Fit To Fight Fires? An Assessment of Mandatory Participation In Exercise Programs and Mandatory Fitness Standards of the San Marcos, Texas Fire Department

by

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Submitted to the Department of Political Science
Southwest Texas State University
In Partial Fulfillment
For the Requirements for the Degree of

Masters of Public Administration

Spring *1996*

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Acknowledgments

I thank the members of the San Marcos Fire Department for their willingness to allow me to use their fitness data and for their participation in the survey. I especially thank Dan O'Leary and Todd Derkacz for granting me interviews, answering many questions, providing documentation, and giving me insight into the world of the professional fire fighter. I thank Jana Green for her patience in fielding many of my calls and answering many questions.

I thank Dr. Patricia M. Shields for directing my applied research project and for her guidance and encouragement. I thank Dr. Theodore T. Hindson for serving as second reader and as a member of my oral committee. I thank Dr. George M. Weinberger for serving on my oral committee and for his contribution to my academic development.

Table of Contents

Tables and Exhibits

Exhibits

Chapter One - Introduction

Introduction

Based upon injury and death statistics, fire fighting is the most dangerous occupation in the United States (Ornberg, 1982, p. 86). Fire protection, suppression, and rescue are the most important services provided by the public sector. Fire protection requires intense training and is physically demanding. The physical fitness of fire fighters should be of concern to individuals, to private and public entities. The primary driving force for this concern is the rising cost of health care and interest in individual well being. The importance of physical fitness takes on new dimensions in the context of f i e fighting.

From a public administration perspective, fire fighter physical fimess is important for many reasons. The well being and safety of the fire fighters are two major reasons. In this context, fire fighter physical fitness is equated to providing a safe work environment and equipping fire fighters to do their job. Public safety is impacted by the physical fitness levels of fire fighters. The public pays for, and has a right to expect, fire fighters to be physically fit - lives may depend upon it. The public administrator is concerned about all of these issues and, in addition, must find the finances and mechanisms to provide for physical fitness programs. Providing such fitness programs is a challenge, especially in austere financial times.

Fire fighters who are not physically fit are a liability to themselves, their co-workers, and the public they serve. Fire fighting places unique physiological demands upon fire fighters. These unique demands are the result of the protective clothing and equipment required, nature of the fire, and the demands of fire ground activities[1].

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[1] Fire ground activities are those activities that occur at the site of the fire.

The Fire Fighters Job

In the United States, a fire department responds to an alarm every hour of every day. Most people don't think frequently about fire departments and the men and women whose job it is to protect lives and property. We are confident when we call that these people will respond to our plea for help. Fire fighters don't question why the emergency exists or what caused it, they respond to the alarm. They respond to situations that are the result of circumstances beyond their control. Often they respond to situations that are the result of human error, carelessness, or stupidity. Karter & LeBlanc (1992, p. 64) describe one such incident:

> A fire fighter sustained first-degree and seconddegree burns on his face and neck on February 28, 1991 when he attempted to rescue a 6-year-old girl from a fire in the apartment she occupied with her mother in a two-story duplex apartment building of ordinary construction. A woman telephoned the fire department at 4:30 a.m. to report a fire that had started in a living room sofa in her second floor apartment. The 31-year-old woman, a heavy smoker who used both drugs and alcohol, told her daughter to go to her bedroom while she attempted to put out the fire. The woman than left the apartment to alert occupants of the first-floor apartment. One of them ran up to the second-story floor to rescue the little girl, but he was unable to enter because the fire had grown too large. A 44-year-old fire fighter climbed a ground ladder to the second floor and entered the child's bedroom through a window. By this time, the front of the apartment was heavily involved in fire. After he had searched the room and failed to find the child, the fire fighter was about to leave the building through the same window when the fire developed rapidly and he was engulfed by flames. The full protective clothing and SCBA (self contained breathing apparatus) he was wearing are credited with saving his life and preventing major burns. He was taken to a hospital, where he was treated and released, but was out of work of 32 days. The girl's body was discovered later in a second-floor hallway.

These men and women put their lives at risk as a routine part of their day. They don't question why the fire occurred - they respond to the crisis. A fire fighter's job description could read as follows:

> As part of your duties you will routinely put your life at risk. You will see grisly sites that will cause you to have nightmares and flashbacks. You will be under extreme physiological and psychological stress during fire ground activities and over-haul[2]. You will be in a profession that has been classified as the most dangerous profession in the United States. You may die or become disabled by the time you are 45 years old. You may have cancer, related to your occupation, by the time you are 45 years old. You are guaranteed not to amass great wealth based upon your salary.

We assume that for every job in the United States there are OSHA rules and regulations designed to keep the work environment safe and secure. While there are regulations regarding safety in the fire service, these regulations can provide only so much protection. Standing between a fire fighter and injury, disability and/or death is equipment, good training, his/her follow fire fighters, his/her level of physical fitness, and luck.

Fire Fighter's Environment

The fire fighter's work environment is often a roaring fire with temperatures averaging 700°F to 800°F. The air is filled with blinding smoke, toxic fumes and gases. The surroundings are unfamiliar. There may be victims that must be rescued and these victims may be injured and/or unconscious. It may be necessary to crawl through narrow spaces and put the body in contortion like positions to accomplish the rescue, while in a superheated environment and wearing approximately 60 pounds of protective equipment, clothing, and self-contained breathing equipment. When fire fighters enter a burning building they are often, literally working blind, due to the thick, black smoke. A few fire

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[2]Over-haul is the process of securing, cleaninng-up, identifying, exposing & extinguishing hidden fires, and salvaging that occurs after the primary blaze is extinguished.

departments have special night vision equipment that allows the fire fighters to see through the smoke but the equipment is expensive and few departments can afford it. It is often difficult to determine exactly how the building is constructed. Fire fighters run the risk of falling through floors or into basements. Ceilings cave in, walls collapse, back-drafts occur. People die in burning buildings -- both fire fighters and others. Karter & LeBlanc (1994, p. 57) described one fire suppression incident as follows:

> On October 3,1993, two fire fighters responding to a report of a rubbish fire were injured during fire fighting operations at a one-story carpet storage warehouse that was closed for the evening. The two men were venting the roof when they fell to the cement floor 19 feet below through an unapproved skylight that had been removed and covered over, though not to the same specifications as the roof. One of the fire fighters fractured his left wrist and hand. He was hospitalized for 4 days and missed 66 work days. The other fire fighter received multiple crushing fractures to the left ankle and foot and a fracture to the right fibula and ankle. He was hospitalized for 12 days, and it is not known whether he will be able to return to duty.

Karter and LeBlanc (1994, p. 1994) go on to emphasize that incidents as described above are not unusual. Due to the complexity and variation of the fire fighters work environment their risk of on-the-job death and injury are quite high.

Physical Fitness and Fire Fighting

Fire fighting requires a high degree of physical stamina. Within seconds a fire fighter's body must go from a total resting state to full-throttle, both physically and psychologically. Fear and anxiety prevail. Heavy protective equipment must be worn including safety clothing, equipment, and a self contained breathing apparatus (SCBA). The protective equipment, clothing, and SCBA weighs about 60 pounds. Heavy hoses must be pulled, ladders placed and climbed. Often, it is necessary to break-down heavy doors. This air is filled with toxic smoke and fumes, there may be victims of various

weights to rescue, and there may be fellow fire fighters to rescue before it's over. Conditions inside burning buildings can deteriorate rapidly. During all of this mayhem, a fire fighter must think clearly, respond quickly, and keep going physically for a long time.

For a fire fighter the work isn't over when the fire is out. Overhaul and salvage may take hours. Overhaul and salvage occur after everyone is exhausted and it isn't a glamorous or publicly lauded part of the job and it is physiologically demanding. The overhaul environment is not safe, just because the fire has been extinguished. Structures may be unstable and toxins may be present in the air. It is dangerous, hard, wet, dirty, stinky, work - but it must be done. Overhaul and salvage involve the following (National Fire Protection Association, **1992,** p. **1001-10):**

- Identification of structural instability
- Identification of hidden fires
- Exposure of hidden fires by opening ceilings, walls, and floors and by pulling apart burned materials.
- Separation, removal, and relocation of charred material to safe location while protecting the area of origin for determination of cause.
- Removal of debris, removal and routing of water from the structure.
- Using salvage covers to cover property.
- Covering or closing of building openings doors, windows, floors and roofs.
- Providing security and surveillance if required.

Being physically fit is important from the first sound of the alarm until the fire fighter returns to the fire station.

The Importance of Physical Fitness

While no one will argue the importance of protective clothing, equipment and SCBA to fire fighter safety, physical fitness of fire fighters is just as important to their safety. Grieve **(1993,** p. **17)** states "...a review of national statistics indicates that the majority of firefighter deaths and injuries are caused not by dangerous conditions or poor equipment, but by the poor physical fitness levels of the firefighters themselves." Ornberg **(1982,** p. **86)** states "According to fitness experts, however, a significant number of line-of-duty and job-related deaths could be eliminated by the fire fighter himself through the maintenance of his own physical fitness."

History of the San Marcos Fire Department's Mandatory Fitness Program

This research is descriptive and reflexive in design and is an assessment of the mandatory physical fitness program of the San Marcos Texas Fire Department. This department began its' mandatory fitness program in October **1991** and it is ongoing. The program is comprised of mandatory exercise and fitness requirements. At the inception of the program a structured mandatory exercise format was utilized. Everyone participated in the same form of exercise at the same time. This format was used until January **1993.** At that time, until the present, the mandatory exercise and fitness component remains in place but each individual is allowed to choose the type of exercise they will engage in. Everyone exercises at the same time and they must exercise, but they choose the format. Because there are no professional standards or requirements for mandatory fitness programs for fire fighters, this research will attempt to determine the effects of the mandatory exercise format on the physical fitness of the San Marcos, Texas fire fighters.

Purpose of the Research

There are no professional standards or requirements for physical fitness programs for fire fighters. No statistics are kept regarding number and types of fire department fitness programs in the United States. Because physical fitness is such a critical issue for fire fighters and the public they serve, the issue has special significance for public administration. The San Marcos, Texas Fire Department has a physical fimess policy that includes mandatory participation in exercise and mandatory fimess standards. The policy has been in place for five years. Originally, the exercise format was very structured, requiring everyone to participate in the same type of exercise at the same time. In January 1993 the structured aspect of the mandatory exercise format was eliminated and individuals were allowed to choose what type of exercise to engage in.

The purpose of this research is three fold: (1) to describe the impact of the mandatory exercise and fimess standards policy on the physical fimess of the fire fighters, based upon the results of the 1995 tests of physical fitness, (2) to determine what effects the structured mandatory exercise format had on physical fitness, and (3) to determine what effects the elimination of the structured mandatory exercise format had on the physical fitness levels of the fire fighters.

Physical fimess of the fire fighters will be measured through the use of seven categories and components as follows:

1. Total fimess (total of scores attained on measurements of aerobic capacity, body composition, flexibility, muscular strength, and muscular endurance).
2. Aerobic capacity
3. Body composition
4. Flexibility
5. Muscular endurance
6. Muscular strength
7. Combat test

Descriptive statistics will be used to analyze the data which includes scores on the tests of physiological components and the combat test. Data will be analyzed based upon accepted fimess standards. Mean scores will be used to determine where the fire fighters clustered. The mean scores will analyzed for three time frames: **(1) 1995** fitness scores, **(2)** scores **during** the structured mandatory exercise format, and **(3)** scores after the elimination of the structured mandatory exercise format

This researcher expects to find that the mandatory exercise and fimess program has contributed **to** improved levels of physical fitness in the San Marcos fire fighters. It is hoped that this applied research project will yield results on the fitness levels of the fire fighters in the San Marcos Fire Department and provide information useful to fire department and city officials in San Marcos and other cities.

Chapter Summaries

Chapter Two - Literature Review is a summary of current literature on physical fitness programs, the fire fighting profession and physical fitness, descriptions of fire department fitness programs in selected cities, support requirements of physical fitness programs, public relations and physical fimess programs, the physiological components of physical fimess, and measurements of fimess levels. Chapter Two concludes with the conceptual framework of this research project. In Chapter Three - Research Setting the research setting is presented. It includes descriptions of the city and geographical environment of the San Marcos Fire Department, an overview of the structure of the department, the evolution of the mandatory fimess program, an interview with the fire chief and the assistant fire chief, descriptions of the structured and unstructured exercise formats, the San Marcos Fire Department Physical Fitness Policy, and other aspects and components of the fitness program. Chapter Four - Methodology describes the research methodology used in this study and its appropriateness for this study. Chapter Five -

Results presents the results of the data analyses. Data are analyzed based on scores applicable to each of the three hypotheses. In the final chapter, Chapter Six - Summary and Recommendations, discusses and summarizes the research, makes recommendations, and presents implications for further studies.

Chapter Two - Literature Review

Introduction

Physical fitness programs are varied in name and design. Nomenclature includes wellness, fitness and health promotion programs. Physical fitness programs began in the private sector. High ranking Fortune 500 companies are most likely to provide a fitness programs (Hollander, 1988, p. 495). Table 2.1 lists the potential advantages of health promotion programs for employers, employees, and society.

