Running head: FIREFIGHTER PHYSICAL TRAINING: RUNNING

Leading Community Risk Reduction

Physical Training for Recruit Firefighters: The Value of Running

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September 2005

Abstract

Injuries have occurred during running in basic firefighting training. The purpose was to determine: related fire service standards, if running is necessary, how to make running safer, causes of running injuries, and alternatives to running. Descriptive research used literature review, local injury data, a survey of similar fire departments, and interviews. The results indicated NFPA 1983 is a recognized standard, fire departments do include running in recruit physical training, running is a viable part of basic firefighting training, several precautions may reduce running injuries, and there are alternatives to running but running is the best option for building aerobic capacity. It was recommended that running continue to be part of physical training for recruit firefighters with implementation of improved procedures.

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Physical Training for Recruit Firefighters: The Value of Running

Firefighting has always been a very dangerous and physical activity. Death and injury are a constant threat during firefighting activities. Improved firefighter physical fitness has increasingly been considered one of the best ways to reduce the probability and severity of line of duty death and injury. In an attempt to reduce firefighter death and injury, most career fire departments include a physical training regimen as a part of their basic fire training program and have some requirements for maintaining physical fitness throughout a firefighter's career. Many of these physical training programs include running as one of the primary activities. As with any physical activity, running may cause some injuries.

This research project was initiated as a result of excessive running injuries during basic fire training courses. The problem is 21 running related injuries, most minor, have occurred since January of 2002 during Gwinnett County Fire and Emergency Services recruit training programs. (See Appendix A) These injuries may have resulted in pain, lost time, and in rare cases, loss of employment for new recruits. As a result of new employee injuries, the department may experience loss of valuable training time, delays in filling vacancies, additional costs, and increased risk. Although each injury was evaluated by training staff and the department Safety Committee, little study of the collective running related injuries had been conducted.

The purpose of the research was to determine what the fire service considers typical recruit firefighter physical training, determine if running is an appropriate physical training activity for recruit firefighters and, if deemed appropriate, how it can be done more safely, evaluate the possible causes of running injuries, and search for possible alternatives to running that may provide similar benefits with less injuries.

Descriptive research was used to answer the following research questions:

1. What are the industry standards for recruit firefighter physical training?
2. Is running a necessary and appropriate activity for recruit firefighter physical training and if so, what can be done to prevent injury?
3. What are the possible causes of running injury?

4. Are there alternative physical training activities that are safer, readily available, and provide the same benefits as running?

The research questions were addressed through a literature review, local risk management program documents, a survey of similar fire departments, and interviews.

Background and Significance

Gwinnett County is a suburb of Atlanta Georgia covering 437 square miles with a population of approximately 700,000. Gwinnett County Department of Fire and Emergency Services is the only fire department in the county and provides fire, rescue, and emergency medical services for the entire area including 15 legal jurisdictions. Gwinnett County has been one of the fastest growing areas in the United States for several years with few signs of slowing. Since its inception in 1971, the fire department has grown to 25 fire stations with additional stations under construction and in planning. (Gwinnett County Government, 2005)

Gwinnett County Department of Fire and Emergency Services has a workforce of approximately 650 personnel with continued growth projected. Employees are trained by the department's Fire Rescue Training Academy/College (Fire College). The Fire College has a current staff of 15 including the Director of Training, two Administrative Assistants, two Training Supervisors (Captains), two Training Coordinators (Lieutenants), six Training Officers (Engineers and Firefighters), and two operations personnel on long term, temporary assignments. In addition to training staff, the department's company officers are all required to be certified fire instructors. The Fire College is responsible for fire and emergency medical training and education, research and development, the Health and Safety Committee, and related programs.

One of the primary responsibilities of the Fire College is Fire Recruit Training. The department's fire recruit class is 640 hours over a period of 16 weeks and includes typical basic fire training topics and National Professional Qualifications certifications. New employees complete training leading to National Registry EMT-I certification after basic fire training and being placed on shift. Firefighting and rescue activities are necessarily very rigorous physical activities and the basic training to prepare employees to conduct these activities safely must

reflect the vigorous physical nature of the job. Physical training to develop strength, endurance, and hopefully, a positive fitness attitude, in employees is a major component of our basic fire training. It is our goal not only to improve new employees physical fitness while in basic training but, to instill in them knowledge, skills, and desire to keep themselves physically fit throughout their careers.

Running has been a vital part of recruit physical training for many years. The department has continuously improved the running regimen in an attempt to make it as safe as possible, however, since January of 2002, 21 running related injuries, have been reported, five in 2002, ten in 2003, four in 2004, and two in 2005 thus far. These statistics are significant considering that in 2004 we trained more recruit firefighters than in other years but had less running related injuries. Although it appears our initial efforts to reduce injury are working, the department must make every effort to ensure that we are both teaching and performing physical training correctly and to the extent possible, injury free.

Although most of the running injuries were relatively minor strains and sprains, even the simplest disrupt the employee's basic training. Inability to participate in drills and physical training may cause the individual to fall behind in skill development and conditioning. Additional Fire College resources are required to assist the injured recruit in making up missed skill stations further taxing an already overtaxed training staff. In a few instances, employees have been placed on light duty for periods that were too long to enable them to make up the material they missed. In most cases, provided the employee is considered viable in all other ways, the department will re-assign what was intended to be an operations position to a temporary job while the employee heals and awaits the next recruit school. In at least two cases, when the employee returned to the next recruit class they eventually resigned. Gwinnett is no different than many other departments in that one of our worst problems is daily staffing and use of overtime. Any loss, even temporary, of an operations employee is a significant event.

In a few cases, new employees have decided early after beginning recruit class that the fire service is not for them. Although no documentation is available, some have mentioned the

physical activity and in particular running as possible reasons contributing to their decisions to resign. It is usually too late in the training process to replace recruits who have resigned so the department must compensate for a vacancy until the next class is hired. When the department has vacant positions, for any reason, it creates a staffing issue. Less people means we cannot serve the customer as well and may add an element of risk to both the department and the community. The often-used alternative, filling in with personnel on overtime, cost the department and the community money.

Although each injury in the department is carefully documented and reviewed by the employee's chain of command and the Safety Committee, considering running injuries individually does not have the same impact as considering them collectively. The tendency was to consider each injury an "accident" rather than a preventable act. By conducting research on the running injuries collectively, and running as a physical training activity in general, the problem was viewed from a more global perspective and better solutions were considered.

This research is linked to the National Fire Academy "Leading Community Risk Reduction" course in several ways. Our main concern is to reduce the risk of injury to our personnel from running during physical training. In addition to the possible pain and lost time to the injured employee, the county assumes the risk of increased costs and liability for on the job injuries. Indirectly, anything that reduces staffing increases risk to other firefighters and to the community. Reducing recruit injuries is a part of community risk reduction. In a few ways, we have involved the community in potential solutions. We have started running in a local park rather than on the highways and streets. This reduces the risk of an accident involving a runner to both the firefighter and the drivers of automobiles. We have also included local businesses in determining appropriate foot ware for recruit firefighters.

This research relates directly to one of the United States Fire Administration's operational objectives: Reduce the loss of life from fire of firefighters. One of the main reasons for having physical training in fire recruit school is to combat the number one cause of firefighter, line of duty deaths, heart attack. Running and related exercises can directly reduce

several risk factors including obesity, high cholesterol, and high blood pressure. (American Heart Association, 2003) Running and related exercises can also improve the capabilities of firefighters heart and lungs. Obviously more fit firefighters may also reduce loss of life in the community including those ages 14 years and below and 65 years and above.

Literature Review

Previous work specifically regarding running as a component of physical training for recruit fire fighters was difficult to find. More general literature about physical training or running was available. There was virtually no literature available specifically on fire service running injuries however, literature regarding fire fighter deaths due to heart attack during recruit physical training, and specifically running were available. This finding led to a broadening of the literature review into sources concerning prevention of heart attack, typically the leading cause of fire fighter death each year.

12 case studies concerning fire fighter death during physical training were reviewed, 10 from the National Institute for Occupational Safety and Health (NIOSH), one from Frederick County Department of Fire and Rescue Services, and one from Jacksonville Fire-Rescue. Sources indicate that while running is one of the best ways to prevent death and injury, particularly from heart attack and related causes, that it can at times be a contributing factor. Along with reducing the minor injuries that initiated this research, consideration was also given to prevention of running and physical training related deaths.

The National Institute for Occupational Safety and Health (NIOSH), *Death in the Line of Duty* reports are part of the Fire Fighter Fatality Investigation and Prevention Program. The 10 reports reviewed were all related to sudden cardiac death during physical fitness training or rigorous basic fire training. All the deaths reviewed have occurred since 1997. Circumstances leading to the deaths were varied and included: previously unknown conditions, varied ages, different tasks being performed, different levels of treatment available at different times, and others. Not all of the deaths reviewed were during recruit fire training and not all were during running activities. The value of the NIOSH reports was primarily in the recommendations that

were similar for most of the cases reviewed. The following list is a compilation from several reports.

1. Consider incorporating exercise stress tests as part of the fire department's medical evaluation program. (NIOSH, 2004 January)
2. Equip Training instructors with portable radios. (NIOSH, 2004 January)
3. Ensure defibrillation equipment is readily available for emergency use during training. (NIOSH, 2004 January)
4. Conduct Mandatory pre-placement and annual medical evaluations consistent with NFPA 1582 on ALL fire fighters… (NIOSH, 2004 January)
5. Ensure that Firefighters are cleared for duty by a physician knowledgeable about the physical demands of fire fighting. (NIOSH, 2005 July)
6. Provide exercise equipment in all fire stations. (NIOSH, 2002 October)
7. Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by phasing in a mandatory wellness/fitness program for firefighters. (NIOSH, 2001 April)

The NIOSH recommendations provide both suggestions for making physical training safer and justification for physical training including running.

The line-of-duty death of firefighter recruit Andrew J. Waybright occurred July 3, 2002 in Frederick County, Maryland. Firefighter Recruit (FF-R) Waybright was a member of Recruit Class No. 6 that had begun July 1, 2002. He was a 23-year-old male, six feet two inches in height and weighing 247 pounds. He was an EMT-B and had previous firefighting experience with Taneytown and Harney Volunteer Fire Companies. He had exercised and lost weight in preparation for the recruit class. Waybright participated in a recruit class physical training session beginning at about 0700 and collapsed near the end of the session prior to 0810. He was transported to the emergency room and died at 0922 with a core body temperature of 107.4 degrees Fahrenheit. The cause of death was concluded to be hyperthermia by the Chief Medical Examiner for the State of Maryland. (Board of Inquiry, Frederick County Maryland, 2002)

FF-R Waybright's death led to the formation of an independent Board of Inquiry that was charged with investigating the circumstances surrounding the death. The Board met 18 times over six months and conducted 41 interviews, analyzed departmental policy, procedures and practices, and reviewed related documentation including dispatch tapes and the autopsy report. From their findings, the Board produced a report that made 64 recommendations in five categories:

1. Preparation for the Physical Training Session
2. Weather Factors
3. The Physical Training Event
4. Related Training Issues
5. Interviews

(Board of Inquiry, Frederick County Maryland, 2002)

The reported recommendations have proven to be some of the most valuable information found for this project. (See Appendix B)

Recruit Class No. 6 began July 1, 2002 with administrative tasks. Day two included an "exercise run" of 2.78 miles without incident. Wednesday, July 3, 2002 began with recruits signing in from 0630–0700 followed by a physical training session. The Acting Lieutenant of Training and Safety who would normally have led the physical training was off duty and replaced by a firefighter/paramedic. The substitute had not received substantial training or certification in leading physical training nor was he provided with guidelines or curriculum to follow.

The physical training group was accompanied by three additional persons who were on-site to prepare for a Combat Challenge Team event. One person for the entire evolution and two for part of it. The class walked for a short distance, then began to jog until reaching a park. At this time the group stopped to perform calisthenics including significant exercises. After calisthenics, the group jogged a bit more then stopped to perform wind sprints up a hill. One recruit reported being dizzy and was advised to sit down by the instructor. When recruits could

not perform the wind sprints as ordered, the instructor required students to perform push-ups, and continue with the wind sprints. After wind sprints, the group re-assembled and continued jogging. As they approached the training center, FF-R Waybright collapsed. Recruits had traveled approximately 4.34 miles. (Board of Inquiry, Frederick County Maryland, 2002)

The July 3, 2002 physical training session was considerably more difficult than the day two session led by the primary instructor. On day two, the department had presented to recruits a power point class indicating the importance of re-hydration, however, throughout the entire exercise period, no water for re-hydration was provided.

After the collapse, the one remaining member of the Combat Challenge Team who had accompanied the group and the instructor stayed with Waybright. The instructor ordered the rest of the group to return to the training center unsupervised. After a short time the instructor left Waybright with the Combat Challenge Team member to return to the training center for help. He asked another combat challenge team member to get a truck and go to assist with FF-R Waybright. On his arrival, Waybright had gone unconscious and he was told to go get help. The combat challenge team member returned to the training center and asked another member of the department to call 911, picked up a paramedic, and returned to the scene. The 911 center received the call at 0810 and dispatched an ambulance at 0813. A supervisor also responded. The combat challenge team member dropped off the paramedic then returned to the training center for water. When he again returned to the scene, CPR was in progress. The Combat Challenge team member once again returned to the training center to get EMS supplies but could not find them. He picked up another firefighter with a personal aid kit and returned to the scene. The EMS supervisor had arrived and had initiated advanced life support measures by 0817. The ambulance left with Waybright at 0832 and arrived at the hospital at 0840. (Board of Inquiry, Frederick County Maryland, 2002)

Several recommendations of the Board of Inquiry were influential to this project and are listed in abbreviated form. (See Appendix B)

A 22-year-old Jacksonville Florida Fire-Rescue recruit died nine days after collapsing May 19, 2005 during physical training. (Firehouse.com) In an interview with Captian Nick Tyson of Jacksonville Fire Department, it was found that Firefighter Karl Kramer was 10 weeks into his basic training program. Kramer was approximately six foot, three or four and weighed approximately 305 pounds. The temperature at the time of the collapse was approximately 79 degrees Fahrenheit. The autopsy results were not available at the time of the interview. It is speculated that an existing condition may have contributed to death by hyperthermia.

