Reduction of Firefighter Injuries

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A proposed research project submitted to the Ohio Fire Executive Program

January 2011

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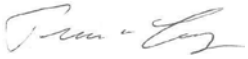
Signed: 

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ABSTRACT

After witnessing multiple fire departments fall victim to recurring plagues of injury, it is essential to not only discover the root problem of these injuries, but also to search for ways to mitigate this growing problem. With the hazardous nature of fire and emergency services, it is common for firefighters to sustain injuries in the line of duty. The major focus when examining these injuries is, despite the technological advancements made to firefighter gear and safety equipment, statistics have shown an increasing trend of non-fire ground firefighter injuries within the past five years.

To gain a better understanding of this problem, research questions were used to guide this study. The research questions focused on two key themes. First and foremost, this study sought to identify the most common type of injury. The second focus of this study was to determine the adequacy of the current health and wellness program with respect to preventing injury and promoting physical fitness, and to discover an approach to improve the quality of these programs. In order to answer these questions, surveys were distributed not only to various fire departments, but also to certified personal trainers.

The results of the surveys, coupled with literary research, revealed that the most common form of injury was a musculoskeletal strain or sprain. Furthermore, the study confirmed that the majority demographic affected were victims at the firefighter rank with between 11 – 20 years of service. The surveys also proved to be a catalyst for change in the health and wellness program. Of all physical fitness professionals surveyed, a vast majority found the current health and wellness program to be below industry standards, especially in the area of fitness education. This study has concluded that the key to reducing injury lies in improving fitness education throughout the department with focus on proper body ergonomics.

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INTRODUCTION

Air Force Fire Protection is a dynamic career field. Both Federal service and military firefighters are jointly responsible for a wide array of emergency services throughout the United States Air Force and the Department of Defense. Air Force firefighters face significant challenges and unique hazards which place them at a greater risk for injury or even death. Air Force firefighters encounter dangers associated with large scale industrial facilities, aircraft rescue operations, large petroleum facilities, research & development facilities, munitions storage areas, and business facilities with occupational loads of up to 20,000 people. In order to maintain a high degree of safety for firefighting personnel, many programs have been developed to help off-set risks associated with firefighting operations.

Enhanced training and safety programs focusing on operational risk management help ensure firefighters have both the cognition and motor skills necessary to conduct operations safely. These programs place emphasis on education, risk control measures, and environmental controls to ensure firefighters perform with a high degree of safety in mind for any operation they participate in. Additionally, just as important as the training and safety programs, firefighter physical fitness programs have been developed to ensure firefighters maintain the strength, endurance, and aerobic capacity needed for fire ground operations. Certainly, one of the most crucial areas consists of firefighter health/wellness programs. Each Air Force firefighter undergoes a complete National Fire Protection Association Standard 1582 physical examination conducted by a physician. This comprehensive physical examination provides a mechanism for a physician to determine if the firefighter is fit for duty and can perform fire ground operations. This physician certification is one element of a health/wellness program that is essential to the reduction of work place injuries and preventing firefighter deaths. Additional elements of the

health/wellness program consist of dietary controls, personal trainer consultation, smoking cessation classes, substance abuse courses, and peer support groups.

Yet, despite the establishment of robust training, safety, and health/wellness programs, there has been a 38% increase in firefighter on-the-job injuries at Wright-Patterson Air Force Base Fire Emergency Services (WPAFB FES) over the past few years. *The problem this study will address is the root cause for these injuries and the identification of risk control measures which can be applied to reduce or eliminate firefighter injuries.*

It is the duty of the WPAFB FES managerial team to evaluate all injuries and track causes of these injuries by working collaboratively with both the Civil Engineering and Installation Safety Offices. WPAFB FES is an element of the Civil Engineers within the Air Force. The Air Force has identified Battlefield Airmen and Civil Engineers as having an increased risk for injuries and injury related musculoskeletal disorders. Throughout the Air Force over 490 thousand Airmen receive $348 million in VA disability annually. Additionally, the Air Force pays $125 million annually for civilian workers compensation. Lost time injuries alone cause over 17 thousand lost duty days annually. Locally, WPAFB FES has encountered numerous on-the-job injuries within the past few years which have increased overtime costs by 30%, lost man hours by 20% and placed several personnel on restricted duty, resulting in a potential mission compromise. The most common type of injury within WPAFB FES is musculoskeletal injuries not related to fire ground operations. These injuries are related to activities such as mandatory physical fitness (weight training, jogging etc.), extra-curricular sports activities, or firefighter combat challenge training. Fire ground injuries are not very common; however they represent the highest amount of lost time injuries within WPAFB FES. Again the most common type of fire ground injury is musculoskeletal such as sprained ankles,

back strains, and joint dislocations. It is crucial to discover the root cause of these injuries and implement measures to protect firefighters and enhance the mission.

The purpose of the applied research paper is to evaluate the effectiveness of the current health/wellness and safety programs at WPAFB FES. This research paper will explore epidemiology and biomechanics associated with the injury increase and define high risk groups within the organization. The evaluative research method was chosen as the method for this applied research project (ARP). The project will identify areas in need of improvement for the development of control actions, solutions, or environmental controls which are to be implemented. This information will be vital in assisting the Wright-Patterson FES managerial team develop a plan of action which will reduce injuries. *The research questions this study will investigate are*:

1. Over the past five years, what is the type and statistical trend of firefighter injuries?

2. Based on the common type of firefighter injuries, what are the current risk control measures for these types?

3. Does the Health and Wellness program provide adequate physical training, dietary guidance, ergonomic training, and life style information necessary to reduce firefighter injuries?

4. Is the Division (or Department) in compliance with applicable National Standards, Federal or State Codes, and/or Department of Defense Instructions (if applicable)?

BACKGROUND AND SIGNIFICANCE

Wright-Patterson AFB is the most organizationally complex base in the U. S. Air Force. This 8,243-acre military reservation, located near Dayton, Ohio, has over 500 office, laboratory, and support buildings in addition to 1,000 housing units. It employs over 25,000 people and generates an annual payroll of almost $1 billion. The base is the largest single site employer in the state of Ohio and the largest employer among Air Force bases worldwide. Its occupants include more than 100 tenant organizations. With over 350 structures and historic sites dating from the pre-1946 period, Wright-Patterson may also be the Air Force's most historically significant base.

