. Maintain or work to reach a healthy weight.
2. Perform regular, moderate-intensity aerobic activity to develop and maintain an MVO₂ at or above 42 / at or above 12 METs.
3. Work with local health and wellness resources to develop a specific cardio and or weight management plan.

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3) Alcohol, Energy Drinks and Tobacco Use

A heavy drinker is defined as a female that drinks 8 or more drinks a week or a male who drinks 15 or more drinks a week (greater than 2 standard drinks/day for men, 1 standard drink/day for women). Binge drinking is defined as greater than 5 drinks within 2 hours for men and greater than 4 drinks within 2 hours for women. Alcohol is often the number two source of off duty caloric intake in firefighters (Haddock, 2015). Long term alcohol consumption, especially when defined as a “heavy drinker” led to increased risk of Atrial Fibrillation (Loc Djousse, 2004). Circulation also published an article regarding “heavy drinking” and its significant correlation to ventricular arrhythmia and sudden cardiac death (Christine Albert, 1999). These risk factors combined with workplace stress and demanding physical workload further contributes to firefighter cardiac events.

The onset of the first REM sleep period is significantly delayed at all doses and appears to be the most recognizable effect of alcohol on REM sleep followed by the reduction in total night REM sleep. (2013 Apr;37(4):539-49. doi: 10.1111/acer.12006. Epub 2013 Jan 24. **Alcohol and sleep I: effects on normal sleep.**[Ebrahim IO¹](#), [Shapiro CM](#), [Williams AJ](#), [Fenwick PB.](#))

Our study findings suggest significant prolongation of the QT interval 2 hours after energy drink consumption when compared with caffeine. Systolic BP remained significantly elevated over the caffeine control at 6 hours post energy drink consumption. Ingredients contained in energy drinks other than caffeine warrant further investigation.

J Am Heart Assoc. 2017;6:e004448; originally published April 26, 2017; (Randomized Controlled Trial of High-Volume Energy Drink Versus Caffeine Consumption on ECG and Hemodynamic Parameters) Emily A. Fletcher, PharmD; Carolyn S. Lacey, MD; Melenie Aaron, BS; Mark Kolasa, MD; Andrew Occiano, PharmD; Sachin A. Shah, PharmD

Tobacco use contributes to overall health issues. Smoking is a significant risk factor for cardiovascular disease and nearly 50% of all firefighters that experience a coronary heart disease related death were smokers (Stefanos Kales, 2017). Smokeless or chewing tobacco is more common among firefighters than the normal population. Smokeless tobacco has similar cardiovascular effects to smoking, however the total amount of nicotine absorbed is generally higher and lasts longer than from cigarettes. All tobacco use leads to increased risk of coronary artery and peripheral vascular disease (Benowitz, 1988).

Recommendations:

1. Reduce overall alcohol consumption, being certain to avoid “heavy” and “binge” drinking
2. Utilize appropriate resources offered as needed to manage alcohol consumption, including EAP, Fire Strong, Peer Support Team, Chaplain, etc.
3. Promote a tobacco free workplace and encourage tobacco cessation

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4) Nutrition

Emphasis on healthy dietary patterns in the reduction of CVD is strongly supported in research by the American College of Cardiology. Strong evidence suggests Firefighters need to shift their nutrition, as much as possible, toward natural, whole foods and away from processed carbohydrates and sugar. Although an occasional celebration can be harmless, regularly eating foods that are toxic to your body will only worsen the epidemic of obesity and low fitness that plagues the fire service.