Three articles were reviewed that dealt with firefighter deaths in general, and led to some conclusions on how to prevent them. The July/August 2005 *NFPA Journal* included the National Fire Protection Association's (NFPA) report *U.S. Firefighter Fatalities for 2004.* "Stress and overexertion, which usually results in heart attacks or other sudden cardiac events, continued to be the leading cause of fatal injury." (Leblanc and Fahy, 2005) When separated by cause of injury, 50 % of firefighter deaths in 2004 were caused by overexertion or stress. When categorized by nature of injury, 47 % of firefighter deaths in 2004 were caused by heart attack. "Over the 25 years NFPA has published this study the number of deaths annually in this category has dropped by a third." (Leblanc and Fahy, 2005) A recent sharp increase in sudden cardiac death among firefighters has been noted from 37 in 2002 to 47 in 2003 and 48 in 2004. This article suggests several NFPA Standards as providing guidelines to assist in the prevention of firefighter deaths. NFPA 1500 *Fire Department Occupational Safety and Health Program,* NFPA 1583, *Health-Related Fitness Programs for Firefighters,* and NFPA 1582, *Comprehensive Occupational Medical Program for Fire Departments*. These documents suggest a multifaceted approach to prevention of firefighter death and injury including medical assessment, and physical fitness.

Sudden Cardiac Death: U.S. Firefighter Fatalities Due to Sudden Cardiac Death 1995-2004 is a companion article to *U.S. Firefighter Fatalities for 2004.* The term "sudden cardiac death" is used as an umbrella term to include heart attacks, as well as other heart related deaths. (Fahy, 2005) 1006 firefighter fatalities over a 10-year period were studied. Of those studied, 440

or 43.7%, fell into the sudden cardiac death category. (Fahy, 2005) Over half of those with documented prior medical conditions had known heart problems. (Fahy, 2005) This raises questions as to why those with known conditions would be allowed, or choose, to continue firefighting and stresses the importance of continued medical evaluation throughout the career. As would be expected, more deaths falling into the cardiac category occur in older firefighters with significant increases after age forty and very significant increases after age 60.

The following steps are suggested by Fahy to reduce the risk of heart attacks among firefighters.

1. Conducting Annual Medical Evaluations.
2. Screening for Coronary Artery Disease (CAD) risk factors.
3. Conducting exercise stress tests for those with CAD risk factors.
4. Giving appropriate treatment for those risk factors and restrictions for firefighters with positive stress tests.

The significance of these suggestions for this research is in two areas. Appropriate medical assessment prior to beginning firefighting training will not only be beneficial for finding cardiac related conditions but also for finding conditions that may contribute to other possible injuries during training including physical training and running. The second area of significance relates to the risk factors for sudden cardiac death. “The risk factors for CAD include diabetes, smoking, high cholesterol, high blood pressure, family history, obesity and physical inactivity.” (Fahy, 2005) Other literature and research indicate that most of these are effectively reduced by regular physical training, specifically rigorous aerobic exercises such as running, bicycling and swimming.

In his article *The Key to Reducing Firefighter Deaths*, in *Firehouse*, August 2005, Dr. Raymond Basri, MD, FACP states “One statistic says it all: every year, nearly half of the line-of-duty deaths of U.S. firefighters are caused by heart attacks.” Written from the perspective of a physician, Dr. Basri’s suggestions echo the recommendations of Fahy and NIOSH regarding medical assessment. The same risk factors seen in other literature are reiterated: high blood

pressure, high cholesterol, elevated blood sugar, smoking, obesity, old age, and family history. Basri points out that some risk factors can be controlled and some cannot. He goes on to state "the more risk factors you have, the greater your chance of developing coronary heart disease at a younger age. Also, the greater the level of each risk factor, the greater the risk." (Basri, 2005)

Basri also suggests a new perspective for firefighters. "The bottom line is this: firefighters must view themselves as athletes who work at maximum emotional and physical stress levels without the advantage of a warm-up in a game that is not win or lose, but life or death." (Basri, 2005) Like others, Basri (2005) reminds us that many of the firefighter deaths are preventable by "improving the maintenance on our human machines." Although Basri's article focuses on health screening and assessment, it clearly establishes that the risk factors contribute to firefighter death by heart attack, and that the firefighters job is much like that of an athlete.

The American Heart Association's Journal, *Circulation* 2003, 107:3109, included an American Heart Association Scientific Statement entitled *Exercise and Physical Activity and Treatment of Atherosclerotic Cardiovascular Disease*. Backed by numerous studies, American Heart Association makes it clear that physical activity using large muscle groups, such as walking, running, or swimming, produces cardiovascular adaptations that increase exercise capacity, endurance, and skeletal muscle strength. In addition, "habitual physical activity prevents the development of coronary artery disease (CAD), and reduces symptoms in patients with established cardiovascular disease. (American Heart Association, 2003) They go on to state that there is evidence that exercise reduces the risk of diabetes and obesity, both risk factors for cardiac related problems. The American Heart Associations statements in this article are central to this research because they validate that appropriate physical training does reduce the risk of heart problems and reduces many of the underlying risk factors. They also cite agreement with other significant organizations. "this evidence supports the recommendation from the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) that individuals should engage in 30 minutes or more of moderate-intensity physical activity on most (preferably all) days of the week." (American Heart Association, 2003)

In the prevention of atherosclerotic vascular disease, the report states " The results are strong, with the most physically active subjects generally demonstrating CAD rates half those of the most sedentary group. Physical activity prevents and helps treat many risk factors including elevated blood pressure, insulin resistance, and glucose intolerance, elevated triglyceride concentrations, low high-density lipoprotein cholesterol (HDL-C) concentrations and obesity." (American Heart Association, 2003) Although clearly validating the benefits of exercise in the prevention of heart related death and reduction of risk factors, the American Heart Association also points out that additional studies are needed on the risks associated with exercise and that individuals with high risk factors or cardiovascular disease should have an exercise stress test prior to vigorous exercise. This is in agreement with NIOSH, NFPA, and other literature specifically related to firefighter deaths.

The American College of Sports Medicine (ACSM) in their publication *Fit Society Page* agrees "good cardiovascular endurance indicates that you are at reduced risk for developing heart and lung disease." (Lloyd, 2001) In the 2001 article, *Are You Ready to Exercise: How to Start an Exercise Program,* Lisa K. Lloyd and the ACSM suggest that "aerobic activities should be performed three to five times each week for 20-60 minutes at an intensity that is equivalent to 65 percent to 90 percent of your maximal heart rate." This recommendation is for the general public. Aerobic activities may include walking, jogging, in-line skating, dance aerobics, swimming, cross-country skiing, and bicycling. The heart rate calculations involve three steps.

1. Maximum Heart Rate (MHR) = 220 – [your age] = _____ beats per minute
2. 65 % of Maximum Heart Rate = 0.65 x [MHR] = _____ beats per minute
3. 90 % of Maximum Heart Rate = 0.90 x [MHR] = _____ beats per minute

(Lloyd, 2001)

These guidelines are cited in other respected literature and are important to this research in that all exercises, including those that are explicitly firefighter job related, may not enable the firefighter to reach the optimum heart rate for the appropriate amount of time. This challenges

firefighters and departments to either discover exercises that are both job related and provide the aerobic benefits needed to best combat heart attack, or choose between them.

In an article from ACSM, *Current Comment,* June 2002, entitled *Energy Expenditure in Different Modes of Exercise,* Len Kravitz and Chantal Vella agree with the fire service when they state "One of the primary goals of any exercise program is to develop and maintain cardiorespiratory fitness. It is important to select a mode of exercise that uses the large muscles of the body in a continuous, rhythmical fashion, and that is relatively easy to maintain at a constant intensity." (Kravitz and Vella, 2002) This fact greatly reduces our choices for aerobic physical training when determining how firefighters should best exercise for better cardiac health. Kravitz and Vella cite the ACSM classification of aerobic exercise modalities. Group I activities include walking, cycling, simulated stair climbing, and jogging. These activities provide a constant intensity and energy expenditure that is not dependant on the participants skill level. Exercises such as aerobic dancing, bench stepping, hiking, swimming, and water aerobics are examples of Group II activities. An individual's skill level will greatly influence and vary the rate of energy expended. Group III activities are even more varied in terms of energy expenditure. Both skill levels and the pace of the activity will have an influence. Group III activities include sports such as basketball, volleyball, and racket sports. (Kravitz and Vella, 2002)

The energy expenditure relates to the cardiorespiratory benefits of the exercise and must be considered when determining what activities are best suited for firefighter physical training. Other considerations include the individual's interest, equipment and facility availability, physical needs, injury risk, and fitness goals. In selecting an "exercise mode" it is recommended that it allow varying the intensity of the activity to increase the energy expenditure and overload the cardiovascular system for short periods. Exercises such as swimming, rowing, and simulated skiing, although including the upper body, do not necessarily engage as much muscle mass as running and so will expend fewer calories at a similar level of intensity. (Kravitz and Vella, 2002) The implication is they will be less effective in improving aerobic capacity and therefore

in preventing heart related problems. Swimming, however, places less pressure on the bones and joints and may reduce the potential for injury.

Another consideration is non-weight bearing versus weight bearing modalities. At the same level of intensity, most will expend more calories performing a weight bearing activity such as running or walking than a non-weight bearing activity such as cycling or a recumbent bike. Additional benefits of weight bearing exercises include maintaining bone mass and preventing osteoporosis, however, non-weight bearing exercises may cause less trauma and allow longer exercise periods. “Research results suggest that weight-bearing aerobic exercise, at a self-selected intensity will elicit the highest energy expenditure. (Kravitz and Vella, 2002)

Several articles were reviewed from fire service literature. In his April 1994, *Fire Engineering* Column, *Training Notebook, Endurance Training for Firefighters,* Frank Fire Jr. agrees with the points discussed in the American Heart Association and American College of Sports Medicine literature. Exercises or sports that optimize endurance include running, bicycling, and swimming along with jumping rope, stair climbers, stationary bikes, and rowing machines. Aerobic Exercise should be done for 20-50 minutes three times per week. The heart rate should be kept in a target range during the exercise period. Fire goes on to discuss details of warming up and each of the exercises listed above.

An August 2003 *Firehouse* article, *The Fire fighter Fitness Pentagon* by Rod Hammer, echoes other literature regarding the benefits of physical conditioning to reducing firefighter death by heart attack. Hammer discusses the need for a balanced approach to physical training. He identifies five components: flexibility, muscular strength, muscular endurance, aerobic capacity and body composition. In the section on aerobic capacity, Hammer states, “the most physically intense tasks performed on the fire ground, require aerobic capacity levels equal to running seven miles per hour.” (Hammer, 2003) He points out that the firefighter with the greater aerobic capacity will be able to perform at higher intensities, for longer periods using less air.

This assumption is validated by William D. Gilman and Paul O. Davis in their March 1993 *NFPA Fire Journal* article, *Fire Fighting Demands Aerobic Fitness.* This study compared

firefighter's heart rates in training fires and exercise tests to determine the level of aerobic fitness required for sustained fire suppression activity. The findings support others assertions that firefighting places heavy demands on the cardiovascular system. "Aerobic capacity refers to the body's ability to take in, transport and use oxygen. The maximum value is expressed as VO_{2max} and reported in liters per minute (L/min aerobic capacity) or relative to body weight, in milliliters per kilogram of body weight per minute (ml/kg/min-aerobic power). (Lecuyer, 1998) "Recommendations by Sothmann et al. found that firefighters should have a minimum aerobic fitness level of at least 33.5 ml/kg/min to complete tasks and an aerobic capacity of 41 ml/kg to allow a safety reserve. (Gilman and Davis, 1993) This closely corresponds with findings from similar research.

Determining aerobic capacity is usually a complicated and time consuming process using a treadmill or cycle ergometer and other equipment to measure respiratory gasses. In his February, 1998 *Fire Engineering* article, *Assessing Firefighter Aerobic Capacity: the Rockport Field Test*, John Lecuyer used firefighters to develop a simplified method of determining aerobic capacity by walking. He maintains "the Rockport one-mile walking test provides the most accurate, inexpensive alternative for field testing multiple subjects." (Lecuyer, 1998) Data using the VO_{2max} values is a method of correlating the necessary fitness levels for firefighters, particularly relating to cardiorespiratory capacity, and the physical training programs needed to achieve them. It may be used in demonstrating job relatedness for fire fighter physical training activities.

The website justmove.org in their publication *Fitness News* cites much of the American Heart Association information discussed previously, including the recommendations for frequency and intensity of exercise and the recommended aerobic activities. They add "adults who maintain a regular routine of physical activity of longer duration and greater intensity are likely to have greater benefits" (Fitness News, 2002) They caution that physical training should not be overdone since too much exercise could cause injury. A balance must be found that is both safe and beneficial. When asked the question, what type of activity is best for improving the

fitness of your heart and lungs? *Fitness News* answers: More vigorous physical activities such as running, swimming, bicycling, roller-skating and jumping rope. They recommend at least three to four times a week for 30-60 minutes at 50–80 percent of maximum capacity. (Fitness News, 2002)

The Candidate Physical Ability Test (CPAT) is a development of the Fire Service Joint Labor Management Wellness/Fitness Initiative. CPAT is a process of testing the physical abilities of candidates for the job of firefighter. It was designed using a process that attempted to create a fair and equitable test that could be standardized and used throughout the fire service. Whether or not that objective has been met, much good has come from CPAT including several ideas applicable to this research. The information is found in the *Candidate Physical Ability Test* manual. The primary component reviewed for this project was Appendix 3-1, CPAT Candidate Preparation Guide.