The WPAFB FES Division is a model organization within the 88 Air Base Wing and Civil Engineering, incorporating the latest fire service technology and providing comprehensive training to ensure firefighters are capable of mitigating structural, aircraft, and wild land fires. Additionally, WPAFB FES provides life saving emergency medical services, performs hazardous material mitigation and special operations such as trench, confined space, and high/low angle rescue. The division consists of three fire stations and ninety-one Federal Service personnel in charge of protecting twelve square miles of response district. On-duty staff consists of a minimum of twenty-three personnel including at least one District Chief and one Senior Fire officer (SFO). WPAFB FES has an average call volume of 1500 emergency responses per year, consisting of 45% emergency medical responses, 43% structural emergencies, 10% aircraft emergencies, and 2% specialized operation emergencies (Hazardous Materials, Technical Rescue, etc.). Based on statistical analysis provided by the WPAFB FES Standards of Response Coverage Guide the majority of these responses happen during duty hours 7:00 AM – 4:00 PM, Monday through Friday when the population within the base is at capacity and the base's

operational tempo is very active. However, responses after duty hours are frequent and are considered the most dangerous because most facilities are vacant and little information can be obtained as to the degree of hazard firefighters' may face when they arrive on the scene. Lastly, the base consists of 1,000 housing units which is considered home for active duty military and civilian families and is a source for many emergency responses during duty and non-duty hours throughout the year.

To become a firefighter with the WPAFB FES, the candidate must possess national firefighter credentials, such as the National Professional Qualifications Board or International Fire Service Accreditation Congress certifications. At a minimum the firefighter candidate must be nationally certified as a firefighter II, airport firefighter, hazardous materials technician, and emergency medical technician (State or National Registry). In conjunction with having the appropriate certification the candidate must pass a physical agility test consisting of a one and three-quarter inch fire hose drag for 100 yards, 150 pound rescue mannequin drag for 100 yards, and a 95 foot aerial ladder climb wearing a 30 pound weighted vest. Once completed, the candidate must pass a comprehensive medical examination conducted by the Wright-Patterson Medical Center, Occupational Health Clinic. The Occupational Health Clinic has assigned a physician to provide services for the Wright-Patterson FES firefighters. The candidate must successfully pass the physical which meets the prescribed criteria as defined by the National Fire Protection Association Standard (NFPA) 1582, Comprehensive Occupational Medical Program for Fire Departments. Once the candidate passes the NFPA 1582 physical examination, he/she earns the fitness for duty clearance and may be hired as a firefighter for the Wright-Patterson FES. The candidate then must undergo one year of probationary employment and attain all upgrade training for driver/operator prior to becoming a permanent employee.

All employees are required to pass a NFPA 1582 physical examination conducted yearly by the Wright-Patterson Occupational Health Clinic in order to achieve a fitness for duty clearance. Each employee is also expected to participate in the FES physical fitness program which is defined in the current management plan. This management plan states that each employee will participate in some sort of physical conditioning program or activity within their shift, this includes participating in sports related activities (softball, basketball, volleyball, etc.) in lieu of traditional cardiovascular or strength & conditioning type training. The FES occupation physician and FES fitness trainers provide oversight of the program and ensure employees are following prescribed fitness exercises. They also customize specific plans for employees upon request based on age, stamina, and flexibility.

In the spirit of cooperation and in a collaborative effort both the International Association of Firefighters (IAFF) Local F-88 and the Wright-Patterson FES managerial teams have had considerable influence in promoting the health/wellness, safety initiatives, and physical conditioning programs. Because of this, there has been a dramatic increase in the amount of employees actively supporting and participating in these programs. This increased activity has yielded many benefits and has changed the mindset and culture within the organization. Yet despite the success with health/wellness, safety initiatives and physical conditioning programs current trending indicates a 38% increase in firefighter injuries within the past few years. Early indications showed most of these injuries were a result of over exertion while lifting weights or sports related musculoskeletal injuries. This injury rate increase disqualified Wright-Patterson FES from its attempt to receive a Gold Star from the Occupational Safety & Health Administration (OSHA) despite the continued participation in OSHA's Voluntary Protection Program (VPP). The injury rate has also increased overtime costs by 25% and increased lost time

hours by 30%. The Wright-Patterson FES Executive Fire Staff is committed to the safety of organizational employees and eliminating or reducing injuries. This commitment is the basis for this applied research paper. *The potential impact this study could have on the WPAFB FES includes the reduction of firefighter injuries through enhanced risk controls measures, modification of physical fitness programs, and the promotion of safety as a core value within the organization.*

LITERATURE REVIEW

Annually, WPAFB FES conducts a comprehensive safety survey. Included in this survey is an assessment of injury types incurred within the year and specific details of time lost injuries. Table 1 depicts injury types and percentages for 2007. Despite risk control measures taken there was a total of 31% injuries on the fire ground. Yet, the most significant of these types of injuries is the non-fire ground musculoskeletal type (strains, sprains, etc.) injuries incurred in 2007. This percentage of musculoskeletal injuries was the first indication of a potential failure within the health/wellness and physical conditioning programs.

As a result of the 2007 safety survey, the WPAFB FES managerial team went to extraordinary measures to enhance the health/wellness and physical conditioning programs. These measures included providing training and certification for ten physical fitness trainers and increasing fitness education opportunities for employees. Additionally, voluntary physical fitness assessments were provided to employees and performed by the physical fitness trainers. Lastly, the FES occupational physician placed emphasis, with each employee, on the importance of proper stretching and physical conditioning during their annual physical examination. With additional measures in place the WAPFB FES managerial team expected a decrease in

musculoskeletal injuries, however over for the next two years, injury rates decreased (or remained the same) in all but one category. As depicted in Table 2, the 2009 safety survey indicated a 1% increase in non-fire ground musculoskeletal type injuries.