Recommendations:

10 steps to take control of your nutrition (Poston, Haddock, & Jahnke, 2011)

1. *Decide to get serious about nutrition.* Think carefully about what you eat, plan ahead, and stock the kitchen at the firehouse with healthy foods and snacks.
2. *Encourage a culture of healthy eating in the department.* It is difficult to maintain good nutrition when efforts are met with negativity from others. Publically support a firefighter who suggests having healthier snacks at the firehouse. Ask local dietitians or fitness professionals to come speak about healthy eating at department meetings to discuss ways to overcome barriers to healthy eating such as cost and access.
3. *Reduce the amount of processed foods* (e.g., foods that come in a wrapper or box) and refined sugars in the home and the firehouse. In particular, avoid white flour, white flour products, and white rice.
4. *Eat high-quality vegetables and fruits.* Focus on eating the highest-quality food that you can find. Food is one area where cheap is not a bargain; you will pay dearly in how you feel, your health, and your quality of life if cost is the only consideration for what you eat.
5. *Focus on high-quality meats and eggs and limit processed meats.* Select meats and eggs that are naturally (e.g., grass-fed beef, wild caught fish, hormone free) and locally produced when possible. Try to avoid highly processed meats such as cold cuts.
6. *Round off your diet with nuts and seeds.* Great options include almonds, macadamia nuts, and walnuts. Nuts and seeds are packed with healthy nutrients and help to keep you feeling full and energetic.
7. *Eliminate trans-fats and high-fructose corn syrup from your diet.* This is getting easier to do as more and more food manufacturers eliminate both of these problematic ingredients in their products. However, they are still out there so read the food labels.
8. *Be sure to drink plenty of water.* Come to work hydrated and stay that way throughout the day.
9. *Take a multivitamin/antioxidant supplement and omega-3 fish oil capsules.* Choose high-quality products, including mercury-free fish oil.
10. *Rethink treats and snacks.* Michael Pollan wrote in his book Food Rules that we should “treat treats as treats.”

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5) Hypertension & Left Ventricular Hypertrophy

Hypertension is a well-established risk factor for Cardiovascular Disease (CVD), with increasing risk beginning in the prehypertension stage. Research indicates that firefighting duties result in increased cardiovascular strain as evidenced by near maximal heart rates, an increase in systolic blood pressure, reduced stroke volume, reduction in plasma volume, increased platelet function and clotting potential, as well as an increase in vascular stiffness (Smith, 2016). Fire Fighter fatality studies have shown that uncontrolled hypertension is associated with approximately a 12-fold increase in cardiovascular related fatality (Kales, 2007).

Category	Systolic Blood Pressure	Diastolic Blood Pressure
Normal	<120	<80
Pre-hypertension	120-139	80-89
Hypertension-Stage I	140-159	90-99
Hypertension-Stage II	≥160	≥100
Hypertensive Urgency	>180	>120
Hypertensive Emergency	>180	>120 and target organ damage

Left Ventricular Hypertrophy (LVH) is an independent predictor of Sudden Cardiac Death. Autopsies in firefighters with SCD frequently reveal left ventricular hypertrophy and/or cardiomegaly (an enlarged heart) 56% of firefighters who succumbed to SCD had LVH based on autopsy. In a group of young firefighters (≤45 years), cardiomegaly was found in 66% of SCD victims and it was associated with a 5-fold increased risk of SCD (Justin Yang, 2013).

Recommendations:

1. Routinely monitor blood pressure and control hypertension if present in coordination with your physician through diet and NFA 1581 preferred medications
2. Maintain or take actions to reach a healthy weight
3. Avoid tobacco use
4. Perform regular aerobic exercise
5. Avoid Energy Drink and Pre-workouts

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6) Hydration

Firefighting requires strenuous work in hot environments while wearing heavy and restrictive clothing and carrying heavy equipment. The average 200-pound firefighter assigned to interior operations at a typical structure fire could easily lose two percent of his body mass within 30 to 60 minutes, depending on work intensity and environmental conditions. The decrease in muscle strength and reduced ability to concentrate from this loss of body mass will affect fireground performance. According to NFPA 1584, every member on scene must participate in rehab, maintain his own hydration, advise his company officer when his performance is affected, and maintain an awareness of the status of other members on scene.

Dehydration leads to lower stroke volume and increased risk of adverse cardiac outcomes (R., 2003). Maintaining normal hydration, also referred to as euhydration, is critical for any person participating in physically demanding, high performance activities like firefighting.