The idea of "candidate preparation" is, for the fire service, a novel approach. Career fire departments, until CPAT, have not typically considered assisting candidates in preparing for a pre-hire physical ability test. This practice has come about partially to ensure an adequate number of candidates are available for hire but more to ensure that an adequate number of candidates in protected classes are available for hire. "This program will ensure that new fire fighter candidates are more physically capable of performing the challenging job of a fire fighter, while making it possible to improve the diversity of the fire service." (Fire Service Joint Labor Management Wellness/Fitness Initiative, 1999)

The CPAT *Candidate Preparation Guide* is to be given to candidates several months prior to taking the Candidate Physical Ability test. It outlines, in a very simple and effective style, topics such as how and why to exercise, hydration, warm-up and stretching, and exercises to perform in each of four physical fitness areas: flexibility, cardiopulmonary endurance, muscular strength, and muscular endurance. Although candidates who participate in a preparatory physical fitness regimen will certainly improve their chances of passing CPAT, an

added benefit will be that candidates, once hired will be in better shape to participate in a physical fitness program as a part of recruit school.

The CPAT *Candidate Preparation Guide* was developed with advice from professional fitness experts. As a part of their suggested cardio-pulmonary endurance program they provide phase one and phase two weekly schedules with five gradually increasing levels in each phase. Running is included as a part of each component, gradually increasing in mileage and intensity over the course of 10 levels. They introduce the principle of progression, which states that: " as the body adapts to the exercise program you must gradually increase the overload to continue to adapt. It is critical that all progressions are gradual and small in nature to prevent over loading the body's ability to recover." (Fire Service Joint Labor Management Wellness/Fitness Initiative, 1999)

Although one of the most significant benefits to ongoing physical training for firefighters is a healthy heart and reduction of risk factors for heart attack, others, such as job performance are as important day-to-day. In the February 2002 *Current Comment* article *Physical Training for Improved Occupational Performance,* American Society of Sports Medicine (ACSM) specifies emergency rescue professions as one of the occupations requiring a high level of physical fitness. They go on to assert "Physical Training interventions can increase worker productivity by overcoming limitations in job performance due to inadequate muscle strength power, endurance, or aerobic capacity." (Nindl & Sharp, 2002) One decision that must be made in determining an appropriate program, and one the fire service is faced with constantly, is whether to do job task specific or generalized physical fitness training. Although job task specific training is important to develop job skills, a more generalized physical fitness program is said by ACSM to be more beneficial. "The advantage of a general physical fitness program is that it increases overall physical capacity and fitness of the individual. The training program is not narrowly focused, thus avoiding muscular imbalance. Increased physical capacity may be generalized to other tasks. Generalized physical fitness training using standard exercises reduces risk of injury compared with job specific training." (Nindl & Sharp, 2002)

In an October 2002 article entitled *Association of Body Mass Index and Health Status in Firefighters* in the *Journal of Environmental Medicine,* Sharon Clark and her associates affirm "firefighting related job tasks require high levels of physical fitness for workplace effectiveness and safety. Individuals with greater physical capacity are better prepared to deal with adverse firefighting conditions." (Clark, Rena, Theurer, & Webster, 2002) The focus of this article is on increased body weight and the related adverse outcomes including a lower aerobic capacity. Clark cites other work suggesting that firefighters need a minimum VO_{2max} of greater that 39. This is within the range cited in other work in the literature review.

Better Fitness equals Less Time on the Scene is the title of a June 1994 article by Paul O. Davis in *Fire Chief* magazine. Davis addresses both brute force and endurance and relates firefighter fitness to a "best-case" ignition to extinguishment timeline. Davis states "Ascending levels of fitness correspond with increased fire suppression capacity. A physically fit person can accomplish the same task in as little as one-third the time it takes an out of shape person." (Davis, 1994) Along with better performance, Davis points out a fit firefighter will be safer because of a greater reserve capacity for unforeseen contingencies.

Literature concerning running and physical training injuries, by the American College of Sports Medicine, were reviewed. Sprains and strains and stress fractures were the primary focus. Recommendations for injury prevention included:

1. Wear appropriate running shoes and replace them after 500-700 kilometers of running,
2. Increase training intensity gradually
3. Begin training on surfaces that will absorb shock well such as asphalt, then progress to other surfaces.

(Beck, 2000)

Based on risk factors listed, knowing of pre-existing conditions would also prevent running injuries. One of the best methods of preventing injuries is being in excellent physical condition.

Another article in ACSM, *Fit Society Page, Knowing Risks Often Prevents Serious Sporting Injuries*, covers other useful information including stretching and warm-up and how the

level of fitness affects ones chances of being injured by physical activity. “Generally speaking, the less fit a person is, the greater chance he or she has of getting injured. The best way to prevent and injury is to gradually increase your fitness level.” (Bracko, 2001)

One issue that has been discussed concerning physical training and running as a part of fire recruit schools is the belief that a 12 to 16 week recruit school is not enough time to have an impact on an individuals physical fitness. Our experiences have certainly proven that assumption false with dramatic improvements in all aspects of physical fitness being demonstrated by new firefighters over the course of 16 weeks. Dennis H. Obermeyer in his February, 1995 *Fire Chief* article, *Steps, Pec Decks, and Fire Combat* agrees. “A recent study shows that just a 10-week fitness program can increase a firefighter’s ability to carry out job duties. The study was conducted by the Lady’s Island-St Helena Fire District of South Carolina and the Newberry College Departments of physical education, mathematics, computer science, and physics. They measured body fat, aerobic capacity, and timed a combat challenge style test at the outset, then prescribed a 10-week fitness program for the volunteers. At the end of the 10 weeks, all categories were improved substantially. Most significant were the times to complete the fire related tasks that were reduced by about one third. (Obermeyer, February, 1995)

Two books, specifically about running, were reviewed. Marathon runner and author, Bill Rodgers, in his book *Lifetime Running Plan*, without any thought of recruit firefighting training, makes very valuable points for firefighters in his discussion of the intangible benefits of running. In discussing how runners will each develop their own habits, and methods, he states, “ In all of them, though, you’re going to have one shared goal – keep going.” (Rodgers, 1996) Both “shared” and “keep going” have proven to be critical for firefighters and are values that may be learned through running. Shared: one of the best team building activities in our recruit classes has been the running component. Keep going: each year it seems we read of firefighters who died just one step from the door. Other intangible benefits of running are “feelings of accomplishment, relaxation, and self confidence” (Rodgers, 1996), also important for firefighters.

In chapter one, *Getting Started*, Rodgers advises there is no universal standard but lists two rules for the first month of running:

1. Do not mix time and distance. If the goal is distance, do not worry about how long it takes and if the goal is time, do not worry about how far you go.
2. No more than three miles or 30 minutes.

(Rodgers, 1996)

Rodgers goes on to suggest “ease into it” being consistent and running about four times per week. “If you rush it, you’ll increase your chances of getting hurt.” (Rodgers, 1996) It is more important not to overdo it than it is to do too little. He advises it is appropriate to mix running and walking. In agreement with other literature in the review, he recommends the “talk test” “if you can’t carry on a conversation while you’re running then you’re going too fast”. (Rodgers, 1996) As time goes on, and running gets easier, Rodgers recommends increasing the weekly mileage no more than 10%.

Rodgers advises that “there will be a certain amount of discomfort” that comes with moving from unfit to fit but that the greatest improvement is seen initially. One is to expect soreness, aches and pains and it is important to learn to distinguish them from injury. He discusses the dangers of hot weather and dehydration and advised to drink fluids and use urine color as an indication of dehydration. Clear urine indicates appropriate hydration.

In chapter two, Rodgers discusses shoes, clothes, diet, and record keeping. Shoes must fit correctly and match the runner’s needs. Foot strike, how it lands and rolls, will dictate the shoe that is best for each individual. Use of good quality shoes, designed for running, and fitted with professional assistance can significantly reduce injuries. It is also important to replace shoes as they lose cushioning and become worn. The running surface can affect the impact on the runner as well. Rodgers recommends running on even dirt or grass to reduce impact. This advice differs slightly from other literature that recommends asphalt.

Fit and function are said to be the most important issues for running apparel. When warm outside, less is best. When cold, layering is a good idea. Clothes with wicking capabilities to

remove moisture from the body and dry quickly are beneficial at times. Rodgers recommends a good running suit over department store sweats. Any clothing that will chafe is not recommended.

Rodgers believes “too much importance is placed on the runners diet.” (Rodgers, 1996) The diet should not be radically different than any healthy diet. Rodgers does give more specific dieting information for older runners, referred to as “master runners”. He stresses it is important for all to drink more water.

Rodgers makes several good points for the fire service in chapter three *Getting Fast*. Although this chapter is primarily for those preparing to race, information important to firefighters can be derived. Rodgers discusses the psychological side of running including “mind over matter”, mental toughness, and pushing yourself. These are important lessons for all firefighters that can be learned partially through running.

The fourth chapter, *Staying Healthy*, discusses running injury treatment and avoidance. The author discusses the ten major running injuries including prevention measures for each. Prevention measures include: appropriate running shoes, medical support if you have flat feet or non-neutral foot strike, running on soft, even, surfaces, include calcium in the diet, warm up correctly, stretch correctly, strengthening all related muscles including abdominal muscles, and maintain good posture. “Easing into it” and stopping or reducing running with abnormal pain also serve to reduce injury.

Cross-training, particularly strength training, is discussed as a method of preventing running injuries. It is important for runners to increase the strength of the muscles connective tissues and to increase strength equally to avoid compensatory injuries due to weakness in one part of the body. Calisthenics and weight lifting are both recommended as appropriate methods of building strength.

Rodgers agrees with other literature in recommending appropriate rest to prevent injury and over-training. He is not specific in his recommendations but clearly validates the importance of rest as part of a well-rounded exercise program.

"As with diet, stretching is one of those areas in which you are most likely to encounter zealots, both pro and con. Some people swear that an intricate, daily stretching ritual is the only thing that keeps them alive, much less running, On the other hand, some runners think stretching is an invitation to injury, and avoid it like they do cigars." (Rodgers, 1996) This comment is born out by other literature in the literature review. Rodgers believes runners should stretch, but within reason and using appropriate guidelines. Do not confuse the warm-up and stretching. Stretching should be done after muscles are warm, after running. Do not over stretch in either time or intensity. Injuries can occur by stretching too far.

Rodgers includes a "Women's Running Section" in Chapter four with advice from Joan Benoit Samuelson. There are unique concerns related to women and running including eating disorders, menstruation, amenorrhea, and osteoporosis. Special considerations and a doctor's advice should also be considered during pregnancy. A sports bra should be added to the apparel considerations for women.

Chapter five is entitled *Getting Older*, and has some information pertinent to fire fighters. As we age our VO_{2max} drops about one percent per year past age 32. Many fire departments, have an average firefighter age of greater than 32. Rodgers points out that training must be altered to further improve aerobic capacity and that it may take longer to recover from significant effort. He also advises that crosstraining becomes more important to maintain muscle mass and strength and that flexibility and bone mass, are also reduced with age. These considerations must be taken into account when planning physical training for older fire recruits.

The second running book reviewed was *Running with Lydiard,* by Arthur Lydiard and Garth Gilimour. Lydiard had 48 years of experience as an athlete and coach at the time of writing and has developed a widely use physical training system based on a balanced combination of aerobic and anaerobic running. His methods, though not by name, have been referred to in other literature reviewed for this project. Lydiard begins with a detailed discussion of the physiology of exercise, more detailed than is necessary for this project, however, the information validates

and agrees with the standards, such as the percentage of maximum heart rate, and other information set forth by other sources.

One important assertion made by Lydiard is “every athlete is a distinct individual with subtly different reactions.” (Lydiard, 2000) In a perfect world, each individual would participate in a physical training program designed specifically for him or her. He also states that we have learned enough “to enable us to lay down, with considerable accuracy, training parameters or guidelines” (Lydiard, 2000) Lydiard also gives justification for running as an exercise in stating “it is not just a matter of working muscles, exercise requires continuing adjustments in respiration, chemical reactions, circulation, temperature-regulating mechanisms, kidney function and so on. The entire body is involved when you run – one of reasons why running is such a fine general conditioner.” (Lydiard, 2000)

“Aerobic running means within your capacity to use oxygen.” (Lydiard, 2000) Running/working within a rate at which your body can breath in, transport, and use oxygen is aerobic exercise. The limit is considered the maximum steady state. Beyond the maximum steady state the body is oxygen deficient and the running/work becomes anaerobic. Lydiards program begins with aerobic training, for at least five weeks, to develop the aerobic capacity. He goes into details in describing the physiology. After steady work to build aerobic capacity, Lydiard recommends pushing to anaerobic levels, on a periodic bases, for continued development. The critical point for this project is the validation of the “ease into it” factor shared in other sources. “The daily program of sustained aerobic running is absolutely essential to achieve the correct respiratory and circulatory development and the longer the periods of running the better the results will be. The anaerobic section of your preparation should be tackled only after you have developed aerobic capacity and maximum steady state possible level.” (Lydiard, 2000)

Lydiard agrees with Rodgers regarding warm-ups for about 15 minutes, but adds that it is important to increase the pulse rate as well. Lydiard advises some athletes incorporate stretching and calisthenics into the warm-up but that the value depends upon the goal of the athlete. There

is no gain from excessively long warm ups. Cooling down or warming down is equally important to warming up.