Table 2.1[3]
Advantages of Fitness Programs

ADVANTAGES FOR EMPLOYERS

Reduced health insurance costs
Reduced disability and death benefits
Reduced treatment costs
Reduced absenteeism
Reduced on-the-job accidents
Reduced turnover rates and replacement costs
Increased productivity
Increased worker morale
Increased worker health and quality of life

ADVANTAGES FOR EMPLOYEES

Reduced health-related costs
Reduced transportation and waiting time for health
Reduced sick leave
Increased co-worker and employer support for positive health behaviors
Increased morale based on management's concern for health
Increased satisfaction with health activities
Improved health and quality of life

ADVANTAGES FOR SOCIETY

Reduced health costs
Improved health and quality of life
Adoption of health promotion emphasis

[3]Source - Hollander, R. B. & Lengermann. J.J. (1988) Corporate characteristics and worksite health promotion programs: survey findings from fortune 500 companies. Social Science and Medicine, Vol. 26, No. 5, 491-501.

The primary motivation for most fitness programs is containment of health care costs (Conrad, 1988, p. 546). "Because there is no national health insurance, corporations pay for a large portion of the national health bills, primarily by providing medical insurance as an employee benefit" (Conrad, 1988, p. 485). Health care costs have risen at twice the general inflation rate, representing more than 12 percent of the gross national product (GNP) in 1990. Estimates are that this percentage will reach more than 18 % by the year 2000. Health care costs include not only direct medical care costs but include costs of absenteeism, turnover rates, employee replacements costs, and decreased and lost productivity due to illness, injury and accidents.

A company or organization may accrue many benefits from fitness programs, but so do employees. Employees spend less money on medical care and transportation and waiting time for health services. They may experience positive reinforcement and support from co-workers as a result of their participation in fitness programs. Increased morale and a more positive attitude are often experienced by employees who work for organizations that exhibit concern for employee health. Improved self-esteem, improved health, and quality of life also accrue from participation in fitness programs.

Benefits accrue to society as a result of employee fitness programs in the form of reduced health care costs. A reduction in health care costs leaves more money to invest in other areas that improve society as a whole. More money to spend for education, research and development - to name a few.

Physical fitness programs are most numerous in the private sector but are receiving increasing attention in the public sector work environment. "Since employees spend a third of their waking hours at work, the workplace is deemed a particularly accessible and appropriate place to reach people about improving their health" (Conrad, 1988, p. 545). This is especially applicable to fire fighters who spend more time at work due to shifts that are usually twenty-four hours on and forty eight hours off.

Fitness programs and control of health care costs are of primary concern to both public and private sector entities but they hold special significance to fire departments. A review of current literature was conducted to determine the components of physical fimess for fire fighters[4] and how those components are evaluated. While many articles address the issue of fire fighter fitness and fitness programs, few articles deal with mandatory fitness programs.

This literature review is a summary of the literature dealing with the components of physical fimess for firefighters and how those components are evaluated. The concepts developed from the literature will be used to analyze the San Marcos, Texas Fire Department's mandatory fitness program.

The Fire Fighting Profession and Physical Fitness

Heart attacks, increased incidence of cancer from inhalation of toxic gases and smoke, and fireground injuries[5] contribute to making fire fighting the most hazardous civilian occupation in the United States (Miller, 1987, p. 24). In this context physical fitness becomes critical.

Due to the dangerous nature of their profession, fire fighters have the highest rates of injury and death of any occupation in the United States. Many fimess experts believe "...a number of line-of-duty and job-related deaths could be eliminated by the fire fighter himself through the maintenance of his own physical fitness" (Ornberg, 1982. p. 86).

Williams and Evenson (April, 1988b, p. 58) stated "Between 20% and 25% of North American fire fighters are unfit to participate in their occupation. One study even ranked the average fire fighter well within the range of the normal sedentary person".

Classified as the most dangerous profession in the United States and having no generally accepted professional standards for fimess, it is not surprising that injuries and

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[4] Firefighter appears as "firefighter" and "fire fighter" in the literature. Fire fighter will be used in this paper unless it appears in quotes as "firefighter".

[5] Fireground injuries are those that occur at the site of the fire.

fatalities are high. In this context physical fimess becomes critical. Thus the definition of fimess for fire fighting is somewhat different than for the private sector.

Definition of Fitness

The definition of fimess varies. "Fitness can be viewed as developing and maintaining body, shape, toning muscles, becoming 'trim', losing or controlling weight or being able to perform at a higher level on physical tasks (e.g. running or aerobics). In short, fitness is conceived of largely in terms of appearance and stamina" (Conrad, P., 1988, p. 547). Davis and Dotson[6], (1991a, pp. 1-1, 1-2) defined fitness as follows:

> Generally, fimess is thought of as the ability to perform your daily job with sufficient reserve to respond to unforeseen emergencies. ... Physical fitness has a number of subcomponents, but they may be divided into three general areas: ***aerobic,*** or ***cardiovascular fitness; muscular fitness***; and ***body composition.***

The National Fire Protection Association, 1980, as mentioned in the Texas Municipal League, (1983, p.15) defined fitness as follows:

> The maintenance of sufficient high levels of aerobic capacity, muscular strength, and endurance, and sufficiently low levels of total body fat to allow for effective fire suppression in extended, high intensity environments.

Physical fitness holds special significance to the fire fighting profession due to the extremely dangerous nature of the profession. Because of the dangerous and unpredictable nature of their working conditions fire fighters are at increased risk of injury and death.

Injuries

In 1993, 101,500 fire fighters were injured in the line of duty (Karter & LeBlanc, 1994, p. 57). Of those injuries, 42.4 % were strains, sprains, and muscular pain; 54.3 %

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[6]Paul O. Davis, Ph.D. FACSM and Charles O. Dolson, Ph.D. are referenced extensively in this paper. They developed the Certified Fitness Coordinator Training Programs offered by ARA/Human Factors. Davis and Dotson are recognized authorities in fitness training for fire fighters in the United States. The San Marcos Fire Department's fitness program is based upon the ARA/Human Factors program.

of these were fireground injuries (Karter & LeBlanc, 1994, p. 59). In 1993 on-the-job injury rates for fire fighters were 4.3 times higher than for individuals in the private sector and lost work hows were 8.5 times higher than in the private sector (Conrad, K., 1994, p. 572). The emergency nature of fire fighting promotes injury. Going from a resting state to a state of high stress and all-out effort increases the potential for injury. "The average age of disability for fire fighters is 44 years and the primary causes are cancer and heart attacks" (Miller, 1987, p. 24).

Fatalities

During 1994, 100 fire fighters were killed on-duty, a 29.9% increase from 1993 (Washburn, LeBlanc, & Fahy, 1995, p. 84). "By all available records, fire fighting appears to have the highest on-duty death rate of any trade in the country" (Texas Municipal League, 1983, p. 1). In 1994, 31% of all career fire fighter deaths were attributable to heart attacks, while on-duty. In the same year, 35.7% of all career fire fighter's deaths were attributable to asphyxiation, while on duty (Washburn, et al., 1995, p. 89).

High injury and death rates in the fire fighting profession and the movement to contain medical care costs and workmen compensation costs have resulted in many fire departments implementing fitness programs for firefighters. Statistics are not kept on how many fire departments have fitness programs in the United States[7].

Fire Department Fitness Programs

While statistics are not kept on fitness programs for the fire fighting profession, the literature is replete with descriptions of cities that have implemented fitness programs for their fire departments. There is significant variation among cities in design and scope of

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[7]Personal communication - telephone conversation with representative of the International Association of Fire Fighters on October 27, 1995.

fitness programs. Based upon the literature, fire department fitness programs appear to be numerous and varied in format.

Los Angeles, California

Los Angeles is believed to be the first city in the country to initiate a physical fitness program in its fire department" (Texas Municipal League, 1983, p. 29). The Los Angeles County Occupational Health Service started a physical fitness and health monitoring program for its 1,800 fire fighters in 1970 (Cady, Thomas, and Karwasky, 1985, p. 110). The Los Angeles mandatory program is considered a model for the fire service profession. The physical fitness program for fire fighters is Los Angeles is comprised of the following: (Texas Municipal League, 1983, p. 29)

- Periodic medical examinations
- Exercise programs tailored to individual needs
- Mandatory fitness standards
- Weight control including nutritional counseling

Cady, et al.. 1985, reported the following results of the Los Angles fitness program after the program had been in place approximately eleven years:

- Physical work capacity increased 16%, with the oldest group (50+ yrs.) showing the most improvement.
- Habitual smokers declined from 44% to 25%.
- Small progressive decline in serum cholesterol for all age groups.
- Reversal of decline of work capacity, strength, and flexibility commonly associated with aging.
- No fire fighters suffered heart attacks while fighting fires.
- Workers' compensations costs decreased 25 percent per $100 of payroll.
- Slight increase in spinal flexibility

- No clear increase in muscle strength
- Obesity did not demonstrate a particularly adverse influence on workers compensation costs.
- Decrease in disabling injuries.

Alexandria, Virginia

Alexandria began a mandatory fitness program in 1977 that included a no-smoking pledge and one hour of exercise per day. The no-smoking pledge was challenged in court and the requirement was upheld. As a result, the department experienced reduced costs of early disability retirements, and a reduction in loss of time due to accidents. (Texas Municipal League, 1983, p. 29)

Beginning in 1978, employment agreements signed by the fire fighters state "...they will maintain a pre-determined level of fitness to remain employed with the department" (Ornberg, 1982, p. 87).

Fort Worth, Texas

Fort Worth began a voluntary fitness program for fire fighters in March 1981, in conjunction with the Texas College of Osteopathic Medicine and its Institute of Human Fitness. In May 1982, the program was made mandatory. The program includes approximately one and a half hours of daily exercise. (Texas Municipal League, 1983, p. 30)

Arlington, Texas

Arlington began a mandatory program for fire fighters in April 1982. As of 1983, performance standards had not been established but were expected to be developed. The department reported a dramatic decrease in blood pressure among its members after the implementation of the mandatory fitness program. (Texas Municipal League, 1983, p. 30)

Austin, Texas

Frost and Dufor (1986) wrote an article describing the physical fimess program developed by the Austin, Texas Fire Department. Austin began a physical fitness program for fire fighters in 1984. The program was initiated because of the high incidence of cardiovascular problems in the Austin fire service. Department policy mandated physical fitness training for all operations personnel that were on 24 hour shifts. In 1986, the department computerized fitness records. Each individual received a confidential seven page annual printout comparing the current years assessment with the previous year. The printout told each fire fighter where improvements were needed and the best way to attain the improvements.

The physical fimess program yielded positive results for the Austin Fire Department. Results on preliminary data were reported by Frost & Dufor (1986, p. 44) as follows:

> ...an overall lowering of body fat by 2.25 percent, a three point decline in the average systolic blood pressure, a half point decrease in diastolic blood pressure, an increase in flexibility, a decrease in the heart attack and stroke risk scores of one point and an overall reduction in body weight.

In spite of the benefits of the program the computerized tracking system was eliminated due to lack of funding[8].

Phoenix, Arizona

Phoenix established a health and fitness policy for its fire fighters. All sworn members are required to "...maintain a high level of health and physical fimess" (Phoenix Fire Department, Health/Fitness Manual, 1994). Fire fighters are allowed a "considerable amount" of individual freedom in choosing exercise activities. Self-rated fitness

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[8]Personal communication - telephone conversation with representative of the Austin Fire Department on January 31,1996.

evaluations are done at six month intervals. Clinical fitness evaluations are done every two years.

The Phoenix F i e Department emphasizes fitness in the following areas: cardiovascular, muscular strength and endurance, body composition and flexibility. The department does not mandate physical fitness activities but encourages fitness activities for fire fighters. The department has developed an extensive health and fitness manual that provides information on fitness testing, nutrition, risk factors, exercise, program design, evaluation methods, stress management, and equipment.

Seattle, Washington

The Seattle Fire Department has a mandatory physical fitness p r o p that requires the participation of all members of the operations division. They are tested annually for aerobic capacity and body composition. Each individual must attain aerobic capacity that corresponds to 40 Mg of oxygen per kilogram of body weight per minute. Fire fighter's body fat composition must not exceed twenty percent.

Aerobic capacity is measured by the submaximal[9] benchstep test, submaximal bicycle ergometer test, the submaximal treadmill test, or the one and one-half mile run test. Body fat is determined by one or more techniques that include skinfold tests and body circumference. Those who fail the first test are further evaluated by the hydrostatic weighing method. (Williams & Evensen, March, 1988a, p. 43)

Those who fail to meet aerobic capacity and body composition standards are placed in a rehabilitation program. Failure to meet minimum standards, after time in rehabilitation, can result in assignment to a desk job and an intensified rehabilitation p r o p . The Seattle

[9] A submaximal test is one in which the individual works to a pre-determined percent of their maximumcapability. Eighty-five percent of maximum heart rate is freauentlv used for submax tests. A maximal test is one in which the individual works to the maximum level they are capable. The workload is increased in specific increments until the subject cannot continue at a given workload. The maximal test has greater predictive value than the submaximal test but the submaximal test is potentially less dangerous. (Davis and Dotson a, 1991. p. 4-3)

Firefighters Union, Local 27 supports the mandatory fitness program. (Williams & Evensen, March, 1988b, pp. 43-44)

Most fire service entities that institute physical fitness programs realize some positive results. The extent of the results depends upon the design of the program. It is apparent from the programs cited above that fitness programs vary significantly from fire department to fire department The differences are the result of variations in available funding, political influences, community attitudes, philosophies of fire service administration, and the lack or requirements for physical fitness programs and standards of physical fitness for the profession.