Table 1

2007 Injury Statistics

Fire Ground	Total	31%
Burns	3%	
Lacerations	12%	
Musculoskeletal	16%	
Non-Fire Ground	Total	69%
Back injuries	23%	
Musculoskeletal	31%	
Miscellaneous	15%	

Table 2

2009 Injury Statistics

Fire Ground	Total	18%
Burns	1%	
Lacerations	3%	
Musculoskeletal	14%	
Non-Fire Ground	Total	62%
Back injuries	12%	
Musculoskeletal	32%	
Miscellaneous	18%	

The United States Fire Administration (USFA) 2008 report *Fire-related Firefighter Injuries in 2004* states "Typically, the leading causes of injury among younger firefighters relate to smoke inhalation and exhaustion, and among older firefighters, strains and sprains are the more common injuries" (USFA, 2008). The report specified firefighters within the age range of

20 – 39 are at the greatest risk for injury. This is consistent with statistics derived from the 2007 and 2009 injury reports from the Wright-Patterson FES. In 2009, 55% of all employees who suffered from musculoskeletal injuries were within the age range specified in the USFA 2008 report. The report also stated 30% of firefighter injuries in 2004 were to the upper and lower extremities (torso, arms, hands, and legs/feet). Overall, sprains and strains accounted for over a third of firefighter injuries in 2004. This data is consistent with the data derived from the Wright-Patterson FES 2007 and 2009 injury reports.

The International Association of Firefighters sponsored a research project by Moore-Merrell, Zhou, McDonald-Valentine, Goldstein, and Slocum (2008) entitled, *Contributing Factors to Firefighter Line-Of-Duty Injury in Metropolitan Fire Departments*, which evaluated nine metropolitan fire departments in the United States. The group evaluated 3450 injuries with dominating contributing factors stemming from a lack of situational awareness at 37.35%, lack of wellness or fitness at 28.57%, and human error at 10.65%. The premise of the research was based on classifying the injuries into contributing factor clusters or contributing factors which occurred together. The contributing factors clusters can be defined as the following:

> Cluster One – Included equipment failure, lack of training, structural failure, act of violence, civilian error, horseplay, or lack of teamwork.
>
> Cluster Two – Included crew's size, lack of wellness or fitness, fatigue, and weather or act of nature.
>
> Cluster Three – Included protective equipment not worn and dangerous substance.
>
> Cluster Four – Included poor decision making, lack of communication, standard operating guideline or procedure breech, protocol breech, human error, and lack of situation awareness.

As a result of this research, it was found that cluster four was responsible for more than 30% of all injuries and cluster two was responsible for 26.2% of injuries over the two year period (Moore-Merrell, 2008). The study also revealed more line-of-duty (LOD) injuries occurred with firefighters less than 6 years of service (30.7%) and in those between 11-20 years of service (31.9%). Also, the majority of firefighters injured are between the ages of 36-45 (39.4%). According to rank, more firefighter LOD injuries occur in the rank of firefighter (72.1%) than in any other rank. While there were many circumstances surrounding the injuries, most occur on the fire ground (30.5%). The most common type of injury was a fracture or muscle strain (61.7%). For the cases studied, more than half required medical aid (62.7%) and the most common body part injured was an extremity (42.0%).

According to the book *Sports Injuries Guidebook* by Robert S. Goltin (2008), the most common joint and ligament injuries result from misuse or direct trauma. When two bones come together in a joint they are held together by tough, inflexible tissues called ligaments. Often referred to as sprains, ligament sprains are common and can occur anywhere in the body. Because ligaments are relatively inelastic, measures must be taken to prevent both initial and recurring injuries. Protective equipment and proper body mechanics can make a significant difference.

Tendons attach muscle to bone. The muscle-tendon unit (also called the musculotendinous unit) helps to stabilize the joint. Injuries to tendons and the rest of the muscle are referred to as strains. Strains to muscles can be as minor as a mild spasm or can involve significant bleeding and swelling. Chronic tendon injuries result from overuse and poor body mechanics, and are very difficult to treat.

In the book *Proof Positive: An Analysis of the Cost-Effectiveness* by Larry S. Chapman (2007), the author conducted a study of forty two health and wellness programs with more than 370 thousand participants. The study revealed that health and wellness programs can:

Reduce sick leave by 27.8%

Reduce health costs by 28.7%

Reduce disability costs by 33.5%

Reduce workers comp costs by 33.5%

Save $5.50 in cost for every dollar invested

The study revealed that health and wellness programs are vital elements within an organization. Health and wellness programs are difficult to establish, but must be viewed by all employees as an essential part of the organization.

The book *Fitness After 40* by Vonda Wright, M.D. focuses on the well being of adults over the age of forty. Flexibility is the ability of muscle to lengthen and allow joints to move through a full range of motion. Maintaining muscle flexibility increases athletic performance, improves running economy (decreased energy expenditure at a given speed), prevents injury, decreases soreness, and hastens rehabilitation following injury. In their relaxed state, muscles and the tendons that attach them to bones are “crinkled up”. In this chronically shortened state, muscles and tendons prevent joints from moving through their full range of motion which changes a person’s posture of even the way he/she can walk. Stiff muscles and tendons can be compared to an old rubber band, one pull and these brittle elastic bands “pop”, causing a moderate to severe injury. Decreased flexibility in older adults contributes to common injuries associated with physical activities. According to the text, *Fitness After 40*, “Flexibility is essential in preventing all kinds of injuries, but tendonitis in particular. Prevention of tendonitis

requires stretching the muscle on a regular basis, which allows less pulling and traction on the tendon's attachment to the bone" (Wright, 2009, p. 45). Basically, tendonitis can be described as "too much, too soon, too often, and with too little rest" (Wright, 2009, p. 138). Unfortunately these problems occur in older athletes and often result from tendonitis. While tendonitis is the acute inflammation of the tendon, tendonitis in the longer term is the cumulative effect of repetitive micro trauma to the tendon that does not properly heal.