Lydiard adds to running technique to the list of previously identified methods of preventing injury. “People who run on the balls of their feet and can not get their heels down first when running aerobically are more susceptible to foot troubles than the runners who land nearly flat footed, touching the heel somewhat on the outer edge and then rolling forward onto the ball of the foot and toes.” (Lydiard, 2000) Particullary for runners who run on their toes, he recommends running on grass or sand, not because it is a softer surface, but to reduce friction causing a braking action and possible injury. Lydiard agrees that strengthening the muscles, particularly front leg muscles, will assist in preventing knee problems. “Ill-fitting or worn down shoes can cause knee or hip problems.” (Lydiard, 2000) Achilles and tendon problems are often a result of resistance or strength training rather than running. Hamstring trouble may be caused by speed running with out proper warm-up and stretching. Pulled muscles may be prevented by proper warm-up and improved conditioning. If running on the road, Lydiard recommends switch sides of the road periodically to prevent injury from compensation for the roads camber. Lydiard re-emphasizes the importance of well fitting, proper shoes and proper warm-up for injury prevention.

Three related National Fire Protection Association (NFPA) standards were reviewed in the literature review. NFPA 1500, *Standard on Fire Department Occupational Safety and Health*, has pertinent information in Chapter 10, *Medical and Physical Requirements*. NFPA 1500, 10.1.1 states “Candidates shall be medically evaluated and certified by the fire department physician.” (National Fire Protection Association [NFPA] 2002) This is in agreement with other sources in the literature review suggesting a pre-hire medical evaluation for all firefighters. Within section 10.2 *Physical Performance Requirements*, NFPA 1500 places responsibility on fire departments to establish physical performance requirements for candidates and members and certify that candidates meet the physical performance requirements specified in NFPA 1583, prior to entering into a training program to become a firefighter. NFPA 1500, 10.3, *Health and*

Fitness, states " The fire department shall establish and provide a health and fitness program that meets the requirements of NFPA 1583", and that the fitness standards should reflect activities that are intended to reduce the probability of and severity of occupational injuries and illnesses." (NFPA, 2002)

NFPA 1582, *Standard on Comprehensive Medical Program for Fire Departments*, has pertinent information in chapter five when it identifies essential job tasks. When determining appropriate physical training for fire recruits, these can assist in make decisions regarding job task specific physical training and whether it can provide the necessary physical training benefits. In chapter eight, NFPA 1582 cites NFPA 1583 regarding recommendations for annual occupational fitness evaluation of members. Discussion of these measures will be with discussion of NFPA 1583. In Appendix A.7.2.2(5), NFPA 1582 states "Universal agreement exists that wellness, fitness, and risk reduction for cardiovascular disease, pulmonary disease, and cancer can be reduced by tobacco abstinence, regular exercise, and control of weight, hypertension, cholesterol, and blood sugar" (NFPA, 2003) This statement is in agreement with other sources.

NFPA 1583, *Standard on Health Related Fitness Programs for Firefighters* is intended to "promote the members ability to perform occupational activities with vigor and to demonstrate the traits and capabilities normally associated with a low risk of premature development of injury, morbidity, and mortality." (NFPA, 2000) The program components are to include: the assignment of a qualified health and fitness coordinator, a periodic fitness assessment for all members, an exercise training program, that is available to all members, education and counseling regarding health promotion for all members, and a process for collecting and maintaining Health-Related Fitness program data. Portions of each of these components could be included in a recruit physical training program.

Section 3.2, *Qualifications for Health and Fitness Coordinator*, is in agreement with other literature in stating that the person responsible for physical fitness should be trained and

have access to pertinent information related to the job. This was a primary recommendation of the Board of Inquiry in the Frederick County Maryland case.

In Chapter four, *Fitness Assessment,* NFPA 1583 stresses "All members shall be cleared for participation in the fitness assessment by the fire department physician." (NFPA 2000) This theme has been repeated throughout the literature review. The standard also recommends a pre-assessment questionnaire to identify contraindications to participation in a fitness assessment that may not have been discovered during the medical evaluation. Similar recommendations were seen in literature by the American College of Sports Medicine.

Chapter 5 of NFPA 1583 establishes exercise fitness training program components:

1. An educational program that describes the components and benefits of exercise, fitness, fitness training, and weight management.
2. An individualized exercise prescription based on the results of the fitness assessment.
3. Warm-up and cool-down exercise guidelines.
4. Aerobic exercise program.
5. Muscular (strength, endurance) exercise program.
6. Flexibility exercise program.
7. Healthy back exercise program.
8. Safety and injury prevention program.

(NFPA, 2000)

Most of these components are found to closely parallel information discussed in other literature.

Appendix B of NFPA 1583 provides a sample fitness plan that includes very valuable information regarding this project. Only the general components and those related to running or aerobic exercise will be discussed in detail. Section B.2 discusses the individualized exercise prescription and includes the components to be included: mode, intensity, duration, frequency, and progression. Each of these is in agreement with other literature reviewed. This section validates the need for physical training stating, "a fitness program designed for public safety personnel should promote health and a higher level of physical fitness. The workout regimen

should include exercises to improve aerobic capacity and muscular fitness components." (NFPA, 2000)

Section B.4 covers aerobic fitness and in B.4.1 *Significance,* re-iterates "Aerobic exercise has many benefits, including increased aerobic capacity, muscular endurance, improved bone density, and improved body composition. The *1996 Surgeon General's Report on Physical Activity and Health,* found that inactivity is hazardous to health. Aerobic exercise generally reduces coronary risk factors, muscle fatigue, injuries, and morbidity. Repeatedly, research has shown the need for fire fighters to have high levels of physical fitness in order to perform their job." (NFPA, 2000) The section goes on to define important terms and provides methods to determine aerobic capacity (VO_{2max}). In a discussion of exercise mode, suggested activities include "Activities that use large muscle groups in a rhythmical continuous manner (e.g, walking, running, swimming, cycling, rowing, stair-climbing, skating, dancing, cross country skiing, rope skipping) are all endurance based activities." (NFPA, 2000) They also address the question of weight bearing versus non-weight bearing exercises and state "since firefighters need to support their own body weight and the additional load of protective clothing and breathing apparatus, the most job specific activities will be those that are weight bearing." (NFPA, 2000)

Under B.4.3.2 *Intensity,* NFPA 1582 cites the ACSM recommendations of exercising at a heart rate between 70 to 90 percent of maximal heart rate or 50 to 85 percent of VO_{2max}. "Studies evaluating fire fighters' heart rate response to fire ground activities find that heart rates range from 80 to 90 percent of maximal heart rate or 70 to 80 percent of VO_{2max}, therefore, a firefighter should consider progressing to a program that includes some high-intensity efforts. (NFPA, 2000) Duration and frequency are addressed and in both cases cite ACSM recommendations. Duration should be 20 to 60 minutes of continuous activity excluding the warm-up and cool-down. Frequency should be at least three times a week to improve physical capabilities.

Procedures

The possible problem of running injuries was verified using data available from the department's risk management program and Safety Committee. Injury reports and Safety

Committee minutes were reviewed from January 2002-July 2005. A documentation package must be completed on all departmental on-the-job injuries and losses and provide a record and some details of each. As the Director of Training, direct knowledge of each injury was available as it occurred in Fire Recruit School. All those in the chain of command, particularly the immediate supervisor of the injured employee, have an opportunity to recommend improvements to prevent similar injuries from occurring in the future. Although the identity of the employees is protected, the data is available. All cases of loss and injury are reviewed by the Safety Committee, with recommendations for prevention of future occurrences offered when appropriate. Safety Committee Meeting Minutes were available for use during the research. Both the recommendations of the employee's chain of command and those of the safety committee were reviewed along with the raw numbers and circumstances surrounding running and related injuries. (See Appendix A)

Interviews conducted informally with injured parties contributed to the information used for this research. These discussions were in a supervisory capacity prior to the initiation of the research, not planned and documented as part of the project. In addition discussions with Fire Academy/College Training Officers take place with each injury to determine details and possible preventative measures. The Training Officer responsible for physical training during much of the time included in the research was Stoney Polite. Training Officer Polite was particularly qualified to discuss physical training injuries as a certified Health and Fitness Instructor through the American College of Sports Medicine, a long time athlete, and a high school football coach. Training Officer Polite had written a report previously addressing running concerns and initiated significant improvements to the physical training regimen used for recruit fire training.

An additional interview was conducted with Captain Nick Tyson with Jacksonville Fire Department upon reading the firehouse.com story on the death of fire recruit Karl "Kliff" Kramer. Captain Tyson was unable to provide specific information as a result of an ongoing investigation and because the autopsy results had not yet been released.

The search for literature occurred over several months and included web searches, articles from periodicals, books, technical reports, and standards. The local library and the National Fire Academy, Learning Resource Center both assisted in searching for information. Searches for: Running Aerobics, & Conditioning, Physical Fitness and Wellness, and Firefighter Training, were somewhat successful. Some of the most useful material was found by broadening the search for firefighter heart related fatalities. This search "backed into" the American Heart Association and American College of Sports Medicine information that proved very useful. The literature search did not prove useful in locating material relating to industry standards for recruit firefighter physical training.

A Physical Training/Running survey was circulated to fire departments similar to Gwinnett County Department of Fire and Emergency Services. (See Appendix B) The survey was initially circulated by e-mail to departments in the Atlanta area through the Metro Atlanta Training Officers Association and to Region IV Training Resource and Data Exchange (TRADE) departments. Bob Bennett of National Fire Academy increased the circulation by re-sending the survey to all TRADE departments. Although this was very helpful it was no longer apparent how many surveys had been sent and therefore not possible to know the percentage of respondents. TRADE departments have at least 400 uniformed personnel and/or serve a population of greater than 200,000 or are the largest department in the state. (United States Fire Administration, 2005) State fire training agencies are also included in TRADE. Gwinnett County is a member of TRADE and TRADE departments are similar in many ways to Gwinnett. A total of 28 surveys were completed and returned. The survey results were tabulated using an excel spreadsheet for both raw numbers and percentages. A list of comments provided by those returning surveys was also compiled and very useful. The surveys were helpful in developing an idea of what similar fire departments do for recruit physical training and somewhat addressed the question of an industry standard for similar departments.

Limitations included the number of surveys returned and incomplete or non-specific injury reports. Only 28 surveys were returned out of an estimated 200-300 sent out. Officers

completing injury reports, used to confirm running injuries, were not detailed in their explanations of the injuries making it difficult to categorize them accurately. Few other limitations were encountered.

Results

The review of department risk management and Safety Committee documents resulted in confirmation that we have had too many running related injuries, but also showed improvement in 2004 and 2005.

Table 1

Numbers of Fire Recruit Running Injuries by Year

2002		5
2003		10
2004		4
2005	(*Through July*)	2
Total		21

Of the 21 injured recruits, four have resigned, three resigned during recruit school and two after recruit school. Not all were solely because of the physical training injury they received. The data available does not indicate the numbers, but several lost time from their injuries and required additional time and resources for remediation to catch–up in their recruit classes.

The data was also sorted by “type of injury” and “mechanism of injury” (Table 2) to determine if any specific problem areas were highlighted. Ankles and knees were by far the most common body parts injured with the ankle injured twice as much as the knee. The “footing, twisted, rolled” category under Mechanism of Injury is a common method of ankle injury and bears this out.

Table 2

Type and Mechanism of Injury

Type of Injury	Number	Mechanism of Injury	Number
All Parts	1	Fall	2
Knee	5	Running	6
Ankle	10	Footing, Twisted. Rolled	5
Foot	2	Not Specific	5
Thigh	1	Previous Injury	1
Wrist	1	Undetermined	2
Lower Legs	1		

This finding has already caused the department to specify where running occurs, either at a local park or high school track, with flat smooth surfaces. When considering running injuries, it is important to note that Gwinnett had zero heat related injuries as a result of physical training during the time studied.

As a result of this research we have confirmed that we need to require more details on injury reports. Several of the narratives on the forms processed to document injuries did not provide enough information to categorize the injuries. Additionally, the department's safety review process only looks at the front-end of the injuries and does not consider final outcomes. Information such as lost time, final diagnosis, results of treatment, and other long-term issues related to the injury are not provided for review by the safety committee. From the data available it was not possible, for example, to determine how many of the injuries were soreness and how many were significant injuries. We know from experience that there were some of both.

The interview with Nick Tyson with Jacksonville Fire Department Training, in August 2005 did not provide specific information regarding the death of recruit Karl Kramer. The speculation of an existing contributing condition reinforced the need for appropriate medical evaluation prior to physical training. The speculation that the death may be related to heat stroke,

even in relatively mild conditions, reinforces the need for constant re-hydration and rehabilitation, as well as the availability of appropriate treatment options. It is important that heat stroke be considered as a possible cause of recruit sickness even when environmental conditions may not be extreme. Because of the importance of rapid treatment, primarily cooling, for heat related injuries, it is important to be prepared to provide it immediately.

The Physical Training/Running survey results were very helpful in determining what fire departments similar to Gwinnett County do for physical training for recruit firefighters. (See Appendix D & E) The first part of the survey requested information about the responding department. A total of 28 surveys were returned with 23 from total paid departments, four from combination departments and one undetermined. Because the research was interested in departments similar to Gwinnett, and the process of circulating surveys was through TRADE organizations, no volunteer departments responded. 18 of the departments considered themselves to be urban, eight suburban, and four rural. Two departments placed themselves in two categories. The departments ranged in size from medium to large with six departments reporting five to 10 stations, eight departments reporting 11 to 20 stations and 13 departments, about 46 %, reporting over 20 stations. One department reported having 51 to 100 personnel, 15 had 101 to 500 personnel, six had 501 to 1000 personnel, and five reported over 1000 personnel. Table 3 demonstrates the relationship of the respondents and Gwinnett County Fire and Emergency Services.