Lack of Standards and Requirements for Physical Fitness Programs

There are no official standards and requirements for physical fitness programs for fire departments or for the fire fighting profession in the United States. The National Fire Protection Association[10] is in the process of developing guidelines for assessment of physical fitness for fire fighters To date this document has not been adopted and it is important to note that it is a recommendation not a requirement or regulation. The recommendation states:

> The purpose of this document is to provide guidelines for the establishment of a physical performance assessment program. The recommendations in this document are not meant to be interpreted as describing the only way such a program may be developed and administered, but are an example of the types of elements that might be included in such a program. The exact design components and administration of the physical performance assessment program should be dependent on the specific and individual needs of a particular department. (National Fire Protection Association, 1995, p. 189)

Included in the National Fire Protection Association's draft document on recommended practice for physical performance assessment for fire fighters there are

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[10]Refers to The National Fire Protection Association's draft document NFPA 1583 draft of "Recommended [illegible] for Fire Fight[illegible] Ph[illegible]i[illegible]l P[illegible]f[illegible] Assesment, 996 E[illegible],

guidelines for physical fitness and health enhancement, physical fitness assessment, physical fitness conditioning, physical performance assessment, recommended tasks for physical performance assessment, and rehabilitation. The National Fire Protection Association's sub-committee recommendations (1995) are summarized in Table 2.2.

Methods of developing, maintaining, and assessing physical fitness of fire fighters are consistent in the literature. The National Fire Protection Association's sub-committee recommendations for developing fitness programs for fire fighters is quite similar to those developed by ARA Human Factors, a primary developer of fitness programs for fire fighters. From a public administration perspective, physical fitness appears to be more critical for the fire fighting profession vis a vis other occupations.

Being physically fit should be considered a professional requirement of a fire fighter. Therefore, it becomes the responsibility of the employing entity to provide the impetus and equipment for employees to achieve and maintain a state of being physically fit. Testing, assessment, equipment, work-out time, and rehabilitation are not inexpensive, regardless of how cost effective they are in the long-run. The expense should be easily justified based upon the critical nature of the service provided by fire departments. Fire fighters who score well on fitness assessments provide further justification for the funding of fitness programs.

Support Requirements for Physical Fitness Programs

As in any public sector organization, development, implementation, and maintenance of programs are not done in a vacuum. Without the support of city officials, the city council, fire department administration, and ultimately the support of tax-payers, physical fitness programs cannot come to fruition or be sustainable.

Physical fitness programs for fire fighters require the approval and goodwill of many individuals and groups if they are to develop and sustain. Unfortunately, physical

Table 2.2[11]
National Fire Protection Association - Guidelines for Physical Assessment of Firefighters

Physical Fitness & Health Enhancement Program:

The fire department should establish a comprehensive physical fitness and health enhancement program for currently employed fire fighters. Physical fitness data should be collected and become a component of a confidential health database.

Physical Fitness Assessment:

The fitness and health enhancement program should include tests of aerobic capacity, flexibility, body composition, muscular strength, muscular endurance. and anaerobic power.

Physical Fitness Conditioning Program:

All fire fighters who engage in fire suppression activities should be required to participate in the conditioning program. The program should include education, evaluation, and individualized exercise recommendations. The program should include exercise routines that reflect fire fighting tasks simulated in the physical performance assessment. (Also called combat test in the literature)

Physical Performance Assessment Program (PPA):

Administration of the PPA should be done by the fire department physician and may be assisted by the department health and fitness coordinator. The department should establish a minimum acceptable performance level. The level should be set to protect the safety of participants while providing appropriate delivery of fire suppression and rescue activities.

The PPA should be a component of the candidate selection process.

Standard protective clothing and equipment should be worn including self-contained breathing apparatus (SCBA).

Those who do not meet minimum requirements should be prohibited from fire suppression activities and required to enter a rehabilitation program.

Physical Tasks for Physical Performance Assessment:

Victim rescue, forcible entry and ventilation, hose advance, stairclimb (with load). and hoisting.

Rehabilitation:

Rehabilitation programs should be provided for fire fighters who suffer from occupational illness or injury or do not meet the minimum requirements of PPA.

[11] From the National Fire Protection Association's draft document NFPA 1583-F95 ROC, pp. 190-193.

fitness programs in fire departments are often scaled-down or eliminated completely in austere financial periods. It is not uncommon for local government officials to resist the additional expense of implementing and sustaining physical fitness programs. The taxpayers may complain about seeing fire fighters exercising and interpret such activity as "playing" without realizing the benefits of having physically fit fire fighters.[12] It is the responsibility of the fire department to develop a public relations plan to educate those who ultimately make funding decisions for the fire services.

Public Relations and Physical Fitness Programs

Why The Public Complains

Many people outside the fire fighting profession do not have knowledge of the inherent dangers of fire fighting. They aren't aware of the "...long term cost savings and other organizational benefits that well-designed health enhancement programs provide" (Pearson, March, 1995, p.18).

Lack of information isn't the only reason the public complains. Many members of the public do not have access to fitness programs where they work, are not given time out of the working day to exercise, and cannot afford to join private fitness facilities. As a result, they view physical fitness programs for fire fighters as an unnecessary luxury, a waste of time, and a waste of taxpayer dollars. Public complaints about fire fighters "playing" on duty have serious implications. Complaints to politicians and city administrators can seriously impact funding.

[12]Based upon conversations with various fire service professionals.

Dealing With Public Complaints

Fire department administrators should take every citizen complaint seriously and determine if the complaint is justified. If a complaint is determined to be justified, remedial action should be taken immediately. In the event of a justified complaint the following questions should be asked (Pearson, March, 1995, pp. 18-19):

- Is exercise time used efficiently?
- Is the exercise appropriate for developing fire fighter physical fitness? Recreational sports such as basketball and tennis are not effective forms of conditioning, and often result in unnecessary injuries.
- Are program costs appropriate and justifiable?
- Do personnel have the proper attitude? Personnel should recognize their role in promoting the program to the public. Negative comments about the program can be very destructive.

Because of the importance of public perceptions and public goodwill it is important that public relations activities be in place, on-going, and responsive to problems as they occur.

Public Relations Activities

As in many situations, ***an ounce of prevention is worth a pound of cure.*** A carefully designed, cost-effective fitness program is a necessary and justifiable use of fire department personnel and resources. It is important that the benefits of the fitness program be conveyed to the public. An informed public is not likely to criticize. Pearson, 1995. recommends utilizing the entire range of public relations tactics and methods. Suggested public relations tools are publications, presentations, special events, press releases, media briefings, and advertising. All of these tools can be utilized to promote the physical fitness program to the public they serve. Public relations activities are as important to public sector entities as to the private sector. Once the public becomes educated on the inherent dangers

of fire fighting and the intense physiological demands placed upon fire fighters during fire suppression and rescue activities, they will be more likely to support fitness programs.

Physiological Demands of Fire Fighting

"Actual fire fighting requires intense physical exertion, mental concentration, and high levels of teamwork in an unpredictable work environment" (Glazner, 1992, p. 45). From the time the fire alarm sounds in the station until the over haul is completed a fire fighter experiences intense physical and emotional stress. "...the sound of the alarm may pierce the station house. Within seconds, without protective warm up exercises, each fire fighter's heart gallops to double its normal pace in anticipation of an unknown peril" (Miller, 1987, p. 24). Once the alarm sounds muscles tense, heart rate increases, as does respiration, perspiration, body temperature, and anxiety .

There are many things in the fire fighting environment that contribute to the physiological demands of the profession. Some intrinsic and physiological others are extrinsic and induced by the required equipment and the environment. More fire fighters die as a result of heart attacks than any other cause. The physiological demands of f i fighting place extreme stress on the cardiovascular system. It is therefore, critical to understand heart rate function in relation to the fire fighting profession.

Heart Rate & Fire Fighting

The formula for calculating maximum heart rate is 220 minus age. The resulting figure is considered the "red line" for individuals working in arduous situations (Gilman & Davis, 1993, p. 69). Gilman & Davis, 1993, cites a study by Manning & Griggs, 1983, that dealt with heart rates of fire fighters in simulated fire ground situations. "The mean heart rates achieved during the fires ranged from 163 to 183 bpm. This was 80 to 90 percent of the maximal heart rate response observed on a graded treadmill exercise test"

(Gilrnan & Davis, 1993, p. 69). The average person cannot sustain maximal heart rate for very long but some marathon runners can maintain a 90 percent rate for more than two hours (Gilman and Davis, 1993, p. 69). As aerobic capacity increases so does the ability to maintain near maximum heart rate. The implication for fire fighters is that by increasing aerobic capacity, higher heart rates can be safely sustained for longer periods of time resulting in lowering the incidence of heart attacks. Increased aerobic capacity is a significant prophylactic to reduction of heart attacks in fire fighters.

Sothmann, et al., 1992, analyzed the heart rates of fire fighters in actual fire fighting situations. Their data "...indicated an average heart rate of 157 ± 8 bpm, which represented 88 ± 6 % of heart rate max. The typical duration which this heart rate was sustained was 15 ± 7 min." (Sothmann, et al., 1992, p. 799). Their findings closely reflect those of Manning and Griggs, 1983 and reinforce the importance of aerobic fitness for fire fighters.

Stress

The stress of fire fighting causes muscles to tense and remain tense for extended periods of time. The tensing of muscles conmbutes to musculoskeletal injury. The major type of injuries that occurred in fire fighters in fireground activities were strains, sprains, and muscle pain accounting for 35.6 percent of all injuries during 1993 (Karter & LeBlanc, 1994, p. 58).

Psychological stress produces physical stress. Fire fighting is extremely stressful both physiologically and psychologically. Fire fighting has two constants - danger and unpredictability. The dangers, unpredictability, and stresses of the fire fighting profession cannot be eliminated but their effects can be mitigated by physical fitness programs.

Physiological Stress

The physiological responses experienced by fire fighters begin with the sound of the alarm and are maintained throughout fire suppression activities. The body's reaction to stress is rapid and involves almost all physiological systems. "If a stress is extreme, unusual, or long lasting...the stress triggers a wide-ranging set of bodily changes called the general adaptation syndrome" (Tortora and Anagnostakos, **1984,** p. **427).** The general adaptation syndrome is triggered when the hypothalamus perceives stress. These mggers are called stressors. "A stressor may be almost any disturbance - heat or cold, environmental poison, poisons given off by bacteria during a raging infection, heavy bleeding from a wound or surgery, or a strong emotional reaction" (Tortora and Anagnostakos, **1984,** p. **427).** The adaptation syndrome is divided into three stages: alarm reaction or flight-or-flight response, resistance reaction, and exhaustion.

Fire fighters routinely experience multiple stressors in the performance of fire response, fire suppression, rescue, and overhaul activities. To fully appreciate the intensity of physiological stress experienced by fire fighters it is helpful to analyze the three stages of the general adaptation syndrome, refer to Table 2.3.

Tortora and Anagnostakos, **(1984,** p. **429)** stated "...ability to handle stressors is determined to a large degree by general health." Because fire fighters are required to endure multiple stressors for extended periods of time, being in good physical condition is a necessity . The physiological components for fitness must be developed and maintained to enable fire fighter's to successfully adapt to stress.

Psychological Stress

Psychological stress results from working in uncertain and life threatening situations, being responsible for the safety and lives of co-workers and the public, disrupted sleep patterns, and disrupted social patterns. Social problems result from the

limited amount of time available to engage in family and social activities. Glazner. 1992, reported increased use of alcohol by some fire fighters, attributable to the negative effects of shift work.

Protective Equipment

Fire fighters must wear protective clothing, often referred to as turn out gear, and a self contained breathing apparatus (SCBA). The combined weight of the turn out gear and SCBA is approximately 55 to 60 Ibs. The turn out gear and SCBA are not only heavy, they trap body heat, are bulky, and restrict body movement. "The equipment they wear places the single most imposing limitation on a fue fighter's performance" (Gilman and Davis, 1993. p. 69).

Effects of Shift Work

Professional fire fighters work in shifts that tend to be one of the following: (a) 10 hour shifts, from 8 a.m. to 6 p.m., (2) 14 hours shifts from 6 p.m. to 8 a.m., or (3) 24 hour shifts with 24 hours on and 72 hours off duty (Glazner, 1992, p. 45). Another common shift is 24 hours on and 48 hours off. By nature humans are day-adapted, their biological clock is set to rest a night and be active during the day. Shift work has been correlated with disruption of eating, sleeping and social habits in 10 to 20 percent of fire fighters (Glazner, 1992, p. 45). Sleep disruption and the dangerous nature of fire fighting also contributes to psychological and physiological stress that result in increased injury rates.

Table 2.3
General Adaptation Syndrome
Source: **Tortora** and **Anagnostakos,** (1984, pp. 428-429)

Stage One - Alarm Reaction

1. The heart rate and strength of cardiac muscle contraction increase. This response circulates substances in the blood very quickly to areas where they are needed to combat the stress.