According to the book *Repetitive Strain Injury* by Emil Pascarelli, M.D. (2004), occupational injuries may not be the only reason for lower back injuries. In upper body strains there are many causes, and this creates confusion. Risk factors are related to home life, sport activities, physical condition, and diet. However, additional factors include genetic makeup, sex, age, and any underlying illness. The strongest risk factors for lower back strain are statics or awkward posture, anxiety, mental stress depression and job satisfaction. "Because of its sheer number of victims, lower back pain has become a serious socioeconomic problem, costing industry and the health care system billions of dollars annually" (Pascarelli, 2004, p.106). In the United States, approximately $14 billion a year is spent dealing with the results of lower back pain. The average adult will experience an episode of lower back pain at least three times in his or her life.

The study of bio mechanics is essential in the development of solutions and corrective actions that could be implemented to reduce injuries. In the book *Repetitive Strain Injury*, biomechanics is defined as "how we interact without tools and how we can do so without incurring injury" (Pascarelli, 2004, p.146). There is an important relationship between ergonomics, the external factor or equipment, and biomechanics, the internal factor or the body. The essence of this relationship is that optimal biomechanical activity is easiest to achieve if the

groundwork has been laid by using ergonomically sound equipment. If a person is not physically and mentally fit and their workstation is not adequately set up, injury can be expected no matter how proper the technique is on any activity. Biomechanical training or retraining is the critical final step in a program that will stimulate recovery from repetitive strain injury.

In the training manual *Fire Department Occupation Safety* much emphasis is placed on the benefits and necessity for fire departments to have physical fitness and wellness programs. Firefighters must be physically and mentally prepared for the job, or stress will take its toll.

> Physical fitness and health programs can help reduce accidents, injuries, heart attacks, illnesses, and mental stress caused by the rigors of the job. Healthy, physically fit firefighters will be able to perform their duties better, longer, and more safely than unfit firefighters. (Fire Protection Publications Oklahoma State University, 1991, p.45).

The manual specifies that physical fitness programs should be designed to develop and maintain the physical fitness necessary to carry out strenuous firefighting activities. Physical fitness programs are vital to all firefighters, not just new recruits.

The transition from a relaxed state to a state of heavy physical exertion places a tremendous amount of stress on all of the bodily systems. The training manual specifies that many departments have recognized the value of a continuing fitness program. Since the implementation of these programs, departments have experienced lower injury rates, reduced severity of injuries, and fewer service-connected disability retirements. Firefighters participating in such fitness programs have enjoyed better general health and higher work capacity. Programs may range from sports-related activities, such as basketball, to highly structured exercise programs put together by professional consultants. The Fire Department physician should monitor the program as well as determine appropriate levels of fitness. When developing and

implementing a physical fitness program, there are several areas that must be considered such as medical restrictions, support of fitness program, and motivation.

A major component to any physical fitness program is cardiovascular training. The ability of the lungs, heart and circulatory system to deliver oxygen can be greatly affected by physical training. To train the cardiovascular, it must be placed under a fairly constant load. As training progresses, the increased efficiency of the heart can be measured by a drop in pulse rate for a given load. Likewise, the resting heart rate will decrease. A second and equally important aspect of a physical fitness program is the strengthening of muscles and joints of the back, abdomen, legs and arms.

The employee wellness element is just as important as the physical fitness element within the program. “Surveys have indicated that a significant portion of firefighters who are forced into medical-related retirements are suffering from advanced heart disease. Because of this, heart disease is certainly a health problem that should concern firefighters” *(Fire Protection Publications Oklahoma State University, 1991, p.45).* To reduce the risk of heart disease, firefighters need to limit the intake of saturated cholesterol fats. The hazards of smoking can only be reduced if the smoker stops smoking cessation. The early recognition and control of high blood pressure will lessen the risk of heart disease. Each firefighter should have annual physical examinations to detect high blood pressure. Physical inactivity is also a contributing factor to heart disease. Firefighters should put every effort into remaining active within a physical fitness program, paying close attention to their nutrition and diet, and providing peer support for those struggling with smoking cessation, high blood pressure, and heart disease.

According to the training manual *Fire Department Safety Officer* by Fire Protection publications, the National Fire Protection Association Standard (NFPA) 1500 (Occupational Safety) requires the fire department to establish and provide a physical fitness program that meets the requirements of NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters, 200th edition. The intent of this standard is to enable members to develop and maintain an appropriate level of fitness to safely perform their assigned functions. These levels must reflect the firefighter's assigned functions and activities and the severity of occupational injuries and illnesses associated with these activities. The manual specifies, before exercise can begin, an assessment must be made of the individual's level of fitness. This assessment allows the health and safety office or health fitness coordinator to determine the correct exercise plan to meet the individual's needs. The physical performance assessment is a series of exercises that the individual is required to perform. The individual performance is then scored and compared to a predetermined scale. Once the level of fitness assessment is complete, a physical fitness program can be developed for each individual based on age, need, and gender. "The United States Fire Administration has developed the Physical Fitness Coordinator's Manual for Fire Departments that contains a detailed description of the assessment process and recommended exercises" (Fire Protection Publications, 2001, p.44). The physical fitness component of the health and wellness program must address flexibility, muscular fitness, and body composition. Implementation of specific exercise should be used to improve individual deficiencies in each of these areas.

The Voluntary Protection Program (VPP) policies and procedure manual specifies background information pertaining to the origins of VPP Programs. On July 2, 1982 the Occupational Safety and Health Administration (OSHA) announced the establishment of the

VPP programs. The intent of the programs was to recognize and promote effective worksite-based safety and health management systems. In the VPP, management, labor, and OSHA established cooperative relationships at workplaces that are implementing or have implemented comprehensive safety and health management systems. Approval into VPP is OSHA's official recognition of the outstanding efforts of employers and employees who have created exemplary worksite safety and health management systems. OSHA offers on-site assistance to organizations committed to achieving the VPP level of excellence. The following principles are embodied in the VPP programs:

- Voluntarism
- Cooperation
- A systems approach
- Model worksites for safety and health
- Continuous improvement
- Employee and employer rights

Categories of participation for VPP program consists of the following:

- Star Programs, recognizes the safety and health and excellence of worksites where employees are successfully protected from fatality, injury, and illness by the implementation of comprehensive and effective workplace safety and health management systems. These worksites are self-sufficient in identifying and controlling workplace hazards.
- Merit Program, the merit program recognizes worksites that have good safety and health managements systems and that show the willingness, commitment, and ability to achieve site-specific goals that will qualify them for Star participation.