Table 3

Number of Stations

1	0	0.00 %
2 to 4	0	0.00 %
5 to 10	6	21.43 %
11 to 20	8	28.57 %
Over 20	13	46.43 % (Gwinnett)

Table 3 (continued)

Number of Personnel		
1 to 25	0	0.00 %
26 to 50	0	0.00 %
51 to 100	1	3.57 %
101 to 500	15	53.57 %
501 to 1000	6	21.43 % (Gwinnett)
Over 1000	5	17.86 %

All departments indicated they had a fire recruit training program that included a physical training component. The number of recruits trained per year varied fairly evenly across the range of choices (Table 4) Approximately 61 % of the respondents, 17 departments, reported their basic fire training classes were 11 to 16 weeks in length. Gwinnett County's program falls into this category at 16 weeks long. Table 4 indicates specific results which is significant because for physical training and running to effectively improve the condition of new employees, the exercises must be done over an appropriate amount of time. No specific amount of time was found in the literature review however, studies were found demonstrating that 10 weeks of appropriate physical training demonstrated positive results. (Obermeyer, February, 1995)

Table 4

Number of Recruit Firefighters Trained per Year		
0 to 10	5	17.86 %
10 to 30	9	32.14 %
30 to 50	5	17.86 % (Gwinnett)
Over 50	9	32.14 %

Table 4 (Continued)

Length of Basic Fire Training Program (Excluding EMT)

Less than 5 Weeks	1	3.57 %
5 to 10 Weeks	2	7.14 %
11 to 16 Weeks	17	60.71 % (Gwinnett)
Over 16 Weeks	8	28.57 %

Of the 28 respondents, only 10 indicated they had written guidelines documenting and standardizing their physical training programs. All of those responding affirmatively that they had written guidelines advised they were willing to share them. Telephone calls were made, or e-mail sent, to most of the departments to request copies of their written guidelines. Only one department responded with anything and none of the departments sent what would be considered complete guidelines for fire recruit physical training.

Physical Training is conducted daily by 21 (75 %) of the responding departments. Six departments perform physical training three days per week and one four days per week. Data was not collected indicating what physical training activities were conducted each day. Table 5 indicates the duration of physical training sessions. Duration of aerobic activities is addressed by American Heart Association and the American College of Sports Medicine and is important to ensuring the value of the exercise is realized. The recommendation is 20-60 minutes at an intensity that is equivalent to 65 percent to 90 percent of your maximal heart rate. (Lloyd 2001)

Table 5

Duration of Physical Training Sessions

0 to 0.5 hours	2	7.14 %
0.5 to 1 hour	13	46.43 %
1 to 1.5 hours	10	35.71 % (Gwinnett)
1.5 to 2 hours	3	10.71 %

Table 6 indicates major categories of exercises used by each department for fire recruit physical training. About 96 % of the departments returning surveys use running or jogging, warm-up, and flexibility exercises in their programs. For the 28 departments returning surveys, this could be considered a standard practice. This is the only data found in the research resembling a standard activity for fire recruit physical training and it is widely varied as to duration and intensity.

Table 6

Components of Physical Training

Warm-up Stretching Exercises	27	96.43 %	(Gwinnett)
Flexibility Exercises	27	96.43 %	(Gwinnett)
Strength Calisthenics	22	78.57 %	(Gwinnett)
Weight Training	15	53.57 %	
Firefighter Task Related Equipment	16	57.14 %	(Gwinnett)
Non-firefighting Exercise Equipment	17	60.71 %	
Running/Jogging	27	96.43 %	(Gwinnett)

Table 7 documents the results of the question “where do you run?” and includes not only consideration of the physical location but also the running surface. Respondents were asked to indicate all that applied. The potential for injury and traffic disruption can be reduced by carefully selecting where recruits run. No data was collected on how often each surface is used by departments that vary where they run. There were some differences of opinion in the survey and in the literature depending on the most significant need. Rodgers (1996) recommends grass or dirt, particularly to combat injuries caused by friction with the shoes and forcing the feet forward. Others recommend asphalt. All agree the running area should be free of trip hazards and irregularities, particularly for beginning runners.

Table 7

Running Location and Surface

Public Road	14	50.00 %	(Gwinnett)
School Track	7	25.00 %	(Gwinnett)
Parking Lot	12	42.86 %	(Gwinnett)
Gymnasium	1	3.57 %	
Hard Smooth Surface	18	64.29 %	(Gwinnett)
Gravel or Dirt	6	21.43 %	
All Terrain	4	14.29 %	
Up and Down Steps	16	57.14 %	

Running may vary significantly in intensity, and duration and may be further altered by conditions such as clothing. The survey question “What type of running do you do?” simplified the differences by asking respondents to choose between jogging and sprinting and gym clothes and firefighting gear. About 96% of the respondents use jogging with 32 % including sprinting in their physical training regimen. About 86 % of departments require recruits to run in gym clothes, and 25 % indicated they run in firefighting gear. No data was collected to determine how often or the intensity and duration of running while in firefighting gear. One department wrote in that they do circuit training with six stations two days per week and full physical training with a run three days per week.

How often one runs is another important factor in the development of an exercise program. One department responded that they run occasionally. Six departments advised they run one to two times per week. Ten (35.71 %) departments run three times per week and 11 (39.29 %) departments run daily. Distance is another factor, to consider when developing an exercise program including running. Table 8 indicates the distances recruits run in the respondent departments at the beginning and end of fire recruit training programs. No data was collected to

specify how often each distance is run, or how it is determined that progression, an increase in duration or intensity, takes place throughout the programs.

Table 8

Running Distances at the Beginning of Recruit Training

Less than 1 Mile	13	46.43 %	
2 to 3 Miles	14	50.00 %	(Gwinnett)
3 to 4 Miles	0	0.00 %	
5 to 6 Miles	0	0.00 %	
Over 6 Miles	0	0.00 %	
Running Distances at the End of Recruit Training			
1 to 2 Miles	9	32.14 %	
2 to 3 Miles	5	17.86 %	
3 to 4 Miles	8	28.57 %	
5 to 6 Miles	3	10.71 %	(Gwinnett)
Over 6 Miles	1	3.57 %	

Note: One department does not run in recruit school.

Other information on the survey included opportunities for respondents to write in comments and answers to specific questions/statements. (See Appendix E) The responses have been compiled and in some cases categorized. This section of the survey proved to be very valuable and offered several ideas for improved physical training programs when validated by other research and literature. Much of the information in this section is the opinion of the individual completing the survey.

The first research question, “What are industry standards for recruit firefighter physical training?” was answered primarily by NFPA 1583 *Standard on Health-Related Fitness Programs for Firefighters*. The Physical Training/Running survey established some broad

generalizations among the responding departments but demonstrated variations when the comments are considered along with numerical data. The generalizations may be used to great advantage in developing a recruit firefighter physical training program.

NFPA 1583 *Standard on Health-Related Fitness Programs for Firefighters* is the formal fire service standard for firefighter physical fitness and provides an excellent general framework for a fire department exercise and fitness training program and would certainly apply to a fire recruit physical training program. As discussed in the literature review, Chapter 5 and Appendix B of NFPA 1583 provide program components and a sample fitness plan. The health related components of fitness are broken down into Aerobic Capacity, Muscular Strength, Muscular Endurance, Flexibility, and Body Composition. For each of these components the standard recommends an "Individualized Exercise Prescription" including the Mode, Intensity, Duration, Frequency, and Progression. (NFPA, 2000) The term individualized is important indicating that physical training should be prescribed for each person depending on their needs.

One of the most specific and widely recognized, standards is in the section on aerobic capacity. NFPA 1583 cites the American College of Sports Medicine recommendation of exercising at a heart rate between 70 to 90 percent of maximal heart rate for 20 to 60 minutes of continuous activity a minimum of three times per week to improve fitness. (NFPA, 2000) Other literature validates derivatives of this standard in numerous citations by doctors, fitness experts, and fire service personnel.

The Physical Training/Running Survey generally indicates that the respondents are in agreement with NFPA 1583. Although the survey was not broken down into the NFPA 1583 categories of Aerobic Capacity, Muscular Strength, Muscular Endurance, Flexibility, and Body Composition, the exercises in Table 6 represent activities in each area. All of the exercises in Table 6 are used by at least 53 % of the departments. Running, warm-ups, and flexibility are used by 27 of 28 respondents and certainly fall within the recommendations of NFPA 1583.

The second research question has two parts "Is running a necessary and appropriate activity for recruit firefighter physical training? and if so, what can be done to prevent injury?"

The second part will be addressed with the research question, “What are the possible causes of running related injuries?”

The research found that running is a necessary and appropriate activity for recruit firefighter physical training for Gwinnett County Department of Fire and Emergency Services and for most other fire departments. The answer was derived in two steps. First it was determined that recruit firefighters needed the type of aerobic exercise provided by running. Second the research found running to be the best exercise choice of several methods, for Gwinnett County recruits, to achieve the necessary aerobic benefits.

Literature from American Heart Association, American College of Sports Medicine, and numerous others clearly state that all people need aerobic activity at appropriate levels to reduce the probability of heart attack and related illness. There is total agreement in all of the literature reviewed that many of the risk factors for heart and related problems are reduced by appropriate aerobic exercise. Fire service literature strongly agrees. The most prominent reason is that heart attack continues to be responsible for approximately 50 percent of firefighter line of duty deaths each year. Other benefits such as increased productivity and efficiency, and injury prevention are also of great (many would say equal) importance. Any issue that is responsible for half of firefighter line of duty deaths deserves significant attention in our basic firefighter training courses.

The literature agrees that to achieve the cardiovascular benefits from aerobic exercise, one must maintain a heart rate between 70 to 90 percent of maximal heart rate for 20 to 60 minutes of continuous activity a minimum of three times per week. Some fire service literature suggests that firefighters need to exercise at the high end of the scale. Running/jogging is the one exercise listed in all of the literature, and used by 27 of 28 departments responding to the survey that allows recruits to meet this standard.

In considering alternative exercises to running to fully answer the question, “Is running a necessary and appropriate activity for recruit firefighter physical training?” we address the research question, “Are there alternative physical training activities that are safer, readily

available and provide the same benefits for firefighters as running?" Restated, what other exercises are available that will allow participants to maintain a heart rate between 70 to 90 percent of maximal heart rate for 20 to 60 minutes of continuous activity a minimum of three times per week that are also accessible to Gwinnett Fire recruits.

Several exercises and limiting factors were considered and are charted on Table 9. There are many other alternative exercises available. Those selected for consideration included those listed in NFPA 1583, those for which energy expenditure data was available, those that could be considered viable, and those that are commonly suggested as alternatives to running in basic firefighting training. The energy expended and the benefit achieved from any aerobic activity will vary based on the intensity and duration of the activity and in some cases the skill of the participant. There is not a particularly objective method of comparing. The ratings on Table 9 are a combination of general information from the literature review and subjective opinions based on experience and the situation in Gwinnett County, and should only be considered a visual aid to the discussion in the text. Footnotes are provided to clarify the origin of the information used.

Based on the factors considered, running/jogging is a necessary and appropriate activity for recruit fire training and, running is the best alternative to increase aerobic capacity, and reduce the risk of heart attack and related illness. Alternative exercises are available but none measure up to running when overall safety, availability, cost, convenience and aerobic benefit are considered. Other alternatives do have a significant place in basic fire training and should be used in recruit firefighter physical training programs. Running, however, should not be excluded.

Table 9

Acceptable Aerobic Exercises and Limitations

Exercise	Acceptance	Risk	Energy	Equipment	Facilities	Cost	Time	Skill	Total
Walking	2	3	1	3	3	3	2	3	20
Running/Jogging	2	2	3	3	3	3	3	3	22
Swimming	2	3	2	1	1	2	1	1	13
Cycling	2	2	3	1	1	1	3	2	15
Rowing, Machine, Boat	2	2	3	1	1	1	1	2	13
Stair Climbing, Simulated	2	3	2	1	1	1	1	3	14
Stair Climbing, Actual	1	2	3*	3	3	3	3	3	21
Skating	2	2	3	2	1	2	2	1	15
Aerobics, Dancing, Step	1	3	3	2	3	2	3	3	20
Cross Country Skiing	2	3	3	1	1	1	1	1	13
Rope Skipping	2	3	3	3	3	3	3	2	22
Firefighting Tasks	3	2	3*	2	2	2	3	3	19

Each Exercise was rated in each category using a scale of 1-3 as related to benefit for Gwinnett County Fire Recruit Training. 1 =Least Beneficial 3 = Most Beneficial.

* *These activities, although expending much energy, are difficult to maintain for the amounts of time recommended by experts to achieve the full aerobic cardiorespiratory benefits of running. They are considered excellent anaerobic activities when used in a physical training program in conjunction with aerobic activities after significant aerobic capacity has been developed.*

Sources:

Energy *(Kravitz and Vella, 2002)*, (American Heart Association, 2002)

Skill *(Kravitz and Vella, 2002)*

All Others Situational, Subjective

Walking is equivalent to running in all but two categories, energy and time, and exceeds running in the safety category. The main problem with walking is that it expends significantly less energy and would require a great deal more time to achieve the same aerobic benefits as running. Justmove.org, in an article entitled *About Your Heart and Exercise*, advises that a 150 pound person, running at five and one half miles per hour will use 660 calories while walking at three miles per hour will only use 320 calories. (American Heart Association, 2002) Walking is considered less stressful on the body than running and would likely result in less injuries. Walking should be considered a viable exercise for warming up prior to running, and early in the physical training program alternating with running. Walking may be combined with firefighting protective clothing to increase the intensity.

Swimming is perhaps the best aerobic exercise for injury reduction, but it requires a pool or other appropriate facility. In Gwinnett County some facilities are available, but the travel time makes it prohibitive for recruit classes. Swimming is also considered less effective than running for increasing aerobic capacity (Kravitz and Vella, 2002) and each individual's skill level is more likely to have an impact on the aerobic benefits than with walking or running. NFPA 1583 recommends weight-bearing exercises such as running over swimming because firefighters are required to support their own body weight along with that of protective clothing and breathing apparatus.

Cycling, rowing, skating, cross-country skiing, and simulated stair climbing all require significant amounts of expensive equipment that is not available to recruits in Gwinnett County. For cycling, a location to ride with a group of 20-30 students would also be difficult. Simulated rowing, stair climbing, cycling, and skiing machines, as well as others would be a benefit and could be used in a circuit to great effect as an alternative to running. Budgetary limitations and a facility to house them currently prevent their use for Gwinnett County.