2. Blood vessels supplying the skin and viscera, except the heart and lungs, undergo construction. Blood vessels supplying the skeletal muscles and brain undergo dilation. These responses route more blood to organs active in the stress responses while decreasing blood supply to organs that do not assume an immediate, active role.

3. The spleen constricts and discharges stored blood into general circulation to provide additional blood. Red blood cell production is accelerated and the ability of the blood to clot is increased. These preparations are made to combat bleeding.

4. The liver transforms large amounts of stored glycogen into glucose and releases it into the bloodstream. The glucose is broken down by the active cells to provide the energy needed to meet the stressor.

5. Sweat production increases. This response helps lower body temperature, which is elevated as circulation increases and body catabolism increases. Profuse sweating also helps to eliminate wastes produced as a result of accelerated catabolism.

6. The rate of breathing increases, and the respiratory passageways widen to accommodate more air. This response enables the body to acquire more oxygen, which is needed in the decomposition reactions of catabolism. It also allows the body to eliminate more carbon dioxide, which is produced as a side product during catabolism.

7. Production of saliva, stomach enzymes, and intestinal enzymes decreases. This reaction takes place since digestive activity is not essential for counteracting the stress.

8. Sympathetic impulses to the adrenal medulla increase its secretion of epinephrine and norepinephrine. These hormones supplement and prolong passageways, increasing the rate of catabolism, decreasing the rate of digestion, and increasing blood sugar level.

Note: If the stress is great enough, at this stage, the body mechanisms may not be able to cope and death can result.

Continued —>

Table 2.3 Continued
General Adaptation Syndrome
Source: Tortora and Anagnostakos, **(1984,** pp. **428-429)**

Stage Two - Resistance Reaction

1. The glucocorticoids accelerate protein catabolism and the conversion of amino acids into glucose so that the body has a large supply of energy long after the immediate store of glucose has been used up. The glucocorticoids also stimulate the liver to break them down into amino acids. The amino acids can then be rebuilt into enzymes that are needed to catalyze the increased chemical activities of the cells or be converted to glucose.

2. The glucocorticoids make blood vessels more sensitive to stimuli that bring about their constriction. This response counteracts a drop in blood pressure caused by bleeding.

3. The glucocorticoids also inhibit the production of fibroblasts, which develop into connective tissue cells. Injured fibroblasts release chemicals that play a role in stimulating the inflammatory response. Thus the glucocorticoids reduce inflammation and prevent it from becoming disruptive rather than protective. Unfortunately, through their effect on fibroblasts, the glucocorticoids also discourage connective tissue formation. Wound healing is therefore slow during a prolonged resistance stage.

Note: The resistance stage of the general adaptation syndrome allows the body to continue fighting a stressor long after the effects of the alarm reaction have dissipated. This stage is usually successful in seeing us through a stressful situation, and our bodies then return to normal. Occasionally, the resistance stage fails to combat the stressor and the body "gives up" and the body moves into stage three - exhaustion.

Stage Three - Exhaustion

1. Loss of potassium results in progressive loss of cell function ultimately resulting in the death of cells. Unless rapidly reversed, vital organs cease functioning and the person dies.

2. Depletion of glucocorticoids results in a sudden loss of cell nutrients.

3. The organs begin to weaken as a result of sustained stress

Conceptual Framework

Many fire departments in the United States encourage physical fitness and some provide facilities for physical fitness activities, but few have mandatory physical fitness requirements. Clearly fitness is a multifaceted concept The fitness requirements generally accepted in the literature will be used to classify and measure fire fighter fitness in this study. The purpose of this study is to assess the effect of the mandatory exercise participation and the mandatory fitness requirements of the San Marcos, Texas Fie Department. There are three primary hypotheses that form the conceptual framework for this applied research project Each primary hypotheses is comprised of six sub hypotheses.

The first hypothesis (H1) and subhypotheses of this applied research project deal with the effects of the mandatory exercise participation and mandatory fitness standards on the physical fitness of the firefighters from the inception of the program to August 1995. Hypothesis one and the sub-hypotheses are as follows:

H1: *August 1995 total fitness scores will meet or exceed acceptable standards.*

H1a: *August 1995 scores of aerobic capacity will meet or exceed acceptable standards.*

H1b: *August 1995 scores of body composition will meet or exceed acceptable standards.*

Hlc: *August 1995 scores of flexibility will meet or exceed acceptable standards.*

Hld: *August 1995 scores of muscular endurance will meet or exceed acceptable standards.*

Hle: *August 1995 scores of muscular strength will meet or exceed acceptable standards.*

Hlf: *August 1995 scores on the combat test will meet of exceed acceptable standards.*

Hypothesis two (H2) and sub-hypotheses deal with fitness scores from the inception of the mandatory exercise participation and fitness standards program during the period of time that a structured exercise format was in place from October 1991 to January 1993. It is anticipated that the structured mandatory exercise format resulted in improved fitness scores that fall within acceptable established ranges. Hypothesis two and the sub-hypotheses are as follows:

H2: *There is a positive relationship between the structured mandatory exercise format and total fitness scores.*

H2a: *There is a positive relationship between the structured mandatory exercise format and aerobic capacity.*

H2b: *There is a positive relationship between the structured mandatory exercise format and body composition.*

H2c: *There is a positive relationship between the structured mandatory exercise format and flexibility.*

H2d: *There is a positive relationship between he structured mandatory exercise format and muscular endurance.*

H2e: *There is a positive relationship between the structured mandatory exercise format and muscular strength.*

H2f: *There is a positive relationship between the structured mandatory exercise format and performance on the combat test.*

Hypothesis three (H3) and sub-hypotheses deal with the period of time from the elimination of the structured exercise format to the most recent fitness tests, August 1995. It is anticipated that fitness scores will show a decline but remain within acceptable ranges. Hypothesis three and the sub-hypotheses are as follows:

H3: *There is a negative relationship between elimination of the structured mandatory exercise format and overall fitness scores.*

H3a: *There is a negative relationship between elimination of the structured mandatory exercise format and aerobic capacity.*

H3b: *There is a negative relationship between elimination of the structured mandatory exercise format and body composition.*

H3c: *There is a negative relationship between elimination of the structured mandatory exercise format and flexibility.*

H3d: *There is a negative relationship between elimination of the structured mandatory exercise format and muscular endurance.*

H3e: *There is a negative relationship between elimination of the structured mandatory exercise format and muscular strength.*

H3f: *There is a negative relationship between elimination of the structured mandatory exercise format and performance on the combat test.*

Table 2.4 provides a summation of the hypotheses as they comprise the conceptual framework.

Physiological Components of Fitness

The literature consistently identifies five physiological components of fitness. Most authors recognize aerobic capacity, muscular strength, muscular endurance, body composition, and flexibility as the primary components of physical fimess programs.

Aerobic Capacity

Aerobic capacity is the ability of the cells to take up and utilize oxygen to transform energy to support muscle activity. "Aerobic fimess is defined as the ability to participate in sustained arduous physical activity for extended periods of time" (Davis and Dotson, 1991a, p. 1-3). Aerobic exercise increases aerobic capacity and has positive impacts on

many of the body's systems. ARA Human Factors-On-Target Update (1993, p. 5) described the benefits of aerobic exercise as follows:

> Besides making the heart stronger and maintaining the vital capacity of the lungs, these exercises increase the size and number of the mitochrondia (and important enzymes), the part of the cell that produces energy. They make the cells more efficient and thereby increase the endurance of the individual. Increased aerobic training also helps the red blood cells unload oxygen faster with the exercising tissues. Aerobic conditioning further makes the removal of the "waste products" (carbon dioxide and lactic acid) much more efficient. The benefits of increased aerobic capacity for firefighters should be evident to all - they can work longer with less fatigue. Aerobic fitness even has an impact when performing short bursts of intense physical activity by helping flush out the blood lactates faster. The bottom line is that you can recover more quickly from any physical activity if you have a high level of aerobic fitness. Another important benefit is the reduced risk of cardiovascular disease.

Musculoskeletal Fitness

Musculoskeletal fitness is best described by its components: (1) muscular strength, (2) muscular endurance, and (3) muscular power. All three contribute to a state of muscle fitness.

Muscular Strength

Muscular strength is the ability of muscles to exert force. Lifting weights is an example of muscle strength. "Strength can be dynamic, where the weight or mass is moved, or static (isometric), where nothing moves and a gauge is used to determine the force" Davis and Dotson, (1991a, p. 1-5). Anaerobic capacity is a component of muscular strength. ARA Human Factors - On•Target Update, (1993, p. 5) described the importance of muscular strength/anaerobic capacity for fire fighters as follows:

> All of the physiological studies conducted by exercise scientists in developing physical performance tests for firefighters reveal that the first three to ten minutes at the scene of a fire or accident are

Table 2.4
Overview of Hypotheses and Conceptual Framework

Fitness Category	H1 Current Mean Fitness Scores Meet or Exceed Standards	H2 Two Years After Implementation Mean Fitness Scores Improved	H3 After Elimination Of Structured Exercise Format Mean Fitness Scores Decline But Remain Within Acceptable Range
Aerobic Capacity	Yes	Yes	Yes
Body Composition	Yes	Yes	Yes
Flexibility	Yes	Yes	Yes
Muscular Endurance	Yes	Yes	Yes
Muscular Strength	Yes	Yes	Yes
Combat Test	Yes	Yes	Yes

the most critical and physically demanding. This is the time period when firefighters and EMS personnel must move quickly to set up heavy equipment, suppress flames, effect the rescue of trapped people, perform forcible entry, etc. This must be done as rapidly and safely as possible, often using SCBA. The physical requirements to do this require a high level of strength - brute force.

Muscular Endurance and Power

"Muscular endurance is the ability of muscles to *sustain* contractions (Davis and Dotson, 1991a, pp. 1-5, 1-6). Muscular endurance is the ability of a muscle or group of muscles to execute repetitive actions (Texas Municipal League, 1983, p. 15).

"Muscular power is sometimes referred to as *explosive strength"* (Davis and Dotson, 1991a, p. 1-6). Examples of exercises that require muscular power (explosive strength) are pole vaulting, shot put, dashes, and the hammer throw.

Flexibility

"Flexibility is best defined as the *range of motion* (ROM) through which the limbs attached to a joint are capable of moving. The range is usually described in *degrees"* (Davis and Dotson, 1993, p. 1-6). Being flexible is a significant conmbutor to prevention of injury especially back and musculoskeletal injuries, which are common injuries in the fire fighting profession.

Body Composition

Davis and Dotson, (1991a, p. 1-7) defined body composition as "[T]he ratio of fat (adipose) tissue to total body weight, which includes fat and lean (fat free) tissue, is your body composition or percent of fat value". Body composition is considered a more accurate measure of fitness than is the use of height and weight charts.

Fitness Testing

Testing is an important component of any physical fimess program and can provide benefits to participants. Davis and Dotson, (1991a, pp. 4-2 & 4-3) cited the five major benefits of testing as follows:

1. Provides a reference point for comparison with future progress.
2. Develops an exercise program specific to the needs of each subject.
3. Minimizes risks to individuals with physical limitations.
4. Provides incentive and motivation for adherence and improvement.
5. Provides realistic expectations for improvement.

Scoring and Point Ranges of Fitness Tests

Davis and Dotson, (1991a) recommended testing methods for each of the five physiological components of fitness and developed an On-Target method of calculating points from the raw scores obtained in each physiological component category. The raw score for each physiological component is determined by performance levels attained on tests of each component. The raw score attained in each component is equated to a ring value. The ring value is multiplied by a constant multiplier assigned to the component, the resulting product is the total points obtained for that category. The sum of the five categories is called the On-Target Score[13]. A fire fighter's fimess level is rated upon point range categories. Refer to Table 2.5 and Exhibit 4.1 for further explanation of standards for measuring and scoring physiological components.

[13]Referred to as the total fitness score for the purposes of this research.

Table 2.5[14]
Standards of Testing, Measurement, and Scoring of Physiological Components

Physiological Component	Test	Category	Raw Score Range Males	Females
Aerobic Capacity	Step Test	Excellent	> 54.9	> 43.9
		Good	42.0 - 54.9	34.0 - 43.9
		Average	35.0 - 41.9	28.0 - 33.9
		Fair	30.0 - 34.9	24.0 - 27.9
		Poor	< 30.0	< 24.0
Muscular Strength	Hand Grip (Lbs.)	Excellent	>118.9	> 53.9
		Good	109.9 - 118.9	49.4 - 53.9
		Average	104.0 - 108.9	47.2 - 49.3
		Fair	94.0 - 103.9	42.6 - 47.1
		Poor	< 9 4.0	< 42.6
Muscular Endurance	Average of Max. Number of Sit-Ups & Total Number of Push-Ups in	Excellent	> 39.9	> 29.9
		Good	34.0 - 39.9	25.0 - 29.9
		Average	26.0 - 33.9	19.0 - 24.9
		Fair	17.0 - 25.9	12.0 - 18.9
		Poor	< 17.0	< 12
Body Composition	Neck/Abdomen Ratio	Excellent	< 16.0%	< 22.0%
		Good	16.0 - 18.0 %	22.0 - 24.0%
		Average	18.1 - 22.0%	24.1 - 28.0%
		Fair	22.1 - 25.0%	28.1 - 31.0%
		Poor	> 25.0%	> 31.0%
Flexibility	Sit-and Reach Test	Excellent	> 44.9"	> +6.9"
		Good	+2.0 - 44.9"	44.0 - +6.9"
		Average	0.0 - +1.9"	+2.0 - +3.9"
		Fair	-2.0 - -0.1"	0.0 - +1.9"
		Poor	< -2.0	< 0.0

Testing Methods

Aerobic Capacity

Davis and Dotson, (1991a, 4-3, 4-6) recommended mile-and-a-half run/walk tests, step tests, bicycle ergometer, or a one mile walking test to measure aerobic capacity. The one mile walking test is recommended for "...individuals who might not be capable of completing the 1.5 mile run" (Davis and Dotson, 1991a, p. 4-7).