Recommendations:

1. Fire Departments should ensure that adequate hydration/re-hydration, rest cycles and medical monitoring is provided for at all training and fireground operations. This can be part of a formalized rehabilitation process or an informal crew based process as is determined to be appropriate.
2. Maintain hydration on a daily basis
 - Try to consume at least half of your body weight in ounces of water; a 200lb individual should drink at least 100 oz throughout the day.
 - Limit alcohol consumption the day prior to reporting for duty and avoid alcohol for at least 8 -10 hours prior to reporting for duty.
 - Avoid high level caffeine products during your duty day.
 - Post urine color charts in restrooms as a self-evaluation tool.
 - Focus on increased water intake day prior to your shift
3. Prior to Fireground Training, Operations or Physical Training
 - Drink at least 16 oz. of water an hour before operations/ exercise to ensure your fluid levels are up to par. If you're dehydrated prior to exercise, try to consume 32 oz. of water.
4. During Fireground Training, Operations or Physical Training
 - Drink cool (40 degrees F) dilute fluids at a minimum rate of at least 8 oz. every 15 minutes or 34 oz. per hour. Those who are dehydrated must drink 8 oz. every 10 minutes or 50 oz. per hour
 - If exercising longer than 90 minutes, drink 8–10 oz. of a sports drink (with no more than 8% carbohydrate) every 15–30 minutes.

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5. After Fireground Training, Operations or Physical Training
 - If the exercise (fireground activity) lasts for less than an hour, the body should have sufficient electrolyte and carbohydrate supplies to maintain optimal performance. Therefore, for short periods of exercise, water is just as good as sports drinks.
 - If exercise (fireground activity) lasts for more than an hour, use a sports drink with electrolytes and carbohydrates along with water to rehydrate the body.
 - If no water was consumed during exercise (fireground operations), aggressively rehydrate at a rate of 16 oz. of fluid every 15–20 minutes

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7) Heat Stress

In 2007, Orange County Fire completed a study with 100 participants, of all fitness levels, wearing full PPE for a 30-minute work cycle simulating live-fire attack drills. After the 30-minute work cycle, the average firefighters core temp was 101.8F, with 44% over 102.1F. After five minutes of rest, the average core temperature continued to rise, and after 15 minutes of rest with no intervention, the average core temperature was still 101.1F. These findings show that on average almost all firefighters are experiencing heat stress after one work cycle in full PPE.

Even moderate heat stress added to moderate intensity exercise was found to reduce endothelial vascular function. This relationship may relate to the increased risk of acute coronary events associated with firefighting (Ives, 2016). Rehab sector is established to help cool firefighters off to a safe level thereby reducing this heat stress risk factor before performing another work cycle. The study found that active cooling was 50-60% more effective than passive cooling. Passive cooling included removing gear lowered temps 0.75F, and a misting fan lowered temps 0.88F. Active cooling includes using a cold and wet towel on head and neck lowered temps 1.18F and forearm immersion in ice water lowered temps 1.22F (Dodson, 2016).

Numerous studies have also been conducted to determine effectiveness of heat acclimation. Overall, performing exercise under controlled hyperthermic conditions that replicate predicted work needs will lead to more complete and sustained heat adaptation (Taylor, 2006).

Recommendations:

1. Utilize Full Rehab Sector after each work cycle per NFPA 1584:
 - Members shall undergo rehabilitation following the use of a second 30 minute or 45 minute SCBA cylinder, a single 60 minute SCBA cylinder, or 40 minutes of intense work without SCBA.
2. Participate in Passive and Active Cooling
 - Remove all protective clothing, including boots, to allow for maximal cooling and utilize a misting fan where appropriate. Cold wet towels on head and neck and or forearm immersion in ice water buckets are both inexpensive and highly effective options.
3. Perform regular drilling and exercise that replicate working conditions, especially in turnouts to produce effective heat acclimation. Provide an adequate period of time to adapt to the increased workload and stress, adding additional time and turnouts slowly and incrementally. Retaining a physical capacity to respond remains a priority.
4. Maintain proper hydration – noted in prior section

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