Actual stair climbing and other firefighting activities are available to Gwinnett recruits. Stair climbing could be done on a five-story training tower and scores just one point less than running in the comparison on Table 9. Two issues not factored into Table 9 are the length of time

a participant would be able to continue stair climbing and some fire fighting activities, and the targeting of some muscles over others. It is not likely that the recommended 20 to 60 minutes could be maintained. It is also likely that stair climbing and many firefighting activities would become anaerobic, more like a sprint than a rhythmical continuous exercise. Anaerobic means the body is not able to keep up with the need for oxygen for a prolonged period of time. Anaerobic activities should be included in the physical training program, but not early in the program and not as a replacement for running.

Aerobic dancing or step aerobics score just two points less than running in the comparison on Table 9 and would appear to be a viable alternative. No data was collected comparing the probability of injury. Gwinnett Fire does not currently have an aerobics instructor available to conduct classes.

Rope skipping equals running in the comparison however would require more skill to achieve the same benefits. Jumping rope would use 750 calories per hour for a 150 pound person as compared to 660 calories for running. Although no data was found, one would expect less probability of injury than with running. It appears to be a viable alternative to running and could be an appropriate addition to the physical training program. (American Heart Association, 2002)

The final research question, “What are the possible causes of running related injuries?” will be addressed in conjunction with the question, “what can be done to prevent running injuries?” Common causes of running injuries found through local data, the literature review, and the survey, include: previous conditions prior to the recruit academy, recruits significantly out of shape, falling while running, rolling or twisting the ankle, stress on bones or joints, poor flexibility, inadequate hydration, traffic accidents, and over training. Sources are in agreement about several ways to prevent injury.

“All Members shall be cleared for participation by the fire department physician.” (NFPA, 2000) All other sources consulted agree with NFPA 1583, candidates should have a thorough physical and be cleared for participation by a physician. This would address many of the pre-existing conditions that contribute to running injuries. The examination would need to

include an appropriate stress test, pulmonary testing and possibly a chest x-ray to rule out heart conditions and consider respiratory issues. Physicals are only as good as the information provided to the physician and several muscular skeletal conditions may go undetected.

Supervision of the development and administration of the physical fitness program by a qualified health and fitness instructor will help to provide over-site to ensure all other components are done correctly. Some major issues would be screening each candidate and prescribing an appropriate program, developing and teaching the educational components of the physical training program, developing and delivering the program curriculum, evaluating the program, training and supervising assisting instructors, and making adjustments as needed.

Closely related to the doctors physical would be a pre-exercise screening to be completed by the health and fitness instructor prior to beginning an exercise program. The questions are more directed to the physical training activities than many health screenings would be and would assist the instructor in knowing the condition and risk factors of each student. This would enable intervention for significant issues, planning around less significant issues, and enhanced cognizance on the part of the instructors.

A preliminary educational presentation should be provided for candidates as soon as possible prior to the beginning of the recruit school as a part of the hiring process to ensure they have legitimate expectations of the physical demands of the profession, and have a recommended program to follow to get in shape prior to the class, such as that provided by the Candidate Physical Ability Test. Some departments provide supervised physical training programs prior to the pre-hire physical assessment. Educational materials regarding diet and physical training should also be provided.

Recruit candidates should be provided with a process to ensure they are professionally and properly fitted for, and acquire appropriate running shoes. There are many variations in the way people walk and run therefore individual fitting is necessary. Many of the injuries caused by repeated impact on the muscular skeletal system may be reduced or prevented with proper shoes.

The ideal situation would be for the department to provide shoes, however that would not be possible in many circumstances due to budgetary constraints.

Appropriate running attire, though not as critical as shoes and other recommendation for injury prevention, can play a role. During hot weather, lightweight and light colored clothing will be beneficial. Fabrics that wick, moving moisture away from the skin, are often considered more comfortable. Clothes designed particularly for running are available and could make the experience more enjoyable.

A progressive program should be developed and documented ensuring that physical training starts at a legitimate, easy level then builds according to the capabilities of the class. This is one of the most important aspects of injury prevention for a program including running. Many recruits arrive out of shape and to be physically appropriate, they must set the pace. All sources agree that starting too rigorously is a dangerous practice that could result in injury, or worse, death. The program must be documented in the form of standard operating guidelines, and lesson plans with outlines. The program should also be supervised, and enforced to ensure all instructors know what is appropriate each day and conduct physical training according to the plan.

Guidelines addressing weather conditions and if needed pollution levels, should be developed and adhered to. Devices are available that take into account the temperature and humidity to calculate a heat index. Studies have developed recommendations for rest time versus work time based on the weather conditions. Cold weather and icy conditions must also be considered dangerous. Alternative plans should be developed and adhered to for extreme weather conditions.

The selection of an appropriate site for running may play a significant role in injury reduction. Many muscular skeletal injuries can be prevented by running on a smooth, flat, surface reducing the probability of falling, or turning an ankle by tripping over or stepping on curbs, pot holes or other obstacles. Access to a modern track may result in a resilient surface further reducing impact and injury. Selecting a location out of traffic reduces the possibility of an

accident involving a vehicle and may significantly reduce risk. If forced to run on or near public roadways, it is recommended that crossing guards be used when crossing streets and students and instructors wear traffic vests. The availability of an indoor track may take heat, cold, pollution and wet surfaces out of play further reducing the probability of injury.

Requiring hydration before, during, and after physical training helps to ensure candidates will not become dehydrated. This recommendation is universal in all of the literature reviewed and can not be overstated. Proper hydration is one of the primary preventative measures in dealing with heat exhaustion and heat stroke injuries, and also helps prevent cramps. Water systems such a “camel back” are available that allow participants to carry water during physical training if needed.

Use of good running technique is addressed in both running books reviewed, and in the justmove.org literature. Candidates should be taught and monitored to ensure good technique. Runners or joggers should land on the heels rather than the balls of the feet to minimize strain on the feet and lower legs. (American Heart Association, 2002)

Proper warm-up is another very important step in preventing running injuries. There is some disagreement noted, not that warm-up is needed, but in how to warm-up. The literature is in agreement that the warm-up should be 10 to 15 minutes of activities similar to that which the participants will be engaging in. For running, an example would be to start out walking at an easy pace, then build to a fast walk increasing the range of motion. Continue to increase the pace to a very easy jog and over the course of 10 to 15 minutes slowly build to full speed. Some of the comments on the survey and witnessed physical training sessions demonstrate that many departments include significant stretching in the warm-up phase. This is not recommended by the literature reviewed for this project and could actually account for some injuries attributed to running. Stretching is recommended only at the end of physical training and not recommended at all by some authorities.

Cool-down is also important. It is recommended that runners continue to jog then walk to slowly taper off the activity as the heart rate returns to normal. Some but not all recommend

stretching after or as a part of the cool-down process. Most sources recommend some form of stretching but also advise not to be overly vigorous. Many authors, including Rodgers, stress caution.

Should injury or illness occur during physical training, the severity may be reduced by proper emergency preparation. Enough qualified personnel should be available to accompany and supervise the run so that if two instructors are needed to stay with an injured participant, the rest of the group would not go unsupervised. It would be prudent to ensure that at least one of the instructors is medically trained at least to the EMT-I level and preferably to the paramedic level.

EMS Equipment, water, and ice, should be available in a trailing vehicle, or if running on a track or similar area, within close proximity. The vehicle should be capable of transporting a slightly injured participant to a safe area or back to the starting point. Communications equipment to enable calling for help should be available at all times. Portable radios and cell phones are recommended.

One of the most appropriate recommendations for running injury prevention was a comment on the survey. “Use common sense.” Although this seems a bit simplistic, it is prudent to realize that different individuals have a different definition of common sense when it comes to physical training. Several cases of recruit physical training injury and death reviewed demonstrate a lack of common sense, or at the least, the false expectation that it will not happen here.

Discussion

The results of the study were validated by the work of others. The National Fire Protection Association’s Report *U.S. Firefighter Fatalities for 2004* says, “Stress and overexertion, which usually results in heart attacks or other sudden cardiac events, continued to be the leading cause of fatal injury.” (Leblanc and Fahy, 2005) Both general and fire service literature agree that one of the best ways to combat this problem is aerobic exercise at the appropriate intensity for an appropriate duration. The respondents to the survey and the literature agree that physical training, including exercises that increase aerobic capacity such as running, is

important to firefighters throughout their careers, beginning with basic fire training. Almost all (96.43%) of the respondents to the survey include running in their physical training regimen and all departments include aerobic exercise. Generic literature from the American Heart Association and American College of Sports Medicine agree that all people should participate in activities to increase aerobic capacity. Fire service literature, including NFPA 1583, *Standard on Health Related Fitness Programs for Firefighters*, states, "A fitness program designed for public safety personnel should promote health and a higher level of physical fitness. The workout regimen should include exercises to improve aerobic capacity and muscular fitness components." (NFPA, 2000)

Literature review and the surveyed departments, demonstrate that actual firefighting activities alone will not provide the appropriate exercise regimen to maximize cardiorespiratory benefits and achieve an adequate $VO_{2max.}$ To achieve the needed workout, aerobic activities should be performed three to five times each week for 20-60 minutes at an intensity that is equivalent to 65 % to 90 % of maximal heart rate for civilians. (Lloyd, 2001) To meet firefighters needs, the physical training would need to be at the high end of the ranges given and the duration and intensity of most firefighting activities do not match the recommendations. The problem is, the most intense firefighting activities become anaerobic within a short time. The body cannot process enough oxygen rapidly enough to sustain the activities for long. The participant cannot, and should not attempt to continue anaerobic activities for the amount of time recommended to improve aerobic capacity. Less stringent firefighting activities may not raise the heart rate to the levels recommended. This is not to say that firefighting activities should not be used for physical training - they should. But they should not replace aerobic exercises that "utilize the large muscle groups in a rhythmical continuous manner." (NFPA 2000) A similar statement is made by Kravitz and Vella (2002) writing for American College of Sports Medicine, "It is important to select a mode of exercise that uses the large muscles of the body in a continuous, rhythmical fashion, and that is relatively easy to maintain at a constant pace."

Lydiard recommends programs that begin with aerobic activities then add anaerobic activities to progress after aerobic capacity has been developed. “The daily program of sustained aerobic running is absolutely essential to achieve the correct respiratory and circulatory development and the longer the periods of running the better the results will be. The anaerobic section of your preparation should be tackled only after you have developed aerobic capacity and maximum steady state possible level.” (Lydiard, 2000) The research results indicate that physical training should begin slow then build in agreement with Lydiard. The survey results agree with half of the departments running two to three miles at the beginning of recruit school and the other half less than one. The running distances tend to increase at the end of recruit school. (See Table 8)

The literature and the survey agree on numerous ways to ensure the safety of participants. A doctor’s clearance prior to firefighting and physical training is widely recommended both in the generic literature and even more so in the fire service literature. Providing candidates with information about how to get in shape prior to recruit class is recommended both in the survey and in the Candidate Physical Ability Test materials. Pre-running activities such as hydration, warm-ups, and wearing proper shoes and clothes, are also recommended both in the survey and in the literature. Starting slow and increasing based on the fitness of the group as aerobic capacity increases is another universal recommendation by both the survey and the literature. During the run, adequate supervision, re-hydration, and site selection, are discussed at length in the literature and in the survey.

The interpretation of the results of the research as it relates to the research questions is clear. Although the industry is not standardized in its fire recruit physical training activities, the aerobic exercise demands for improved aerobic capacity are established and adopted by the fire service standard making body. To meet these standards, Gwinnett County Department of Fire and Emergency Services must include running as a physical training activity in the basic firefighter training program. Running/jogging can be done safely provided the recommendations from the literature review and survey are implemented. Several viable alternatives to running

exist and many should be incorporated into the physical training program, but, because of limitations such as time, facilities, money, and the aerobic value of the activity, running will continue to play a large role in recruit physical training.

The organizational implications of the study will include some continued change in addition to improvements that have already been made. We will continue to use running as a part of physical training for recruit firefighters, however, every attempt will be made to implement the recommended improvements. To implement the improvements some costs will be involved.

Recommendations

The primary recommendation is to continue to use running as part the physical training component in basic firefighter training, but with improvements in the process to reduce the probability of injury and improve the response should an injury occur. It is recommended that in planning for the future development of training facilities, that the department include both indoor and outdoor physical training facilities that will enable more options for acceptable aerobic alternatives to running.

The department needs to improve the pre-hire physical to be much more thorough and meet most of the requirements of NFPA 1582, *Standard On Comprehensive Medical Program For Fire Departments.* Our pre-hire physical does not currently include a stress test or chest x-ray and does not thoroughly evaluate candidates regarding existing muscular skeletal deficiencies. This is one of the primary recommendations of the National Institute for Occupational Safety and Health in most of the line of duty death reports reviewed, National Fire Protection Association standards, and many of the articles reviewed. Gwinnett County has had occasions of fire recruits being hired with existing medical problems that were not detected by the pre-hire physical. When combined with other departmental needs, it is appropriate to recommend the department consider hiring departmental physician.

The department has been providing preliminary information encouraging candidates to prepare physically for the rigors of recruit school. It is recommended that this be reviewed and refined in light of information resulting from the research. The preliminary information should

include educational materials regarding physical training and diet, expectations for recruit school and firefighting, and a suggested program that can be completed without cost to the candidate. For the future, it is recommended that the department provide opportunities for pre-hire physical preparation led by qualified instructors.

The department should support members in efforts to become certified physical trainers either through a program such as the IAFF/IAFC/ACE Peer Fitness Training Certification Program or the American College of Sports Medicine Programs. The Fire Academy/College should have a certified trainer on staff to develop and manage the physical fitness program for recruit school. For the future, a new position should be created for a departmental Health and Fitness Coordinator.