[14]Source: Davis, P. O. & Dotson, C.O. (1991a), Certified Fitness Coordinator Training Program. ARA Human Factors, 10th Ed., 1-2 thru 11-27.

Muscular Strength

Muscular strength can be measured using the following tests: (1) hand grip, (2) pull down, (3) bench press, and (4) leg press. The hand grip test correlates highly with an individuals overall body strength - it represents and individual's ability to move an object. A hand dynamometers is used for this test.

Muscle Endurance

Muscle endurance is measured by calculating the average of the maximum number of push-ups an individual can do and the total number of sit-ups and individual can do in two minutes. (Davis and Dotson, 1991a, p. 4-22)

Body Composition

Body composition is estimated by using one or a combination of techniques including skinfold thickness, body circumference or hydrostatic weighing. Type and number of measurements used depends upon the time and financial resources of the department.

Flexibility

Muscular flexibility is measured by the sit-and-reach test (Davis and Dotson, 1991a, p. 4-21) The individual sits on the floor, back and hips against the wall, knees on the floor, feet flexed at a right angle to the legs, and arms extended. The toes are considered the zero point. The inches an individual can reach past the normal extension of the arm is the measurement. The greater the distance past the toes the better the score. Lower-back and hamstring muscle flexibility is the primary consideration in this test

Fitness in aerobic capacity, muscular strength, muscular endurance, body composition, and flexibility are necessary for attaining acceptable levels of performance on the combat test.

The Combat Test

The combat test is considered the most comprehensive and objective assessment of the physical fitness of fire fighters. In fire departments that measure physical fitness, it is the primary mode of measurement. Tasks of the combat test encompass all of the aforementioned physiological components of fitness.

The combat test is referred to in the literature by various names: combat test, criterion task test, and physical performance assessment are the most common. For purposes of this research, the term 'combat test' will be used. No matter what the test is called the goals are the same - to objectively assess a fire fighter's ability to perform her/his job based on activities that simulate those required in actual fire fighting situations.

Components of Combat Test

The basic components of the combat test are: (1) stair climb, (2) hoisting, (3) forcible entry, (4) hose advance, and (5) victim rescue. The test is performed wearing full turn out gear and SCBA. The components are done in sequence with no pauses between events. Participants must observe the same safety precautions as required in a real fireground situation. The event is scored by the total time to accomplish all events in sequence. An acceptable time on the test is 7:00 minutes, an excellent time is 5:00 minutes or less (Davis and Dotson, 1991b, p. 3)

Stair Climb

The stair climb is done carrying three sections of 1.5 inch hose, nozzle and gated wye up the equivalent of five flights of high-rise stairs (Davis and Dotson, 1991b, p. 1). Davis and Dotson (1991b, pp. 1.2) recommend the following procedure for the stair climb:

> The free hand may be used to assist in the climb by pulling on the handrails. The event starts when the firefighter picks up the hose load, and ends when the hose load is deposited in the circle marked on the fifth floor. ... Not unlike the scene of an actual fire, the firefighter needs to pace to ensure that sufficient reserve is maintained to perform once at the floor of the fire or on the subsequent tasks.

Hoisting

Hoisting is usually done when the participant reaches the fifth floor landing. In most instances a large section of hose is hoisted up five stories. Davis and Dotson, (1991b, p. 2) recommend the following procedure for hoisting

> With the aid of one-half inch utility line, pull with a hand over hand motion the equivalent weight of a fly section of an extension ladder, fan or 50' section of 2.5" hose. Distance to be pulled will depend upon the department's SOP for such tasks. Realistically, four or five stories would be maximum height of such an evolution. Incorporating a pulley placed in the lentil of the window on the top floor is an appropriate representation of the physical demands routinely required for hoisting activity. ... When this evolution is complete enter the stairway for the return to the ground level. Walk down the stairs, making contact with ***every*** step. No skipping of steps is allowed on the way down.

Forcible Entry

Forcible entry is simulated by driving an "I" beam five feet by striking the end of the girder with a special 9 pound sledge hammer (Davis and Dotson, 1991b, p. 2).

Hose Advance

Davis and Dotson, (1991b, p. 2), recommend the following procedure for the hose advance:

> After walking the required distance of 140 feet, pick-up the marked portion of the hose and move it to the "X" mark on the ground (30' to the left). Next take the nozzle end of the 150 foot charged 1.5 " line and advance it 40' to the box marked on the pavement where you will crack the nozzle and discharge water.

Victim Rescue

Victim rescue is simulated by lifting or dragging a 175 pound simulated victim a distance of 100 feet. Both the participant and the victim must cross the finish line (Davis and Dotson, 1991b, p. 2).

The National Fire Protection Association (1995, p. 192) comments on the victim rescue component of the combat test as follows:

> The most critical task expected of fire fighters is the rescue of a member of the community or a fire suppression crew member. The importance of this task transcends all others and is directly responsive to the mission of the fire service; the protection of life and property. This task represents an essential function as defined in the ADA and is one of the most demanding required of fire fighters.

Most fire departments that do combat tests follow the basic design of Davis and Dotson. There are slight variations usually attributable to financial constraints. For example, some departments may improvise what they use to simulate a victim. If they don't have an actual dummy they may use 175 pounds of tires tied to a rope as a substitute.

A national competition is held every year in which fire departments from across the United States participate in combat tests based on Davis and Dotson's design. Fi departments that win these competitions do not necessarily have fitness programs in place. They may have selected one or more individuals who train all year to compete.

Combat Test - Abilities & Training Required

The National F i Protection Association has included abilities required and task-specific training recommendations for each component of the combat test in its s u b committee recommendations on physical performance assessment. The components, abilities required, and training recommendations are presented in Table 2.5.

The combat test is comprehensive and includes all the components of physical fitness. F i fighting uses almost all of the major muscle groups and requires a well-planned fitness program to ensure that training is thorough and comprehensive.

Frequency of Combat Test

Although the combat test is considered the "gold standard of physical fitness measurement for fire fighters, testing of the individual physiological components should be done regularly to determine fitness levels in specific categories. Assessment of the individual categories provides useful information for evaluation of individual exercise plans and overall program design.

Scoring the Combat Test

The combat test is a timed test and is scored in minutes and seconds. An excellent time is 5:00 minutes or less and a acceptable time is 7:00 minutes (Davis and Dotson, 1991b, p.3). The San Marcos. Texas Fire Department requires a minimum score of 7 minutes 30 seconds on the combat test.

Scores on each of the five physiological components, as described in the literature, and the combat test will be assessed based on scores of individuals who participated in the mandatory exercise and fitness requirement program from its inception thru August, 1995. Scores will be analyzed to determine if the scores attained fall within acceptable ranges. based upon the On-Target guidelines. Scores, after elimination of the rigid exercise format,

will be analyzed to determine the impact on scores of total fitness, the physiological components, and the combat test.

Conclusion

The literature review and conversations with fire department administrators and fire service professionals provide the basis for the research and contribute to the development of the conceptual framework. It is apparent in the literature review that there is a lack of descriptive and explanatory information on the impact of mandatory physical fitness requirements in fire departments. There is adequate information to assess the physical fimess levels of fire fighters in total fitness, the five physiological components, and performance on the combat test. The following chapter, Chapter Three - The Research Setting, will describe the San Marcos Fire Department, the geographical setting, the structure of the city government, the evolution of the fitness program, the physical fimess policy of the San Marcos Fire Department, and includes transcripts of an interview with Dan O'Leary, Fire Chief and Todd Derkacz, Assistant Fire Chief.

Chapter Three - The Research Setting

Introduction

The San Marcos Fire Department is located in the city of San Marcos, Hays County, Texas. The city is considered the Gateway to the Texas Hill Country and is located twenty-six miles south of Austin, the State Capital, and forty-five miles north of San Antonio on IH 35. Southwest Texas State University is located in San Marcos. It is a growing state supported university and has an average student population of approximately 21,000 students. The resident population of San Marcos is 37,500, excluding the student population of Southwest Texas State University. San Marcos is the county seat of Hays County. Geographically the city encompasses seventeen square miles and is governed by a council-city manager system that includes six elected council members and a mayor.[15]

San Marcos Fire Department

The San Marcos Fire Department provides fire protection and rescue services for the city of San Marcos. It provides fire protection and rescue services to some outlying communities based upon mutual aid agreements. It provides these services to Southwest Texas State University. In addition, it provides emergency rescue services to Southwest Texas State University upon request. The department maintains three fire stations located within the city limits. It maintains 1 ladder truck, 1 rescue truck, 2 brush trucks, 4 engines, a captain's car, 1 sedan, and 2 pick-up trucks. The San Marcos Fire Department is comprised of thirty-three fire service professionals including one fire marshall, one fire chief, one assistant fire chief, three captains, six lieutenants, twelve engineers, nine fire fighters, and fifteen volunteer fire fighters. The department employees one department secretary.

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[15] Source of information in this paragraph is from Century Telephone, November 1995 Telephone Book. Information provided to Century Telephone by the San Marcos Area Chamber of Commerce.

Evolution of the Mandatory Fitness Program.

The mandatory exercise participation and fitness standards program evolved casually in the 1980's. The Fire Chief at that time was a fitness advocate and he set the stage for the current fitness program. He did so by modeling fitness behavior and by allowing the fire fighters to exercise as part of their normal work routine. By the end of his tenure there was general acceptance of the importance of exercise for fire fighters. In the early 1990's, the program became more formal. A new Fire Chief, Dan O'Leary, realized the efficacy and necessity of physical fitness for fire fighters and implemented a formal fitness program.

An interview with Fire Chief, Dan O'Leary and Assistant Fire Chief, Todd Derkacz gives insight into the evolution of the mandatory fitness program and into the world of the professional fire fighter.

Interview With Fire Chief and Assistant Fire Chief

The following was transcribed from a taped interview with the Fire Chief and Assistant Fire Chief of the San Marcos Fire Department[16]. The interview is insightful both from a public administration and human perspective. It gives life and emotion to the literature review, validates much of the current literature; and, shows how programs, policies, and procedures often evolve and come to fruition in the public sector.

> **Fire Chief:** Most fire firefighter injuries that occur are due to heart attacks. Here's why -- I think that is generally true, at night, a typical call in the middle of the night, -- it is three o'clock in the morning, a guy is dead asleep -- totally relaxed, when the alarm goes off he gets out of bed, puts on about sixty pounds of gear, jumps on a buck, screams to a fire, gets there, and when he gets there, people are usually in a panic, screaming at him, and he's having to drag hose, and, and ladders and axes, and he is going into a house that is probably 700" to 800" degrees and he can't see, everybody is screaming at him, **total, total maxed out.** And all that happens within about four minutes. That's why most of them keel over -- the body just can't handle it -- it is too much. It goes from a total state of relaxation to totally maxed out in four minutes. In no other situation have I ever seen has that happened to anybody. You know, professional athletes warm up

[16]Personal communication, interview, February 19. 1996.

before they play and this (fire fighting) is a situation where the body goes from totally asleep to totally maxed out in four minutes. And its causes a lot of people to keel over, just from heart attacks. So that was really what started us thinking -- you can't do this unless you're in fairly good shape -- you've got to be in better shape than the average person. We've been fortunate here in that we haven't had anybody have a heart attack at a fire but there have been department's around us that have. And we've know fire fighters that have gone to fires and had heart attacks when they arrived. But, usually, what kills fire fighters is that -- going from that total relaxation to totally stressed out. That is usually what does them in -- it is the leading cause of death in fire fighters at a fire.

Interviewer: What goes through your mind, is it exciting, is it fear?

Fire Chief: It is all that - your adrenaline starts flowing right away, you're out of bed, you put your bucket gear on and everybody else is moving fast. You're getting on the truck, you're nervous, you're scared, you turn around you see the fire, people running around. It's just an adrenaline rush.

Interviewer: What do you think about? What do fire fighters think about at this point?

Fire Chief: They think about all the things that they have to do, what jobs do I have to do in the next ten minutes. What is my role here? What is my assignment? You know fire fighters kind of learn real quickly to do what I call disassociate, they are able to step out of themselves. They just go on automatic and put all their feelings, emotions, all that on hold. That's the only way they can deal with the mangled bodies they see and all that stuff. You learn real quickly as a fire fighter how to do that. You just turn your humanity off, so to speak, and do what you have to do and, you start that process. You get ready for that, you get ready for what's about to happen, kind of begin to disassociate. It is kind of scary, it really is. But when they come back to the station they have to deal with that. They have to deal with all those emotions. They still have to deal with what they saw. But, they do it when they come back to the station, after it is all over with. Usually the way they do that is they sit around and talk with the guys and, ah, you know they make sick jokes about stuff. I've found, in talking with psychologists that is pretty normal. The same things that veterans of wars to through, same thing, you kind of disassociate yourself with the reality of what's going on and do your job and then deal with all that stuff later.