- Star Demonstration Program, The star demonstration program recognizes worksites that have star quality safety and health management systems that differ in some significant fashion from the VPP model and thus do not meet the star requirements. A star demonstration programs tests this alternative approach to protecting employees to determine if it is as protective as current star requirements.

In summary, despite measures taken by the WPAFB FES managerial team, annual injury statics indicate a steady increase in musculoskeletal type injuries within the a three year period. As specified in the USFA 2008 report *Fire-related Firefighter Injuries in 2004,* firefighters within the ages of 20 -39 are at the greatest risk for injury. This is consistent with the WPAFB FES annual safety surveys which indicate 55% of all employees who suffered musculoskeletal (non-fire ground) were within the specified age range. This parallels the information provided in the International Association of Firefighters who sponsored a research project entitled *Contributing Factors to Firefighter Line-Of-Duty Injury in Metropolitan Fire Departments.* This report specified the most common type of injury was a fracture or muscle strain and the most common body part inured was an extremity.

Based on the information obtained from this literally review, a better understanding of causes of musculoskeletal type injuries is needed. Organizational health/wellness programs need to address the aspects of strength conditioning as well as flexibility for firefighters. Managerial teams need to address the importance of proper ergonomics and provide additional training to employees to prevent injuries. Emphasis needs to be placed on preventative measures through safety initiatives developed by department Safety Officer(s) and Occupational Physicians. The

combination of safety initiatives, health/wellness, and physical fitness programs “can help reduce accidents, injuries, heart attacks, illness and mental stresses caused by rigors of the job” (Fire Protection Publications Oklahoma State University, 1991, p.45). It has been proven that these programs are considered vital elements to a work force and can save organizations thousands of dollars each year. Employers would eventually see a reduction in sick leave, reduced health costs, and reduced disability costs as a result of health/wellness and physical conditioning programs.

The challenge facing the WPAFB FES managerial team is to reconstruct and enhance the division’s health/wellness and physical conditioning programs, and place emphasis on proper stretching and strength conditioning exercises. Restrictions may need to be placed on the type of sport related activities employees may participate in while on duty. Additionally, WPAFB FES managers should encourage specific age groups to be more active in order to prevent future injuries and conduct physical fitness assessments for all employees. Lastly, training programs need to be enhanced to address proper ergonomics, lifting and moving techniques, and prevention of repetitive motion injuries.

PROCEDURES

The procedures utilized by the ARP will be simplistic, yet, yield a significance amount of information for the WPAFB FES managerial team. While employing the evaluative research methodology, extensive research was conducted through a literature review of fire service journals, industry magazines, National Fire Protection Association Standards, WPAFB FES Comprehensive Safety Surveys, and the internet. Based on the results of the literature review the author of this ARP will focus survey instrumentation primarily on the effectiveness of health/wellness programs, physical fitness programs, compliance with State or Federal codes (or guidelines), and the quality of training in which firefighters are trained.

Survey Population

An electronic survey was distributed to thirty fire departments from both the Department of Defense and local municipal fire departments. The municipal fire departments were chosen based locally around the installation and mutual aid agreements with WPAFB FES. The federal fire departments were chosen based on the geographic size, organizational complexity, number of firefighters, and additional similarities comparable to WPAFB FES. Most federal fire departments selected were from Air Force Materiel Command. Instructions were provided to each chief, requesting the survey be completed by them personally or a delegate. Each survey was anonymous with only one question differentiating Department of Defense Fire Departments from local municipal fire departments.

In addition to the thirty surveys sent to fire departments, a survey was developed and sent to ten individual physical fitness trainers assigned within WPAFB FES. The fitness trainers were targeted due to the importance of their specialized knowledge regarding fitness activities and their ability to influence employees. Information and data obtained from these surveys could

influence a change within current procedures and policies within the WPAFB FES.

Survey Instrumentation

The two electronic survey instruments were designed utilizing the web based program entitled Surveymonkey (www.surverymonkey.com) and composed of ten questions each. The first survey consisted of inquiries for Fire Department Administrators pertaining to health/wellness, physical fitness, and injury prevention programs (Appendix 1). An email was sent to all selected Fire Administrators providing them a link to the survey and requesting participation. The second survey consisted of inquiries for physical fitness trainers pertaining to injury prevention, strength/conditioning, sports related injuries, ergonomics, and fitness education (Appendix 2). Additionally, an email was sent to all selected physical fitness trainer providing a link to the survey and requesting participation. Both surveys were analyzed and interpreted by a third-party reader in order to limit the influence of bias in the study.

Assumptions and Limitations

Members of WPAFB FES are encouraged to employ some sort of physical activity during their tour of duty. While many use traditional methods such as cardiovascular training (treadmill or stair climbing machines), others have chosen to participate in various sports related activities which has caused numerous non-fire ground related injuries the most common type being musculoskeletal strain and sprain type injuries. While, WPAFB FES has an open policy on such activities other fire departments prohibit such activity. This may limit the amount of comparable data received from the surveys.

RESULTS

Research Question #1

Over the past five years, what is the type and statistical trend of firefighter injuries?

Based on national statistical trend firefighter injuries are on the rise with the most common type of injury being musculoskeletal. According to the literature review conducted by the applied research project, the leading cause for injury among older firefighter was strains and sprains (USFA, 2008). This is consistent with a study conducted by International Association of Firefighters which concluded firefighters with 11-20 years of service (31.9%) are at greater risk of injury. Also, the majority of firefighters injured are between the ages of 36-45 (39.4%) and the most common type of injury is a fracture or muscle strain. (Moore-Merrell, 2008).