Basic fire Training Officers currently use a screening form for each student prior to recruit school to ensure they have information pertinent to each individual regarding physical training. This is similar to the form recommended by ACSM. It is recommended that this process be continued, but reviewed and if needed revised to reflect information learned from the research.

The department currently takes recruits to a professional athletic shoe store for evaluation, sizing, and recommendations as to what the appropriate shoe for running for each individual would be. The students are under no obligation to purchase shoes or to purchase shoes from the establishment. Some simply cannot afford to buy top of the line running shoes, one of the most important components of injury prevention. It is recommended that the department budget for and purchase running shoes for recruit firefighters to ensure all have availability to the protection provided by appropriate foot ware.

The Fire Academy/College should develop written procedures for recruit physical training including a progressive program that starts easy and builds, according to established guidelines and the general fitness of the class, to a more rigorous regimen over the 16-week period. No more than 30 minutes or three miles of running should be allowed within the first

month (Rodgers, 1996) and significant anaerobic activities should not be added for at least five weeks. (Lydiard, 2000)

Levels of supervision for various physical activities should be clearly established and enforced. The levels should be such that in the event of a problem with a student, the situation may be handled without leaving recruits unsupervised. Appropriate supervision should also include monitoring and correcting technique, ensuring re-hydration and rest, being vigilant for signs of injury or illness, setting an appropriate example, and documenting the physical training process. A one side of one page Physical Training Report may be developed to document each days preparation and physical training activities.

The written procedures should clearly spell out a program of components including aerobic capacity, body composition, muscular strength, muscular endurance, and flexibility. Each day should be outlined to ensure consistency regardless of which training officer is leading physical training. The guidelines must ensure warm-up and cool down are included and appropriate for the exercises being used.

The written guidelines should include alternatives for extreme weather conditions including how to determine when alternatives should be recommended. It is recommended that the department purchase devices to determine the heat index and adopt existing guidelines concerning work and rest. Alternative plans including opportunities for indoor physical training should also be developed for days with extreme weather and possibly pollution conditions.

In addition to weather conditions, the guidelines should establish procedures that account for and adjust based on drills planned for the remainder of the day. For example, only appropriate warm-up and stretching should be done on a day where numerous live fire exercises are planned. Where the days fire training activities will legitimately replace a particular exercise, allow it to do so.

The guidelines should address hydration prior to, during, and after running and include a provision to ensure students actually drink appropriate fluids. Water should be available at times

during the physical training session. Improper hydration has been central to physical training injuries or sickness in cases published in the past.

The guidelines should address the location and surface on which recruits are expected to run. Flat, smooth surfaces will lessen the probability of a turned ankle or fall. Resilient surfaces will reduce the impact and could reduce injuries. Running on or near roads should be avoided but if it becomes necessary, all participants, including instructors, should wear reflective traffic vests and crossing guards should be used to cross streets.

The guidelines should inform students and instructors that injuries, or potential injuries, should be reported immediately and that there will be no penalty for doing so. Alternative aerobic activities may be considered for those unable to run due to minor injury. Training Officers should be taught to be cognizant for unreported problems such as sickness and injury and to be proactive in their reaction, taking steps immediately to treat and reduce the seriousness of the injury.

Emergency preparation and procedures should be established to ensure personnel, equipment, supplies, transportation, and communication are on-site in known locations, within close proximity to the physical training activities. For running, a trailing vehicle capable of transporting an instructor and a student should be implemented. The trailing vehicle should have medical equipment, water, ice on hot days, and communication capabilities and be with students during physical training. Emergency preparation should also include notification protocols to ensure that all are clear on how to call for help and notify the chain of command. Instructors should have medical training to at least the EMT-I Level with paramedic preferred.

It is recommended that the department evaluate and consider the purchase of heart monitors and the related computer systems to more accurately monitor fitness in recruits. In addition student progress should be monitored and documented periodically throughout the course including physical characteristics such as weight and body composition and physical performance.

Finally it is recommended that when developing the physical training program, when appropriate firefighting activities should be incorporated into the regimen. As students get further along in the course and aerobic capacity has been developed, to progress recruits will need to add more anaerobic activities. For example, instead of sprinting, do standpipe drills, or a firefighter rescue drill. Instead of circuit calisthenics, do a fire fighting skills obstacle course. These options and others allow appropriate physical training wile reinforcing valuable practical firefighting skills.

Our ultimate goal is not only to provide fit firefighters but, to instill in each firefighter a desire and ability to maintain his or her physical fitness throughout a long and healthy career. By doing so, we hope each firefighter can enjoy a long and healthy retirement.

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Appendix A

Running Injuries, Gwinnett Fire Recruit Schools 2001 – July 2005

JANUARY 2002

001OJI2002 Muscular Pain – Calf Muscle, 12/17/2001

No Details Provided

004OJI2002 Pain to all Parts – Non-obvious, 12/31/2001

Recruit lost footing while running in formation with other recruits during physical training. Recruit went to ground, was ambulatory afterwards.

MARCH 2002

021OJI2002 Strain Knee, 02/14/2002

While running employee noticed a sharp pain to the back of his left knee. Continues each time does physical activity. No direct trauma to knee happened but feels like a sharp pull.

APRIL 2002

027OJI2002 Pain to Ankle/Foot, 03/12/2002

Recruit lost footing during P/T Run and injured his left foot/ankle. The Recruit was running with a group of 16 other members.

AUGUST 2002

058OJI2002 Sprain Knee, 07/25/2002 ***Resigned***

During training drills, employee began to notice a tightness in his knee. The next day the right knee began to swell and became stiff and painful.

OCTOBER 2002

083OJI2002 Pain in Right Knee, 10/03/2002

Running up and down steps in the training tower during physical training.

JULY 2003

046OJI2003 Inflammation/Pain Left Foot, 04/23/2003

While running, pain to left foot became extreme, possibly a previous injury that has recurred. Foot began to get sore after physical training on Monday, April 21, 2003.

063OJI2003 Left Ankle Sprain, 06/02/2003

Twisted left ankle while running during physical training.

072OJI2003 Left Ankle Sprain, 06/20/2003

While running during physical training, the employee stepped on uneven ground and twisted left ankle. The ankle began to swell shortly afterwards.

076OJI2003 Muscular Pain – Thigh, 07/03/2003 ***Resigned***

Pain occurred to left hamstring area while running during physical training. Possibly pulled hamstring.

SEPTEMBER 2003

092OJI2003 Sprained Wrist, 08/29/03

Recruit stumbled while running during physical training at the Fire Academy. He landed on his left wrist causing pain.

102OJI2003 Pain – Feet, 09/16/03

While participating in a hasty exit drill from the apparatus, the recruit landed on the asphalt with both feet. This maneuver caused pain to both feet that has gotten worse with time. The recruit has a previous injury to both feet which also happened while doing physical training with the 2003-1 Recruit Class. Injury forms are on file.

104OJI2003 Pain in Lower Legs, 09/12/03 ***Resigned***

Recruit has had lower leg pain in both lower legs during physical training and training drills. This pain was initially attributed to muscle soreness, but has been unrelieved for 1-2 weeks. He has requested to be evaluated by a physician to diagnose the origin of the pain.

107OJI2003 Pain in Ankle, 09/12/03 ***Resigned***

Recruit developed pain to his right leg and ankle during physical training and physical agility drills. No specific act or trauma known to have caused the pain.

118OJI2003 Pain in Foot, 11/03/03

Employee developed pain to his left foot while running during physical training. The pain persisted overnight and employee notified his supervisor the next day.

129OJI2003 Sprain – Knee, 12/01/03

Employee began experiencing knee pain after physical training on December 1, 2003. Instructor was notified the day of the injury. Pain persisted overnight and employee was sent to have knee evaluated at 0800 hours the following morning.

131OJI2003 Pain/Strain – Right Knee, 12/03/03

Employee experienced pain to the right knee while running during physical training at the Fire Academy drill grounds. Pain has continued.

APRIL 2004

033OJI2004 Other: Rolled Left Ankle, 03/24/04

Employee was participating in physical training and while jogging employee stepped on an uneven surface and rolled his left ankle.

035OJI2004 Ankle Sprain, 04/02/04

Employee developed pain and swelling to the right ankle during physical training. No specific action or event noted to cause the pain.

OCTOBER 2004

079OJI2004 Other: Ankle/Foot Pain, 08/06/04

While running during the morning physical training, the employee crossed over Braselton Hwy. onto Jim Moore Road. He made a step off of a curb from a sidewalk to the street. When his foot hit the roadway, it felt slightly uncomfortable but he felt no popping, cracking, or other obvious signs of injury.

082OJI2004 Ankle Sprain, 08/26/04

While running for physical training, the employee twisted his left ankle.

JANUARY 2005

002OJI2005 Ankle Injury, 12/22/04 ***Resigned***

The employee advised that while participating in physical training he rolled his ankle off of the pavement causing a severe pain in his right ankle.

MARCH 2005

013OJI2005 Ankle Sprain, 02/04/05

During physical training, the employee stepped off the curb and sprained his ankle.

Appendix B

Recommendations of the Frederick County Board of Inquiry

Consolidated List

1. Follow hydration recommendations. Ensure recruits have access to water during evolutions, and hydrate prior to beginning evolutions.
2. Provide light colored physical training clothing.
3. During the hiring process, allow time and provide guidance for acclimation to weather conditions.
4. Evaluate the physical condition of recruits prior to starting physical training.
5. Do not assume that recruits completing CPAT can complete a three-mile run.
6. Establish a policy for all outside activities, that considers environmental and weather conditions with appropriate modifications for extreme conditions.
7. Students and instructors should all know the objectives for physical training prior to the session. Documentation including a written curriculum, schedule of activities, and lesson plans for each session including alternative plans for extreme weather and environmental conditions should be used.
8. The Physical Training Program should be reviewed and validated by qualified personnel.
9. Records should be kept of all evolutions.
10. The traditional fire/rescue culture should change. Recruits should be encouraged to notify the instructor of injury, illness, or significant problems without fear of retribution. Instructors should be constantly vigilant for possible problems.
11. Instructors leading physical training should be properly trained and certified for that purpose.
12. A safety officer should observe all evolutions.
13. Sufficient staff should be provided for completion of all needed tasks including supervision during training activities. Staff must accompany recruits to ensure students

are all supervised even in the event of an emergency that requires the full attention of one or more staff members.

14. Written emergency procedures should be developed addressing students or instructors injured or incapacitated including the use of the Incident Command System.
15. Emergency medical gear, water, ice, communications equipment, and transportation should always be available for immediate use during evolutions.
16. The intensity and duration of physical training should be gradually increased.
17. A disciplinary policy should be developed to avoid inappropriate use of physical training for punishment.

Appendix C

GWINNETT FIRE & EMERGENCY SERVICES
Fire Rescue Training Academy

To: Fire Department Training Officers

From: Jeff Yoder, Director of Training

Date: March 30, 2005

Re: Physical Training/Running Survey

In an effort to continuously improve, Gwinnett County Department of Fire and Emergency Services is in the process of reviewing information regarding physical training (PT) for fire recruits. We understand the vital nature of physical fitness for all fighters throughout their careers and want to instill in new employees excellent physical training attitudes and habits. We also need to find an appropriate balance between pure PT and fire related physical activity and attempt to define a reasonable amount of time to dedicate to PT.

We constantly learn from others. Please assist us by completing and returning the attached questionnaire. We will be happy to share the results in the future.

We would also ask, if you have written policies regarding PT as a part of Basic Fire training, that you share them with us. We would be glad to reciprocate if possible.

Thank You.

Gwinnett County
Department of Fire and Emergency Services
Fire Academy/College

Physical Training/Running Survey

General Information

Department: _____

[ ] Paid [ ] Volunteer [ ] Combination [ ] Urban [ ] Suburban [ ] Rural

[ ] 1 Station [ ] 2-4 Stations [ ] 5-10 Stations [ ] 10-20 Stations [ ] Over 20 Stations

Personnel

[ ] 1-25 [ ] 26-50 [ ] 51-100 [ ] 101-200 [ ] 101- 500 [ ] 500 – 1000 [ ] Over 1000

Physical Training/Running Questions

1. Does your department have a Fire Recruit Training Program?

[ ] Yes [ ] No (Please proceed if yes.)

2. Approximately how many recruit firefighters do you train per year?

[ ] 0-10 [ ] 10-30 [ ] 30-50 [ ] over 50

3. What is the length of your Basic Fire Training program, excluding EMT Training?

[ ] 5 weeks or less [ ] 6-10 weeks [ ] 11-16 weeks [ ] Over 16 weeks

4. Does your Basic Fire Training program include regular physical training (PT)?

[ ] Yes [ ] No (Please proceed if yes.)

5. Do you have written guidelines documenting and standardizing your PT program?

[ ] Yes [ ] No

6. If yes, would you be willing to share them?

[ ] Yes [ ] No

7. How often do you conduct Physical Training in your Basic Fire Training Course?

[ ] Daily [ ] Every Other Day [ ] Three Days per Week Other _____

8.Approximately how long do you spend solely for physical training each day?

[ ] 0-30 Minutes [ ] 30 Minutes to 1 Hour [ ] 1-1.5 Hours [ ] 1.5-2 Hours

Other: _____

9. Does your PT Program include:

a. Warm-up Stretching Exercises? [ ] Yes [ ] No

b. Flexibility Exercises? [ ] Yes [ ] No

c. Strength Calisthenics? [ ] Yes [ ] No

d. Weight Training? [ ] Yes [ ] No

e. Use of Firefighting Task Related Equipment? [ ] Yes [ ] No

d. Use of Non-firefighting Exercise Equipment? [ ] Yes [ ] No

10. Does your PT program include running/jogging?

[ ] Yes [ ] No

If Yes:

a. Where to you run? (check all that apply)

[ ] Public Roadways [ ] School Track [ ] Parking Lot [ ] Gymnasium

[ ] Hard Smooth Surface [ ] Gravel or Dirt Surface [ ] All Terrain

[ ] Up and Down Steps Other _____

b. What type of running do you do? (check all that apply)

[ ] Jogging [ ] Sprints [ ] In Firefighting Gear [ ] In Gym Clothes

Other _____

c. How often do you run?