Interviewer: Do they ever suffer from post-traumatic stress syndrome?

Fire Chief: Sure.

Interviewer: What's the average duration? Or can you even say there is an average duration?

Fire Chief: There is not an average duration. They have to deal with it one way or the other. And if they don't, it manifests itself and they have problems at home. F i e fighter's have high divorce rates. It's hard, it's hard to deal with. You know, when I go home and one of my kids has hurt her finger that day, I'm probably not as sympathetic as most fathers might be because I just saw somebody that had their head cut off that day. So, it's just different. And not a lot of people can handle that, they are not able to come back from that reality and step back into their own world and be a normal person. So that's one way it manifests itself. I think depression is another way, guys get depressed real easily. But we're real good about dealing with it. We come back here and we talk about it. I mean everybody talks about what's happened. Every time we have a major incident we get everybody together and talk about what happened, what we did. We call it a critique and we talk about the process we went through, how could we do it better type thing. But it also serves the function of getting guys to talk about the experiences they went through. And that helps. So most of them are pretty good at dealing with it that way. They live here with the other guys so they come back here and sit around the coffee table and talk about what they just saw.

Interviewer: So everybody is free, if they want to make a sick joke they can do that - it's real open?

Fire Chief: Oh yes. Everybody understands what's going on and that's how they deal with it. But we found that being in shape and being in good physical condition helps all that too. Helps in your performance, you know that you were able to do the best you could at that time. When I first became Chief here there were guys who within ten minutes of being in a fire were passed out and I had to ship them off to a hospital. It was just sheer exhaustion, no one had a heart attack, they just couldn't go any more. They were passed out lying on the ground trying to catch their breath, dehydrated and everything else. What we noticed when we started getting guys in shape was that that ended, we don't have that any more. They know how to pace themselves, they understand what is going on with their body, they understand if they are feeling bad what's going on, they know they need to go get some liquids or rest, or whatever. So that has been a big benefit. It was real common, before we started this program, for me to have at least two guy's I would have to send to the hospital and they would be in there for a couple of days recovering.

Anyway, it is hard to describe what the emotions are that guys experience when they are going to a fire but, it is every emotion you can think of. It's the adrenaline, it's an adrenaline rush. You're running pure adrenaline. Your body is maxed out over and above what it normally does, and it's exciting. You're fearful, you're nervous, you're scared you're going to mess up, you're walking into a situation and you have no idea what's going on. You're showing up and people are expecting you to intervene in a crisis, and you know, you may have just been in bed three minutes ago.

Also, our guys use a self contained breathing apparatus. Those things are designed, in optimum conditions, to last thirty minutes of breathing time. You get to a fire and you're really excited and if you're out of shape you

can suck that air out of there in about seven minutes, and some guys would. I noticed after one bottle of oxygen they'd be lying on the ground, they were so tired. And we have noticed over the years (since the implementation of the fitness program) the guys are able to go a whole bottle, the bottle doesn't last seven minutes now it lasts fifteen to twenty minutes. They come back, they put another bottle on and they go back in again. So we saw a big difference in that.

Interviewer: Did the exercise program start informally in the 1980's?

Assistant Fire Chief: The first year we actually started running on duty was as far back as about 1980, but it went in waves and that was just the first time we actually took a fire truck to a location for the purpose of exercising. It was just whoever wanted to go could go.

Fire Chief: But, it was on duty and that was something.

Assistant Fire Chief: Yeah, that was actually pretty remarkable considering the idea of exercising on duty had just sort of come out in the fire service as being even possible.

Fire Chief: It was a culture change that slowly happened over the years. Even in the fire service country-wide I think there are probably some fire departments that don't allow their guys to do any PT. I think there are very few but there may be some still out there.

Assistant Fire Chief: That's true, just for fear of workers comp problems. But it usually ends up being kind of an excuse or a kind of cover because those people that are putting that law down don't want to have to confront that whole matter of physical fitness or getting in shape.

Fire Chief: They are able to consider it a cost and not worth it.

Assistance Fire Chief: But, like Dan was saying, it is a real productivity gain when you can have two bottles per person and have them last fifteen minutes. Manpower is a big issue during a large alarm because we don't have that many people in our department even when everybody shows up, reserves included. It takes a lot of people to see a large alarm all the way through. You have to fight the fire, you have to reload all the equipment, you have to do the overhaul and salvage, it is a lot of heavy lifting, moving, and you're working through the night, perhaps. So it's like having more people on the scene if they can work another hour, two hours, and recover and go back and do it again

Interviewer: In an average fire what's the duration from the time the alarm goes off until the over-haul and salvage is complete?

Fire Chief: Somewhere in the neighborhood of two hours. And usually, if you watch them, when they are picking up they are dragging. They have already spent all their adrenaline, there is no excitement left, it is dark and

usually cold, wet, dirty and stinky. The crowd is gone and they are there having to roll hose and they are dragging - they can barely function.

Assistant Fire Chief: During the 80's the program came and went, we may have told you that Dan's predecessor was at least a fitness nut. He planted a good idea, it never really got off the ground but in a way it got us ready. People became aware that the issue was out there, that fitness counts for something, so I think everybody kind of knew that it was supposed to happen. By that time Chief made a serious effort to see that the program got started.

Fire Chief: Once the fire fighters decided it was a good idea the rest of it was easy. What sold it (physical fitness) to me was when I became Chief. There was one incident, I still remember it today. There was a fire at Allenwood Homes, and there were seven guys on duty that day, daytime fire. And we went to this fire and we paced out and we got very few of our volunteers to come in because most of them have jobs, most of our off-duty guys were out of pocket. So we ended up having only about 8 or 9 guys totally for this house fire. Within fifteen minutes after we were there I had four of the eight guys lying on the ground, they were just gone. And this place is still on fire and I had no one fighting fire. Somebody ran the pump, somebody in charge, there was nobody squirting water on the fire. I realized then we were in trouble if these guys can't go more than 10 or 15 minutes. At the time I became Chief everybody wanted more training and all of a sudden it occurred to me it doesn't matter how well trained you are if your legs can't carry you you're no good. If your legs can't allow you to use your training it's useless. I remember that time, I said "Man, we've go to do something. This is going to kill us." That's the one issue or one incident I can remember where that really hit home to me.

Interviewer: Is that the point when you decided there would be a fitness program?

Fire Chief: That's when I knew, that's when I said "We've got to, we've got to make this as important as any kind of training we do". It doesn't matter how good the guys are, how effective they are in what they do, if they can't carry it out it is ridiculous. I mean, it seems to be so basic that it just hit home. All of a sudden, I realized this just has to be a critical part of what we do.

Interviewer: What did you do from that point? Did you just show up and say "Hey we have to do this?"

Fire Chief: No, I knew that wouldn't work either. It had to be, as we've said here, anytime you start a program like that the guys have to agree and buy into it. We didn't even sit down and plan it out, we just ....

Assistant Fire Chief: We provided the information. There was structure to it but what really makes it happen is when they know it's going to happen and they buy into it. If not every last one of them at least the vast majority. It is like a critical mass where the momentum will carry it. But you still have to be there every day to habituate everybody because if you

aren't there providing motivation to get them out in the bay to do calisthenics or whatever it won't succeed.

Fire Chief: After the incident at Allenwood Homes is when we started doing calisthenics. I actually got out there and lead them and I was in worse shape than they were. I definitely helps when we get out there and work out with them, there's no doubt about it. And then we had to deal with the politics and the community. People in the community weren't used to seeing firemen working out. We had to deal with the letters to the editor - "Why are the fire trucks parked behind the San Marcos Athletic Club?". The public posed questions such as "Is that what these guys do for a living come to work and get to work-out?" But I had the support of the city manger, Larry Gilley. He knew what we were doing and was willing to take the hits. After while that died out, people got used to it. Now it is a part of their culture too -- firemen, one thing they do is they work out, keep in shape. At the time we had a radio station and they had a talk show and I could go on radio explain what was going on. The guy that ran the radio program was a fitness type guy, and he understood what was going on too. We haven't heard a complaint in about three or four years now.

Assistant Fire Chief: And most people do expect to have a physically fit fire department. That has become part of their image of us.

From a casual and intermittent beginning emerged an organized physical fitness program for the San Marcos Fire Department. Prior to the implementation of the mandatory fitness program the Assistant Fire Chief Received formal training from ARA Human/Factors. The training included all aspects of establishing and maintaining fitness programs for the fire service industry. The program formally began in 1991 with the implementation of a structured exercise format -- structured both in activities and time.

Structured Mandatory 'Exercise Format

The implementation of the structured exercise format marked the beginning of the mandatory fitness program in 1991. The format required that all those employed in professional fire service positions participate. Each individual was required to exercise every week day they were on duty - which averaged approximately 2.23 days per week. The format included one hour of aerobic exercise at a local aerobic facility, followed by forty minutes of weight-lifting also at a local facility. The structured work out continued until January 1993. At that time Chief O'Leary noticed that people seemed to be getting

bored with the structured routines. He decided to abolish the structured routines at this point. This did not impact the mandatory aspect of the fitness program, it simply allowed more personal freedom in the format of the exercise. January 1993, marked the beginning of the unstructured exercise format which continues today.

Unstructured Mandatory Exercise Format

The unstructured mandatory exercise format allows total discretion as to the type of exercise they engage in. The frequency of exercise is still 2.23 days per week. Each individual exercises 1.25 hours on the average. The city has arranged for the firefighters to use facilities at Southwest Texas State University and The San Marcos Athletic Club for their exercise activities. Based upon the survey[17] they engage in a variety of exercises. The responses to the question "I routinely engage in the following exercises" appear in Table 3.2.

Thirty-one individuals responded to the survey and of those 77% exercise when they are not on duty, 97% said they enjoy exercising, and 77% think mandatory fitness programs are necessary requirements for professional fire fighters. It appears that Chief O'Leary is correct in his belief that physical fitness is a part of the culture of the San Marcos Fire Department. Even though the majority of the fire fighters support the fitness program the mandatory aspects have not been relaxed. The physical fitness policy is official and mandatory. Chief O'Leary is dedicated to making the fitness environment supportive and non-threatening. He believes that is the only way to make the program a success. However, the department has a policy that recognizes the value and necessity of physical fitness for fire fighters and provides the means to enforce the policy if necessary.

[17] See Appendix for swey.

Table 3.2
Exercises San Marcos Fire Fighters Routinely Engage In

Activity	Number of Responses
Aerobics	2
Basketball	19
Bicycling	10
Drinking Beer	8
Hiking	7
Jogging	11
Lifting Weights	21
Physical Labor	3
Racquetball	13
Sex	1
Soccer	3
Stair Climbing	2
Stairmaster	4
Swimming	5
Tennis	2
Volleyball	1
Walking	13

San Marcos Fire Department Physical Fitness Policy

The following is the official physical fitness policy of the San Marcos Fire Department: (Source: The San Marcos Fire Department, document dated 11-28-94)

18.00 San Marcos Fire Department Physical Fitness Policy

18.01 Members are required to maintain the necessary degree of physical fimess to perform the required duties of their position and participate in physical training and fimess programs prescribed by the Department.

18.02 The officers of the San Marcos Fire Department recognize the hazardous and physical nature of fire fighting and assumes responsibility for deploying a firefighting force that is well skilled and possesses the physical capacity to perform the arduous tasks of fire combat with efficiency and minimal risk. The San Marcos Fire Department will not deploy an individual who is physically unfit to do the job. The citizens we serve expect and deserve no less.

18.03 The purpose of the department physical fimess policy is to put in place a system that ensures a high level of physical fimess among department personnel so that every deployable individual can do the job as safely and efficiently as possible. This policy establishes physical performance standards for department personnel, outlines the procedures for measuring compliance with standards, defines the consequences of non-compliance and explains the physical fitness training procedures.

18.04 It is the policy of this department that, as a condition of employment, members will maintain a state of physical conditioning so that at all times they can meet the physical performance standard. The standard is the successful completion of the Combat Test of the department in seven (7) minutes and 30 seconds or less. There are no adjustments to the department physical performance standard for age, gender, or rank in the classified service.

18.05 This policy applies to all classified employees of the department who are or may be required to wear a Self-Contained Breathing Apparatus, unless specifically exempted by the Fire Chief and then only for medical reasons.

18.06 Department officers are responsible for ensuring that each individual under their command meets physical performance requirements and complies with the provisions of this policy.

18.07 The Combat Test will be given for the official record two times a year for all personnel according to a schedule developed by the department. General physical fitness assessments may be given at the Chiefs discretion. The fitness record documenting each individual's performance will be maintained on a confidential basis.