This data supports the current trend occurring within the WPAFB FES, which has incurred a 38% increase in firefighter on-the-job injuries. A majority of these injuries are incurred in a non-fire ground situation and are often related to sports activities. A survey instrument was developed and issued to thirty fire departments. A majority 60% (18) of the surveys were collected from local municipal departments that surround WPAFB FES, while 40% (12) of the total surveys collected represented Air Force Materiel Command fire departments. All surveyed specified that they had greater than eleven years experience in the fire service with a majority of those surveyed being Chief Officers for their respective departments. The data revealed that 73% surveyed specified fire ground injuries have decreased or remained the same over the past five years. However, 83% of departments surveyed have seen non-fire ground injuries either increase or remain the same over the past five years. This trending increase is concurrent with national statistics and WPAFB FES data.

Research Question #2

Based on the common type of firefighter injuries, what are the current risk control measures for these types?

There are many control measures which have been implemented to offset the risk of firefighters being injured. The most prevalent risk control measure is the implementation of health/wellness programs. These programs place focus on physical fitness activities and are under direct control of certified physical fitness trainers which provide oversight of all activities and fitness assessments. However, despite the establishment of health/wellness programs nearly 70% of fitness trainers surveyed felt the programs were below industry standards and were in need of enhancement. Additionally, 70% of WPAFB FES physical fitness trainers felt the leading cause of musculoskeletal injuries was a result of improper body ergonomics or insufficient training. All physical fitness trainers surveyed believed physical fitness assessments should be mandatory and should be considered a control measure to help reduce injuries. However, 70% of the physical fitness trainers surveyed believed that sports related activities are an adequate substitute for traditional exercises. Despite this, roughly half of the departments surveyed approve of sports related activities while on duty.

WPAFB FES has embraced the VPP concept and is actively pursuing to obtain a star status. To achieve this, several other control measures have been implemented above what was identified in the previous paragraphs. All personnel are required to complete a computer based training course (CBTC). The purpose of the CBTC is to provide awareness pertaining to smart operational risk management decisions and awareness of the VPP incentives. Roughly 80% of the fire departments (both DOD and municipal) surveyed do not currently participate in the OSHA VPP program, which could help reduce injuries.

Research Question #3

Does the Health and Wellness program provide adequate physical training, dietary guidance, ergonomic training, and life style information necessary to reduce firefighter injuries?

Health/wellness programs play an integral role in firefighter safety and health. The most successful programs have an integration of physical fitness, ergonomics and dietary controls. Throughout the literature review the most common approach to employee awareness was offering of training courses to increase employee familiarity. Yet, this action only yielded marginal results and provided no interaction with employees. The study of biomechanics is essential in the development of solutions and corrective actions that could be implemented to reduce injuries (Pascarelli, 2004).

As a result of the survey instrument provided to the WPAFB FES physical fitness trainers, 70% felt the current WPAFB FES fitness programs were below industry standards and all the trainers believed that participation in the health/fitness programs should be made mandatory. Additionally, all of the fitness trainers surveyed felt that mandatory physical fitness assessments should be conducted. Due to the importance of physical fitness education and the study of biomechanics, 90% of the fitness trainers feel WPAFB FES employees did not receive enough fitness education. This lack of education could be the result of the injury increases currently plaguing the division. However, fitness trainers feel strongly that employees should be engaged in some sort of physical activities. Of the fitness trainers surveyed 70% feel that sports related activities are a suitable substitute for traditional exercise. None of the physical fitness trainers felt that eliminating sports related activities would eliminate injuries. Despite these results most of the trainers surveyed had less than four years as a fitness trainer, but yet had over 11 years of fire service experience.

Research Question #4

Is the division (or department) in compliance with applicable national standards, federal or state codes, and/or Department of Defense Instructions (if applicable)?

The survey instrument provided to thirty fire departments inquired about the requirement to comply with National Fire Protection Association (NFPA) Standards. Roughly 60% of the departments that specified they were in compliance with NFPA standards were Department of Defense (DOD) fire departments, with the remaining 40% being identified as municipal fire departments. Based on current federal law, DoD fire departments are obligated to adhere to DoD instructions, Air Force instructions, and NFPA standards. As such, WPAFB FES has instituted health/wellness programs which comply with NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters. Although DoD departments were compliant with NFPA standards, statistics show that non fire ground injuries continue to rise.

Just over half of the departments surveyed specified they have an established health/wellness programs that comply with NFPA 1583. Although there is no obligation to adhere to NFPA standards by municipal fire departments, all are obligated to adhere to the Ohio Revised Code (ORC) statutory requirements for fire protection safety programs. A possible cause for the increase in non fire ground related injury could be due to failure to institute a health/wellness program concurrently with a safety programs.

Additionally, WPAFB FES complies with installation mandates and union partnerships and has instituted an incentive to become an OSHA VPP Gold Star site. This incentive places stronger control measures to offset risk for injury. Yet, 80% of the departments surveyed specified they do not participate in the VPP program due to no obligation or requirement.

DISCUSSION

Compare

The WPAFB FES injury statistics provided in the applied research project are consistent with national trends pertaining to firefighter injuries. Most injuries that occur either on the scene of an emergency or non-fire ground activity are considered musculoskeletal in nature and those at greater risk in the age range of 20-39 (USFA, 2008). However, the majority of injuries that occur within WPAFB FES are from non-fire ground activities. The vast majority of fire departments surveyed indicated compliance with the requirement of NFPA 1500 for pertaining to having a health/wellness program. Yet despite this, 46% of the departments reported an increase in the number of non-fire ground related injuries. Despite having a health/wellness program only 51% of the fire departments polled indicated they have a mandatory physical fitness program and a majority had no mandatory annual employee physical assessment.

A disparity exists between the fire department survey and physical fitness trainer survey in regards to participation of sports related activities by personnel on duty. The survey indicated 70% of physical fitness trainers endorsed the participation of sports related activities while personnel were on duty, but only 56% of the fire departments polled allowed participation of sports related activities while on duty. This clearly shows a concern by fire department management teams regarding the potential of injury of personnel participating in these activities.

“Health/wellness programs are vital elements within an organization” (Chapman, 2007). Because of this there is an inherent risk of injury in any activity, but yet a greater risk for inactivity. The majority of fitness trainers surveyed specified routine strength and conditioning exercise combine with a age specific personalized fitness program would help reduce injuries.