[ ] Only Occasionally [ ] 1-2 Times per Week [ ] 3 Times per Week [ ] Daily

d. How far do candidates run each time at the beginning of your basic fire training?

[ ] Less than 1 mile [ ] 2-3 Miles [ ] 3-4 Miles [ ] 5-6 miles [ ] Over 6 miles

e. How far do candidates run each time at the end of your basic fire training?

[ ] 1-2 Miles [ ] 2-3 Miles [ ] 3-4 Miles [ ] 5-6 miles [ ] Over 6 miles

f. Please list precautions taken to ensure the safety of all participants during running.

_____

_____

_____

_____

_____

g. Have you had any problems related to running?

[ ] Yes [ ] No If yes, please describe them.

_____

_____

_____

_____

11. Answer only if "No" to question 10:

a. Have you ever included running in your Fire Recruit PT program?

[ ] Yes [ ] No

b. If Yes, What caused you to stop?

_____

_____

_____

_____

c. What aerobic exercise(s) do you include in your PT program for Fire Recruits?

_____

_____

_____

_____

d. Are you satisfied with the results of your PT program without running?

[ ] Yes [ ] No

12. Please list any comments, opinions, or advise you may have regarding physical training for recruit firefighters.

_____

_____

_____

_____

_____

_____

_____

_____

13. May we contact your department for additional information regarding physical training for recruit firefighters?

[ ] Yes [ ] No

If yes, please list the information for the appropriate contact from your department:

Name: _____

Phone: _____

E-Mail: _____

Thank you for your time.

Please return survey results by FAX to:

Director Jeff Yoder
Gwinnett Fire Academy/College
3608 Braselton Highway
Dacula, GA 30019

Phone 770-614-2112
FAX 770-614-2340

E-Mail jeffyoder@gwinnettcounty.com

Appendix D

Numerical Survey Results

Total Surveys Returned		***28***
Total Paid Departments	23	82.14%
Total Combination	4	14.29%

Department Type	
Urban	18
Suburban	8
Rural	4

Number of Stations		
1	0	0.00%
2 to 4	0	0.00%
5 to 10	6	21.43%
11 to 20	8	28.57%
over 20	13	46.43%

Number of Personnel	
1 to 25	0
26 to 50	0
51 to 100	1
101 to 500	15
501 to 1000	6
Over 1000	5

Recruit Training Program?		
Yes	28	100.00%
No	0	0.00%

PT included in Basic Fire Training?	
Yes	28
No	0

Number of Recruits Trained per Year		
0 to 10	5	17.86%
10 to 30	9	32.14%
30 to 50	5	17.86%
Over 50	9	32.14%

Length of Fire Training Program (Excl. EMT	
< 5 weeks	1
5-10 weeks	2
11-16 weeks	17
> 16 weeks	8

Written Guidelines for Recruit PT Program?		
Yes	10	35.71%
No	18	64.29%

Willing to Share Guidelines?
All departments who have written guidelines for PT programs indicated that they are willing to share

How often is PT Conducted?		
Daily	21	75.00%
Every Other Day	0	0.00%
3 Days a week	6	21.43%
4 Days a week	1	3.57%

Duration of PT Sessions	
0 to 0.5 hours	2
0.5 to 1 hour	13
1 to 1.5 hours	10
1.5 to 2 hours	3

PT Session Components		
Warm-up Stretching Exercises?	27	96.43%
Flexibility Exercises?	27	96.43%
Strength Calistenics?	22	78.57%
Weight Training?	15	53.57%
Firefighter Task Related Equipment?	16	57.14%
Non-firefighting Exercise Equipment?	17	60.71%
Running/Jogging ?	27	96.43%

Where do you run?	
Public Rd	14
School Track	7
Parking Lot	12
Gym	1
Hard Smooth	18
Gravel/Dirt	6
All Terrain	4
Up/Down Stairs	16

Running Distance at Beginning of Program		
< 1 mile	13	46.43%
2-3 miles	14	50.00%
3-4 miles	0	0.00%
5-6 miles	0	0.00%
> 6 miles	0	0.00%

Running Distance at End of Program	
< 1 mile	9
2-3 miles	5
3-4 miles	8
5-6 miles	3
> 6 miles	1

How often do you run?		
Occasionally	1	3.57%
1-2 Times/Wk	6	21.43%
3 Times/Wk	10	35.71%
Daily	11	39.29%

What type of running do you do?	
Jogging?	27
Sprints?	9
In firefighting gear?	7
In gym clothes?	24

May we contact you for further information?		
Yes	24	85.71%
No	1	3.57%

Appendix E

Compiled Verbal Survey Results

- "Please list precautions taken to ensure the safety of all participants during running."

  Pre-hire or pre-course precautions:

  1. In-depth physical prior to hiring including stress test by a cardiologist.
  2. Pre-course information, letter prior to the academy describing PT.

  Pre-run precautions:

  1. Encourage hydration prior to running.
  2. Ensure proper shoes are used.
  3. Ensure proper running attire.
  4. Use running primarily as a warm-up for other activities.
  5. Warm-up exercises, stretching.
  6. Recruits are counseled that they will not be penalized if they are not able to run for muscular skeletal reasons.
  7. Not running on very hot days.

  Running Considerations:

  1. Progressive routine for of the duration of the academy.
  2. Start off with light running, as aerobic capacity improves open it up a bit.
  3. Ease them into running, slow pace the first two weeks.
  4. Running surface.
  5. Appropriate amount of exercise based on the general fitness of the group.
  6. Run controlled to the speed of the slowest runner.
  7. Different leader each week (carries the flag).
  8. Timed mile run after third week to track improvement.
  9. Run as a group.

During the run:

1. Fitness heart monitors.
2. Supervision (see separate category)
3. All participants wear traffic vests.
4. Use of road guards at intersections and when crossing.
5. Instructor out ahead to warn traffic.
6. Run on side-walks when possible, Run only on sidewalks.
7. Students with soreness or minor injury use a treadmill.
8. Run in formation, four lines of ten to increase visibility.
9. Constant hydration, provision of fluids as needed.

Post Run:

1. Visual check of recruits by training officers, injury checks.
2. Post exercise cool (warm) down.

Supervision:

1. EMS supervision.
2. Minimum of three instructors.
3. Four instructors (some to stay with out of shape candidates).
4. Training officers present and participating.

Emergency Preparation:

1. Van trailing runners with EMS equipment and water.
2. Follow in a golf cart.
3. Accompanied by EMS bike or followed by vehicle with EMS staff.

All categories:

1. Common sense.

- "Describe any problems you have had related to running?"
    1. Shin splints (over 15 responses), strains, sprains, turned ankles, sore knees, leg issues, pulled muscles, stress fracture in foot, fracture (1)
    2. Weak Minds
    3. Over weight out of shape recruits.
    4. Recruits physically unable to complete runs, sick, vomiting.
    5. Public Complaints
- "What aerobic exercise(s) do you include in your physical training program for fire recruits?"
    1. 2 to 3 mile running Course.
    2. Stair climbing with full turn-out gear and a 50 foot section of 2 ½ inch hose.
    3. Drills on each part of the physical agility test.
    4. Circuit Training with six stations, each timed by instructors.
    5. On non-running days after about three to four exercises they run 30 to 40 yards, then a short break, then back to exercises.
- " Please list any comments, opinions, or advice, you may have regarding physical training for recruit firefighters."

    We try to incorporate various cross training in our physical training program. I have found that including "power walking" early in the program, once a week for the first six to eight weeks, helps alleviate some of the shin splints. You can achieve the target heart rate while building up the accessory muscles to the calf shin area. We are also located near the bike/jogging trail so it is easy for anyone to chose the type of surface to run on. (Fort Worth Fire Department)

    We have all recruits reviewed by our "Peer Fitness Trainer" prior to running and all recruits pass am medical evaluation (NFPA 1582) by our fire department doctor prior to running. (Boise Fire Department)

    The primary goal of our morning physical training program has been to warm-up, stretch, and prevent injury while conducting practical drills throughout the academy. We conduct some type of physical training for at least 30 minutes every morning. Additionally, we will do push-ups, sit-ups, and other exercises throughout the day to

increase strength and abilities. We have worked closely with our wellness specialist is designing our physical training activities. When a recruit is struggling at the beginning of our academy, we assign them to work with the wellness specialist to develop a custom nutrition and work out program that will help them succeed. (Tualatin Valley Fire and Rescue)

Recruits want some type of program that challenges them physically. After the recruit training program is over, they have all overwhelmingly stated they appreciated the PT – it made them better. (Casper Fire Department)

Provide a training program that focuses on aerobic capacity, muscular strength, muscular endurance, and flexibility. Provide benchmark testing at the beginning of the academy, middle, and end to evaluate the programs effectiveness. (Los Angeles County Fire Department)

The most important outcome is developing in a recruit the knowledge, the desire, and a passion for maintaining health and fitness throughout a fire career. (Fire Department Unknown)

If you are not doing physical training you need to. It is a very important part of training. It helps the recruit prepare for practical drills and, for some of them, getting in shape. (Norfolk Fire Rescue)

We began a more educated response to physical training with recruits. We make each recruit weigh himself or herself each morning and the instructors will evaluate their weight. A loss of two or more pounds over night raises a red flag. We got a “POLAR computer and we do a physical assessment before and after the academy. In addition we have five wear a POLAR heart rate monitor, download the information on the PC and review the result at the end of academies. The PC evaluates the same as a physical trainer evaluates in a gym: flexibility, endurance, strength, weight, and fat/muscle profile with calipers. We also host a nutrition class before the academy starts. (Hialeah Fire Rescue)

The first five weeks of the academy are for EMT training. During this time we work on building up the recruits aerobic capacity, core strength, and functional strength training. We target the workouts to challenge each recruit and have purchased heart monitors that we will issue to each recruit during the next academy. Once the fire academy starts we cut back on strength training somewhat on the days the recruits will be conducting drills and we concentrate more on aerobics, mostly running stairs. (Anchorage Fire Department)

The major focus of physical training is to reduce injury in the days drills. We do not have the time or the facilities to gain vast improvements in physical strength. The academy itself (during evolutions and drills) provides the physical challenges that tend to build that strength. We had one recruit in the last academy that hired a professional trainer to work with him during the nights and weekends to reach a decent level of performance in the academy. It is always a balance of what is the best thing to do. If you

include physical training, then you run the risk of having injuries during that training period. If you do not, then you run the risk of injuring them during the day and lose the opportunity to make some small improvement on their performance. (Stockton Fire Department)

We consider our morning physical training a warm-up only. Recruits perform manipulative skills for approximately 3.5 to 4 hours per day and therefore get all the exercise they need. (throwing ladders, doing hose lays, working with chain saws, rotary saws, etc…) The physical training includes firefighter related skills such as swinging an ax, raising a ladder, climbing a roof prop, etc… (Long Beach Fire Department)

Physical training is important to us, as we feel fire recruits should be in the best shape of their lives during the academy. We try to elevate their own expectations for themselves as well as meeting our requirements. We tailor most of the physical training to reinforce basic fire skills, thereby getting the most out of our time with them. (City of Fresno Fire Department)

We have a 22-week academy and we workout almost everyday. Our academy is paramilitary. The recruits in class do not walk on campus, they jog. Physical training is from 0800-0930. Each morning begins with a slow jog to warm-up, then we stretch. (specifically the body parts we will be working on) Monday is a calisthenics circuit course run on asphalt on the training grounds. The calisthenics include walking lunges, mountain climbers, push-ups, bar dips, pull-ups, etc… Tuesday is "Tower Tuesday" where we run up and down the six-story training tower. Wednesday is rubber band work (kind of like weight training with out weights) and abs. Thursday is running long distance or sprints or Indian runs or… Friday is firefighting circuit day which includes dragging a tire attached to 1 ¾ inch hose, 16 pound sledge hitting a wrecked automobile, hoisting a piece of telephone pole to the second floor, ascending a staircase, etc… We start slow, build up, the taper off towards the end. We had the program designed by our city physician and his staff. We monitor injuries and make adjustments to the exercise plan accordingly. We also get a functional assessment completed on each recruit before they come to work for us and it helps us focus on the areas that this class is weakest in. We also spend time working on our core strength. We have peer fitness councilors on the department that help with the program. (City of Tucson Fire Department)

It is very important to do stretching exercises before you do any strength building exercises. Try to coordinate training activities with physical training. If you are going to throw ladders and pull on the halyard that day, the do not overwork those muscles during physical training. (Memphis Fire Department)

We periodically substitute our CPAT Course for physical training when we have inclement weather. We also do not do physical training on any live fire days or during vehicle extrication, and maze week. (Henry County Fire Department)

We have found physical training to be and invaluable part of recruit training. Physical training instills teamwork throughout the recruit class and emphasizes the

necessity to remain in top physical shape to perform this profession. We have also included what we call circuit training, which puts the recruits in their fire clothes and often times on air, performing fire ground related tasks. (Climbing stairs, climbing the aerial, firefighter self rescue, firefighter rescue drag, etc…) We would like to see a firefighter physical ability standard like law enforcement that would allow us to remove a recruit from employment for non-compliance. The instructors perform the physical training alongside recruits except for circuit training. (Cincinnati Fire Department)

We provide an orientation session for recruits at six weeks prior to start and provide information on preparation for classroom and field activities. (City of New Haven Fire Department)

There is never enough time to do all that is necessary to bring a recruit to optimum physical ability. At least 50 % of recruits enter the program out of shape. Many recruits fail to continue thee fitness program after training and lose strength and endurance gained in training. (Honolulu Fire Department)