18.08 Individuals who do not meet the minimum physical performance standard of seven minutes and thirty seconds on the Combat Test will have their record flagged as not in compliance with department physical performance standards. These members will not be eligible for favorable personnel actions including:

a. Vacation and Holiday leaves must be taken in periods no less than 72 hours when approved;
b. No exchange of shifts with other department members allowed;
c. Returning from all sick leave, the employee must provide proof of sickness of employee or family member;
d. Employee is ineligible for acting positions except in emergency situations assigned by the supervisor;
e. Employee is ineligible for overtime projects or low manpower except in emergency situation as assigned by the employee's supervisor;
f. Employee is ineligible for special out of department training or navel at department expense.

Further, the employee will be required to undergo assessment and counseling by the Assistant Fire Chief and participate in a mandatory physical fitness program designed by the Department designee.

Individuals will have at least 90 days before they are required to take a second Combat Test. The 90 day period provides time for the individual to improve their fitness to the level needed to meet minimum requirements. Individuals who meet the standard at the next test will have the flag removed from their record and be reinstated to good standing. Individuals who fail to meet the performance standard at their second test will be removed from combat duty and placed on standard 8 to 5 duty. An employee at this time may be required to attend rehabilitation training. A third combat test will be scheduled after the second test, but before six months from the date of the second failed Combat Test. Failure to meet the required standard on the third attempt will result in the Fire Chiefs questioning the physical fitness of the employee and enacting Section 143.081 of Local Government Code 143 entitled "Determination of Physical or Mental Fitness". A finding of the Civil Service commission of unfitness will result in termination. The Fire Chief may extend the Combat Testing periods to allow for rehabilitation of injuries, but only in consultation with physicians of physical therapists.

18.09 At the direction of the Fire Chief, all personnel will undergo at least one general fitness assessment per year. Other physical fitness assessments may be required as deemed appropriate by the F i e Chief.

38.10 Unless otherwise indicated, individuals in full duty status are assumed to be apparently healthy and capable of performing the physically demanding tasks associated with firefighting. As such, they are also assumed to be capable of participating in physical fitness assessments and exercise programs.

> **18.11** Fitness training is considered suppression training and shift officers will incorporate fitness training activities into the daily schedule. At no time will physical training interfere with a shift's responsibility to respond to emergency calls. Participation in training exercises scheduled by the chain of command that involves fire suppression evolutions (drills) for the purpose of improving physical performance is mandatory for all personnel, including practice on the Combat Test

There is a dual nature to this policy, initiated by Chief Dan O'Leary. One component is a mandatory requirement that is an incentive to score adequately on the combat test The second element is a program that makes exercise mandatory, while on duty. Each individual is required to exercise about 1.25 hours while on duty.

Other Aspects & Components of the Fitness Program

All new hires are given a complete physical fimess exam and advised of their fitness capabilities. All individuals who sustain injuries are provided rehabilitation. The fire department contracts with a private company to provide seminars on proper exercise techniques and injury management. Customized exercise routines are made available for those who need them. The department also provides current literature on fitness and healthy lifestyles.

Conclusion

Each fire department is unique. Each has its own culture. The importance of understanding the setting, the organization, and the importance of physical fitness of fire fighters is seen in this chapter. There are many influences on the lives of fire fighters: the community, the city, the political environment, the department, the nature of their job, their level of physical fitness, their personality, and their family environment, to name a few.

One of the most important points in this chapter is the importance of physical fimess in fire fighter safety and performance. Physical fimess is important not only for the individual fire fighter but for their co-workers and the communities they serve. The methods used to assess the mandatory fitness requirements of the San Marcos Fire Department are presented in Chapter Four - Methodology.

Chapter Four • Methodology

Methods

The methodology used to test the hypotheses is reflexive design utilizing the one-group pretest-posttest. The data are derived from archival records. This study will focus on six fitness scores of 25 fire fighters who have been in the mandatory fimess program from October 1991 through August 1995.

In addition to the reflexive design the scores of these individuals will be compared to physical performance standards scores developed by Paul O. Davis, Ph.D., president and founder of ARA/Human Factors. Dr. Davis is a recognized expert in the area of physical performance standards for both public and private sector organizations. He created the Firefighter Combat Challenge® (combat test) and has significant fue service expertise. The mandatory fitness program of the San Marcos, Texas Fire Department is based upon the ARA/Human Factors program and standards for the fire service.

The literature review described the physiological components of physical fitness (aerobic capacity, body composition, flexibility, muscular endurance, muscular strength, and the combat test) for fire fighters. The literature provides a profile of the testing and measurement standards for each component and justification for the use of fitness programs in the fire fighting profession.

Reflexive Design

Reflexive design is a form of quasi-experimental design. Babbie (1995, p. 344) defines quasi-experimental designs as those that "...are distinguished from 'true' experiments primarily by the lack of random assignment of subjects to an experimental and a control group." In a reflexive design the target group is its own control (Bingham and Felbinger, 1989, p. 173). Reflexive designs are often referred to as ***before and after***

studies. The one-group pretest-posttest form of reflexive design will be used for this applied research project.

Bingham and Felbinger, (1989, p. 173) stated that the one-group pretest-posttest design is appropriate when all subjects participate in the program and it is impossible to locate non-participating individuals. The *mandatory* nature of the San Marcos Fire Department's physical fitness program meets these criteria.

The essential justification for use of the one-group pretest-posttestdesign is defined by Bingham and Felbinger (1989, p. 173) as a situation in which "...it is reasonable to believe the targets remain identical in relevant ways before and after the program." Because this research project is an assessment of the physical fitness of individuals within one fire department, the one-group pretest-posttest is appropriate. This study is unique in that there is not a true before and after situation because the program is ongoing. However, it is reasonable to assume that these individuals were identical in relevant ways prior to the inception of the mandatory fitness program and are currently identical in relevant ways. These assumptions appear valid based upon the fire fighters continuity of training, continuing education, working conditions, and performance standards and measurement. The validity of this assumption is further reinforced by the similarity of living conditions while on duty. In addition, each individual's fitness scores are measured, recorded, and maintained in identical fashion. Analysis of those fitness scores is the focus of this research project.

Document Analysis - Archival Records

Data derived from archival records will be used in this research. The archival records to be used are quantitative reports of individual fimess scores in the five physiological categories and the combat tests from 1991 to 1995. Document analysis of archival records is the only available data source therefore triangulation is not possible.

Yin, (1994, p. 80) cited the following as weaknesses of document analysis-archival records:

- retrivability - can be low
- biased selectivity, if collection is incomplete
- reporting bias - reflects unknown bias of author
- access - may be deliberately blocked
- accessibility due to privacy reasons

While these weaknesses of archival records are applicable in some settings the weaknesses are not a major obstacle to this research project.

Retrivability is high because all records can be accessed by authorized fire department personnel, the files are maintained in close proximity to where authorized personnel work, all eligible participants choose to participate, and individual fitness scores are part of the employee's permanent personnel file. Remvability can be accomplished by a telephone call. Only authorized personnel view the personnel files and record the fitness data. Each file is assigned a case number and that case number is indicated on the form provided for the recording of data. On•Target scores of body composition, flexibility, muscular endurance, muscular strength, and aerobic capacity are recorded for each fitness test from October 1991, through August 1995. Scores on combat tests from 1992 through 1995 are provided.

Biased selectivity due to incomplete collection of data is not a problem for this applied research project because data collection is complete. A reporting bias reflecting the unknown bias of the author will not impact this research because the data collected are precise and quantitative and therefore, not subject to contamination by author bias.

The author does not have direct access to personnel files due to privacy reasons. Accessibility to fitness scores is via authorized fire department personnel. Any questions or questionable data can be discussed and/or validated by fire department administrative personnel without impinging upon the privacy of the individual fire fighters.

Yin (1994, p. 80) cited the advantages of documentation of archival records as follows:

- stable - can be reviewed repeatedly
- unobtrusive - not created as a result of the case study
- exact - contains exact names, references and details of an event
- broad coverage - long span of time, many events, and many settings
- precise and quantitative

All of Yin's advantages are applicable to the fitness data collected from personnel files for this study except the use of the individual's names.

Population/Statistics

Babbie (1995, p. 103) defined population as "...that group (usually of people) about whom we want to be able to draw conclusions." The population for this applied research project is the professional fire fighters employed by the San Marcos, Texas Fire Department who have been in the mandatory fitness program from its inception through August, 1995. These individuals comprise the entire population for this study.

All summary statistics such as means and percent distributions are population parameters not estimates (based upon a random sample). Hence, statistical tests of significance are unnecessary since all parameters are true parameters and all differences are true differences. In addition, norms of external validity are not really relevant in this study. The San Marcos leadership is not interested in whether these findings will generalize beyond San Marcos. They are interested in the fitness of their fire fighters.

Unfortunately, in some cases, the data were not available, as indicated by "NA". Some of the scores are 00.0 and were assigned to an individual who scored so poorly that no other score represented their performance. Scores of zero were used in calculating the mean. When the statistical averages were computed they were computed without the data. This problem will be dealt with in more detail in Chapter Six - Summary and Recommendations.

Operationalization of Hypotheses

The dependent variables are aerobic capacity, body composition, flexibility, muscular endurance, muscular strength, total score of physiological components, and the scores on the combat test. The population will be measured and evaluated based upon ARA Human Factors On-Target scores for the physiological components and the combat test.

The first hypothesis (H1) and the sub-hypotheses of this applied research project deal with the effects of the mandatory exercise participation and fitness requirements program from its inception to August 1995. Specifically, what effects the application of the mandatory fitness program had on the August 1995 scores of physical fitness. Physical fitness is measured by scores of aerobic capacity, body composition, flexibility, muscular endurance, muscular strength, total fitness score, and the combat test. Hypothesis H1 and the sub-hypotheses are as follows:

H1: *August 1995 total fitness scores will meet or exceed acceptable standards.*

Hla: *August 1995 scores of aerobic capacity will meet or exceed acceptable standards.*

Hlb: *August 1995 scores of body composition will meet or exceed acceptable standards.*

Hlc: *August 1995 scores of flexibility will meet or exceed acceptable standards.*

Hld: *August 1995 scores of muscular endurance will meet or exceed acceptable standards.*

Hle: *August 1995 scores of muscular strength will meet or exceed acceptable standards.*

Hlf: *August 1995 scores on the combat test will meet of exceed acceptable standards.*

The independent variables for hypotheses H2 and H3 are the mandatory physical fitness requirements. The independent variables are: (1) the results of the structured

mandatory exercise format from October 1991 to January 1993, and (2) the results of the suspension of the structured aspects of the mandatory exercise format from January 1993 to August 1995. Hypothesis two (H2) deals with fimess scores from the inception of the mandatory exercise participation and fitness standards program during the period of time that a structured exercise format was in place from October 1991 to January 1993. The dependent variables are scores of total fitness, aerobic capacity, body composition, flexibility, muscular endurance, muscular strength, and the scores on the combat test It is anticipated that the structured mandatory exercise format will result in improved mean fitness scores that fall within acceptable established ranges. Evidence used to support the hypothesis is a positive difference in the scores. It should be noted that this difference must be large enough to be administratively significant. Administrative significance is a judgment call. Hypothesis two (H2) and the sub-hypotheses are as follows:

H2: *There is a positive relationship between the structured mandatory exercise format and total fitness scores.*

H2a: *There is a positive relationship between the structured mandatory exercise format and aerobic capacity.*

H2b: *There is a positive relationship between the structured mandatory exercise format and body composition.*

H2c: *There is a positive relationship between the structured mandatory exercise format and flexibility.*

H2d: *There is a positive relationship between the structured mandatory exercise format and muscular endurance.*

H2e: *There is a positive relationship between the structured mandatory exercise format and muscular strength.*

H2f: *There is a positive relationship between the structured mandatory exercise format and performance on the combat test.*

Hypothesis three (H3) and the sub-hypotheses deal with the period of time from the elimination of the structured exercise format, January 1993 to August 1995. Again, the differences in scores between 1993 and 1995 will be used to support this hypothesis. It is anticipated that the mean fitness scores will show a decline but remain within acceptable ranges. Hypothesis three (H3) and the sub-hypotheses are as follows:

H3: *There is a negative relationship between elimination of the structured mandatory exercise and total fitness scores.*

H3a: *There is a negative relationship between elimination of the structured mandatory exercise format and aerobic capacity.*

H3b: *There is a negative relationship between elimination of the structured mandatory exercise format and body composition.*

H3c: *There is a negative relationship between elimination of the structured mandatory exercise format and flexibility.*

H3d: *There is a negative relationship between elimination of the structured mandatory exercise format and muscular endurance.*

H3e: *There is a negative relationship between elimination of the structured mandatory exercise format and muscular strength.*

H3f: *There is a negative relationship between elimination of the structured mandatory exercise format and performanceon the combat test.*

Table 4.1 is a summary of the hypotheses and operationalization of the variables for clarification. Exhibit 4.1 is ARA/Human Factors, Inc. On•Target scoring system and is reproduced with the permission of ARA/Human Factors, Inc.

The fire fighters will be measured based upon the dependent variables. For example, each individual will be assessed on performance in each of the five physiological components and the sum of points attained in all five categories and the combat test.

Survey

A survey (Appendix A) was developed and administered to thirty-one fire fighters in the San Marcos Fire Department. Participation in the survey was on a voluntary basis. Thirty-one fire fighters participated. This survey was developed to assess attitudes regarding the mandatory aspects of the fitness program, the combat test, life-style and health habits, and suggestions regarding the fitness program. The survey is primarily an information tool for fire department administrative personnel. Results of the survey may be referred to in the Results and Summary and Conclusion chapters. The survey and results appear in Appendix A.