Additionally, an overwhelming 90% felt more health/wellness training was needed by employees to help off-set the risk of injuries.

Interpretation/Evaluation

It was concluded a majority of the fire departments did not see an increase in fire ground related injuries but did incur an increase in non-fire ground related injuries within the past five years. A majority indicated they have an existing health/wellness program in compliance with NFPA 1500 but do not have mandatory physical fitness programs or mandatory physical fitness assessments. Only 43% of the departments surveyed supported sports related activities while on duty with 57% opposing such activities. Lastly, only 26% indicated they were participating in the OSHA VPP program.

Based on the percentages from the physical fitness trainer surveys it was concluded a vast majority was either a company officer or firefighter rank with 11-12 years experience on the job and 3-4 years experience as a fitness trainer. A majority endorsed the participation of sports related activities while on duty and felt WPAFB FES could do more to improve the physical fitness programs. Based on the survey a majority of the fitness trainers felt improper body ergonomics was a leading cause for injury and more focus needed to be placed on health/wellness and fitness education. Additionally a majority felt routine strength and conditioning exercises in conjunction with a personalized fitness program (age specific) followed by an annual fitness assessment would help reduce injuries.

Implications

The conclusion of each survey revealed a concern for employee safety but yet an attempt to reduce risk for injury to maximize employee potential and reduce workers compensation claims and overtime costs. Yet a balance must be maintained between the ability of an employee to stay active and remain in good health in contrast to being stagnate and increasing the risk of injury due to the inactivity. Firefighting is an inherently dangerous job in which firefighters must maintain good health and fitness in order to maximize productivity on the fire ground. However, it is the responsibility of the employer and the employee to develop a program in which the employee is offered the ability to participate in some form of physical activity to maintain stamina and cardiovascular endurance.

The implications of these surveys indicate a need for WPAFB FES to enhance and further develop its health/wellness program with a detailed focus on the physical fitness aspect. Based on the findings from the survey instrument provided to the fire departments, a complete review of authorized sports activities should be conducted by WPAFB FES managers encouraging employees to stretch prior to activities and participate in routine strength and conditioning exercises. This action could help off-set injuries as a result of sports related activities and further increase productivity on the fire ground. Additionally, WPAFB FES managers need to collaborate with the Local IAFF F-88 bargaining unit to further developing the health/wellness program by implementing mandatory physical fitness assessment by all personnel.

Reducing injuries is the overall goal within any fire department or organization. Employee participation in the health/wellness programs is key in reducing injures. Yet, the health/wellness program must offer the employee the ability to stay active. Programs which are educational, rehabilitative and challenging yield the greatest results.

RECOMMENDATIONS

In order to reduce firefighter injuries, firm policies must be in place to help reduce risk. Based on the information provided in this APR, there is a correlation between non-fire ground activity and increased injury rates. Yet, the information also indicates there is an even greater potential of injury if firefighters do not participate in some form of physical activity. It is the recommendation of this author that the WPAFB FES to implement the following to help reduce injuries:

1. FES managers should enhance and further develop training programs. Fitness and dietary training programs are crucial to achieving a work force focused on healthier living. Employees should receive frequent training on dietary, strength/conditioning, stretching, and proper ergonomics. Frequent training sessions covering these topics will spark interest and promote a culture of change.

2. FES managers need to ensure all sports related physical fitness activity is a sponsored event and all safety precautions are set in place to protect employees. FES employees shall be required to stretch and properly “warm up” prior to any sports related physical fitness activities. All injuries shall be immediately reported to the appropriate authorities. Lastly, if two or more injuries occur from the same event, the activity shall be immediately suspended. Activities such as these are considered “high risk”; however, it does provide a means for employees to be physically active and promotes a healthier work force.

3. The implementation of mandatory physical fitness assessments should be conducted by FES physical fitness trainers. These assessments are vital to ascertain the fitness status of the work force. Employees who score poorly on the fitness examinations present as high risk for

injury or cardiovascular insult. Poor scores should be followed by a physician's review/consultation and recommendation for fitness enhancement.

4. Fitness trainers should assist employees and develop customized physical fitness plans. Based on the information provided in this APR, older age groups seem to be more susceptible to musculoskeletal injury. Because of this, fitness trainers should develop fitness plans catered to each specific age group, level of fitness, and willingness of participation. This peer to peer support is a crucial element in the development of an effective physical fitness program.

5. FES should embrace the Voluntary Protection Plan (VPP) concept. The intent of the Occupational Safety and Health VPP program is for the organization to develop and implement enhanced safety programs to eliminate the risk of injuries. The biggest advantage of the program would be the development of a work place environment which embraces safety. There is a significant amount of employee training which involves operational risk management and workplace safety courses. All of this training accumulates and would assist in the effort of injury reduction.

In conclusion, reducing firefighter injuries can be a difficult task. Firefighting is an inherently dangerous occupation. While operating on the fire ground firefighters are prepared and utilize many control measures to help offset risk and reduce the likelihood for injury. However, when not operating on the fire ground, firefighters tend to take chances and according to the data presented in this APR are more susceptible to injury. If the recommendations specified in this APR are implemented, then the WPAFB FES may see a decrease in any rates related to non-fire ground activity. Overall, firefighters must have the ability to remain active and

perform some form of physical fitness. Yet, the managerial team must provide oversight and ensure activities are consistent with the physical fitness obligations of the division.

REFERENCES

Wright-Patterson Fire Emergency Services, Safety Surveys for 2007 & 2009 (September 28, 2010).

Wright-Patterson Fire Emergency Services, Standards of Response Coverage Guide (September 26, 2010).

National Fire Protection Association. (2007). *NFPA 1582 standard on* comprehensive *occupational medical program for fire departments.* Quincy, MA: National Fire Protection Association.

Chapman, Larry S. (2008) *Proof positive: An analysis of the cost-effectiveness of wellness.* Stevens Point, WI: Summex Health Management

Gotlin, Robert, S. (2007). *Sports injuries guidebook.* Lower Mitcham, South Australia: Human Kinetics Inc.

Moore-Merrell, L., Zhou, A. McDonald-Valentine, S., Goldstein, R. & Slocum C. (2008). *Contributing factors to firefighter line-of-duty injury in metropolitan fire departments in the United States.* International Association of Firefighters. Retrieved May 18, 2010, from http://www.iaff.org/08News/PDF/InjuryReport.pdf

United States Fire Administration. (2008). Fire-related firefighter Injuries in 2004. USFA. Retrieved May 14, 2010, from http://www.usfa.dhs.gov/downloads/pdf/publications/2004_ff_injuires.pdf

Pascarelli, Emil (2004). *Repetitive strain injury*. Hoboken, New Jersey: John Wiley & Sons Inc.

Wright, Vonda (2009) *Fitness after 40*. Broadway, New York: American Management Association.

Fire Protection Publications (1991). *Fire department occupational safety*. Stillwater, OK: Oklahoma State University.

Fire Protection Publication (2001). *Fire department safety officer*. Stillwater, OK: Oklahoma State University.

Occupational Safety and Health Administration (2008), Voluntary Protection Programs Manual, OSHA, Retrieved 20 July, 2010 http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3851

APPENDIX 1 – FIRE ADMINISTRATIVE SURVEY

Survey for Ohio Fire Executive Course Applied Research Project
Fire Department Administration Health Wellness and Injury Survey
October, 2010

Thank you for taking the time to complete this survey. This survey will require completion by the Fire Chief or delegated official knowledgeable on department injury statistics and health/wellness program specifics. Please return it on or before March 20, 2011 for data collection and interpretation.

Please circle the correct response.

1. What is your current rank?
   A. Fire Chief
   B. Assistant Chief
   C. District Chief
   D. Safety Officer

2. How many years have you served in the fire service?
   A. 0-10
   B. 11-20
   C. 21-30
   D. 31 – or greater

3. Your fire department classification is _____
   A. Municipal (City, Township, or County)
   B. Federal/Military
   C. Private
   D. Other _____

4. The number of fire ground injuries over the past 5 years has _____.
   (These types of injuries are incurred on the fire ground in support of any emergency event in which fire crews are engaged in emergency services.)
   A. Increased
   B. Decreased
   C. No change
   D. Unknown

5. The number of non-fire ground injuries over the past 5 years has _____.
   (These type of injuries include physical fitness, sports related activities while on duty, or other injuries incurred other than on the fire ground.)
   A. Increased
   B. Decreased
   C. No change
   D. Unknown

6. Does your department (or division) have a health/wellness program as defined in NFPA 1500?
   A. Yes
   B. No

7. Does your department have a mandatory physical fitness program?
   A. Yes
   B. No

8. Does your department mandate physical fitness assessments each year?
   A. Yes
   B. No

9. Does your department allow members to participate in sports related activities while on duty in lieu of cardiovascular or strength and conditioning training?
   A. Yes
   B. No

10. Does your department participate in the Occupational Safety and Health Voluntary Protection Program?
    A. Yes, Gold Start Recognized
    B. Yes, Bronze Star Recognized
    C. No, compliance pending
    D. No, participation not necessary

Your name is not required on this survey and results will remain strictly anonymous. The data and information collected will be analyzed to determine if any changes are needed to current policies, procedures or practices within my organization.

Thank you! If you would like to have a copy of the results of this survey, please contact me at (937) 533-3500 or email at tracy.young@wpafb.af.mil.

APPENDIX 2 – FIRE DEPARTMENT PHYSICAL TRAINER SURVEY

Survey for Ohio Fire Executive Course Applied Research Project
Fire Department Physical Fitness Trainer Survey
October, 2010

Thank you for taking the time to complete this survey. This survey will require completion by a certified (W.I.T.S, A.C.E or other) physical fitness trainer knowledgeable on department and health/wellness program specifics. Please return it on or before March 20, 2011 for data collection and interpretation.

Please circle the correct response.

1. What is your current rank within your department?
   A. Fire Chief
   B. Assistant Chief or District Chief
   C. Company Officer (Capt. & Lt.)
   D. Firefighter

2. How many years have you served in the fire service?
   A. 0-10
   B. 11-20
   C. 21-30
   D. 31 – or greater

3. How many years have you been certified as a fitness trainer?
   A. 1 – 2 years
   B. 3 – 4 years
   C. 5 – 6 years
   D. 7 years or greater

4. Do you encourage (or endorse) sports related activities for personnel on duty as a substitute for cardiovascular and/or strength conditioning exercises?
   (This includes but not limited to; softball, football, basketball, etc)
   A. Yes
   B. No

5. Does the Wright-Patterson Fire Emergency Services physical fitness program meet applicable industry standards?
   A. Yes
   B. No

6. What do you believe is the number one reason firefighters are injured during non- fire ground activities?
   A. Slips and falls
   B. Improper body ergonomics
   C. Sports related activities
   D. Insufficient fitness education

7. In response to question #6, which is the best solution in order to reduce injury rates?
   A. Enhance health/wellness and physical fitness education programs
   B. Eliminate participation in sports related activities while on duty
   C. Institute mandatory physical fitness assessments
   D. Eliminate all physical fitness activities due to risk

8. In your opinion, which is the preferred method (control measures) to reduce muscle sprain and strain type injuries?
   A. Proper stretching prior to any exercise
   B. Routine strength and conditioning training
   C. Enhance employee knowledge on these types of injuries
   D. Personalized fitness programs, age specific for employees

9. In your opinion, mandatory fitness assessments would be beneficial for the division?
   A. Strongly agree
   B. Agree
   C. Disagree
   D. Strongly disagree

10. Do you feel employees receive enough continued education pertaining to health/ wellness (dietary control, ergonomic training, etc.) and physical fitness initiative type programs?
    A. Strongly agree
    B. Agree
    C. Disagree
    D. Strongly disagree

Your name is not required on this survey and results will remain strictly anonymous. The data and information collected will be analyzed to determine if any changes or needed to current policies, procedures or practices within our organization.

Thank you! If you would like to have a copy of the results of this survey, please contact me at (937) 533-3500 or email at tracy.young@wpafb.af.mil.