Conclusion

The purpose of this research is to determine whether the physical fimess scores of the fire fighters improved after the implementation of the mandatory exercise participation and fitness standards program and where those scores fall on the continuum of fimess scores. In addition, this design can determine if the physical fitness of the fire fighters declined after the elimination of the structured exercise format and where those physical fitness scores fall on the continuum of fitness scores.

By determining the effects of the mandatory exercise participation and fitness standards requirements on the physical fitness levels of the fire fighters, this research hopes to lay the foundation for the justification, design, and implementation of mandatory physical fimess programs in fire departments. The findings of the data analysis will be presented in the following chapter, Chapter Five - Results. Chapter Six - Summary and Recommendations will provide a summary of conclusions that can be drawn from the findings.

Table 4.1
Summary Of Hypotheses And Operationalization Of The Variables

Dependent Variable	H1*	H2**	H3***	Measurement	Category	Score Range	Category	Points
Aerobic Capacity	P	P	N	Step Test - Heart Rate After 5 Minutes Of Stepping	Excellent Good Average Fair Poor	>54.9 42.0 - 54.9 35.0 - 41.9 30.0 - 34.9 <30.0	Excellent Good Acceptable Mediocre Fair Poor	≥ 21.25 17.50 - 21.24 15.00 - 17.49 10.00 - 14.99 3.75 - 9.99 < 3.75
Body Composition	P	P	N	Neck Abdomen Ratio Based On The Circumference Of The Neck & The Circumference Of The Abdomen	Excelled Good Average Fair Poor	< 16.0% 16.0 - 18.0% 18.1 - 22.0% 22.1 - 25.0% > 25.0%	Excellent Good Acceptable Mediocre Fair Poor	≤ 17.00 14.00 - 16.99 12.00 - 13.99 8.00 - 11.99 3.00 - 6.90 < 3.00
Flexibility	P	P	N	Sit-and-Reach Test Based On Inches Reached Past Toes	Excellent Good Average Fair Poor	> 4.9" +2.0 - +4.9" 0.0 - +1.9" -2.0 - -0.1" < -2.0"	Excellent Good Acceptable Mediocre Fair Poor	> 12.75 10.50 - 12.74 9.00 - 10.49 6.00 - 8.99 2.25 - 6.99 ≤ 2.25
Muscular Endurance	P	P	N	Average Of Sit-ups Done In 2 Minutes Plus Push-Ups Done In 2 Minutes	Excellent Good Average Fair Poor	> 39.9 34.0 - 39.9 26.0 - 33.9 17.0 - 25.9 < 17.0	Excellent Good Acceptable Mediocre Fair Poor	≥ 17.00 14.00 - 16.99 12.00 - 13.99 8.00 - 11.99 3.00 - 6.90 ≤ 3.00

Continued —>

* August 1995 Scores Meet or Exceed Acceptable Standards - Positive Relationship
** Scores of January 1993 Will Meet or Exceed Acceptable Standards - T i e Period of Structured Exercise Format - Positive Relationship
*** Scores of August 1995 Will Fall Within Acceptable Ranges But Below January 1993 Scores - Negative Relationship

Table 4.1 -- Continued

Dependent Variable	H1*	H2**	H3***	Measurement	Category	Score Range	Category	Points
Muscular Strength	P	P	N	Hand Grip Based On Pounds Gripped	Excellent Good Average Fair Poor	> 118.9 109.9 - 118.9 104.0 - 108.9 94.0 - 103.9 < 94.0	Excellent Good Acceptable Mediocre Fair Poor	≥ 17.00 14.00 - 16.99 12.00 - 13.99 8.00 - 11.99 3.00 - 6.90 ≤ 3.00
Total Score	P	P	N	Sum of Points In All Five Categories: Aerobic Capacity, Body Composition, Flexibility, Muscular Endurance, and Muscular Strength			Excellent Good Acceptable Mediocre Fair Poor	≥ 85 70 - 84 60 - 69 40 - 59 15 - 39 < 15
Combat Test	P	P	N	Minutes and Seconds Required To Complete			Excellent Acceptable Unacceptable	≤ 5:00 Min. 7:00 - 7:30 Min. ≥ 7:31 Min.

* August 1995 Scores Meet or Exceed Acceptable Standards - Positive Relationship

** Scores of January 1993 Will Meet or Exceed Acceptable Standards - Time Period of Structured Exercise Format - Positive Relationship

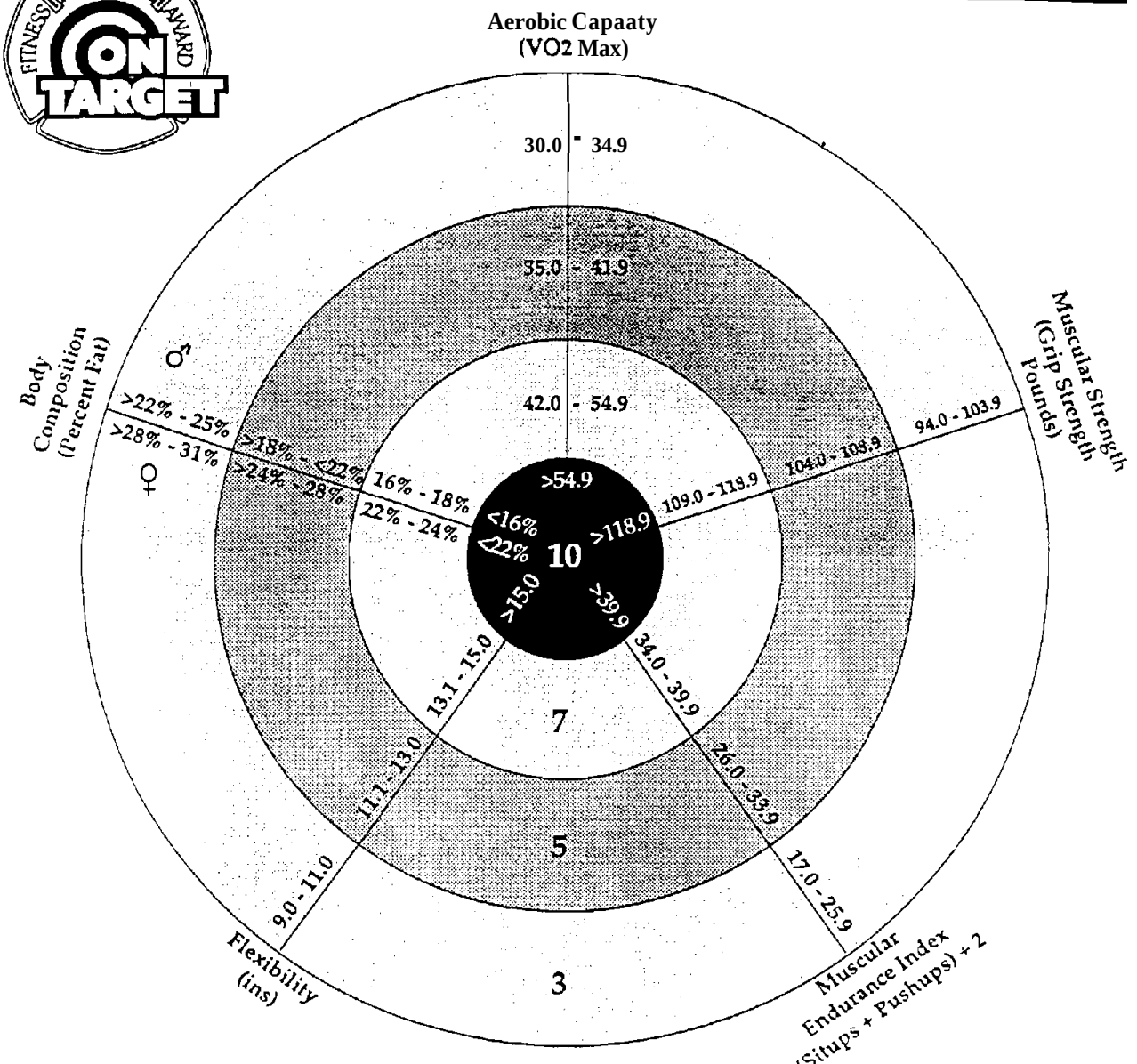
*** Scores of August 1995 Will Fall Within Acceptable Ranges But Below January 1993 Scores - Negative Relationship

Exhibit 4.1

Used With Permission of Paul Davis Per Telephone Conversation **January** 10, 1996.

FITNESS FIRE/RESCUE AWARD
ON TARGET

Name: _____



	Raw Score	Ring Value	X	Points
Aerobic Capacity			2.5	
Muscular Strength			2.0	
(Push-ups + Sit-ups) ÷2 = Muscular Endurance..			2.0	
Body Composition			2.0	
Flexibility			1.5	
Total On-Target Score				

Point Range	Award Category
>85	Excellent (Gold Award)
70-85	Good (Silver Award)
60-69	Acceptable
40-59	Mediocre
15-39	Fair
<15	Poor

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Chapter Five - Results

Introduction

Analysis of scores attained on tests of total fitness, the five components of physical fitness and the combat test are presented in this chapter. Data are presented in table format in the order of the hypotheses of this applied research paper. Mean fitness scores are used to analyze the data. Individual fitness scores of total fitness, the five physiological components, and the combat test appear in Appendix B.

The measurements of the physiological components are done once a year. The combat test is routinely given one to two times a year. No combat test was given in 1991. One combat test was given in 1992 and in 1993 respectively. Two combat tests were given in 1994 and 1995 respectively. In years that the combat test was given twice, the individual's best score is used for analysis.

The first hypotheses, H1, deals with the effects of the mandatory physical fitness requirements on 1995 fitness scores.

Data Analysis - Hypotheses H1

Standards - Hypothesis H1 - scores will meet or exceed acceptable standards, descriptive expectations, no relationship expected.

Hypothesis HI August 1995 total fitness scores will meet or exceed acceptable standards .

The data supports Hypothesis H1. The mean total fitness scores of all five physiological components in August 1995 is 79.24, which is classified as "good".

Table **5.1** summarizes the August **1995** mean score of total fitness by score, category, and point range.

Table 5.1 Summary Of Mean Score Of Total Fitness August *1995*		
Component	Category	Point Range
Mean Total Fitness Score August 1995: **79.24**.....	Excellent **Good** Acceptable Mediocre Fair Poor	≥ *85* **70 - 84** ***60 - 69*** ***40*** - 59 15 - ***39*** < 15

Table **5.2** provides a breakdown of the August **1995** total fitness scores by category, number of individuals scoring within each category and the percent of the total population scoring in each category. It is interesting to note that 86% of the population scored in the top two categories, **95%** scored "acceptable" or above, and only one individual scored below acceptable. This speaks to the success of the mandatory physical fitness program.

Table 5.2 Scores Of Total Fitness By Category And Percentage August 1995		
Category	Number Scoring In Each Category	Percent Of Population
Excellent	8	38%
Good	10	48%
Acceptable	2	9%
Mediocre	0	-
Fair	1	5%
Poor	0	0
Total	21	100%

***Hypothesis H1a**: August **1995** scores of **aerobic capacity will meet** or exceed acceptable standards.*

The data supports Hypothesis H1a. The mean score of aerobic capacity for August **1995** is 16.07, which is classified as "acceptable". Table **5.3** summarizes the August **1995** mean score of aerobic capacity by score, category, and point range.

Table 5.3
Summary Of Mean Score Of Aerobic Capacity
August 1995

Component	Category	Point Range
Mean Score of **Aerobic Capacity** August 1995: **16.07 .....**	Excellent	≥ 21.25
	Good	17.50 - 21.24
	Acceptable	**15.00 - 17.49**
	Mediocre	10.00 - 14.99
	Fair	3.75 - 9.99
	Poor	≤ 3.75

Table 5.4 provides a breakdown of the August **1995** total **fitness** scores by category, number of individuals scoring within each category, and the percent of the total population scoring in each category. It should be noted that although the mean is within the **range** of **acceptability,** no fire fighter scored in the "acceptable" category. The percent distribution reveals a type of **bimodal** scoring with 62% scoring above "acceptable" and **38%** scoring below "acceptable."

Table 5.4 Scores Of Aerobic Capacity By Category And Percentages August 1995		
Category	Number Scoring In Each Category	Percent Of Population
Excellent	3	14%
Good	10	48%
Acceptable	0	0%
Mediocre	7	33%
Fair	0	0%
Poor	1	5%
Total	21	100

Because cardiovascular failure is the primary cause of death in fire fighters the August 1995 scores of aerobic capacity are reason for some concern. While 62% of the fire fighters were categorized as above "acceptable". 38% were below "acceptable". This bimodal result is considered administratively significant.

Hypothesis H1b: August 1995 scores of body composition will meet or exceed acceptable standards.

The data supports Hypothesis H1b. The August 1995 mean score of body composition is 12.05 which is categorized as "acceptable". Table 5.5 summarizes the August 1995 mean score of body composition by score, category, and point range.

Table 5.5 Summary Of Mean Score Of Body Composition August 1995		
Component	Category	Points
Mean Score of Body Composition August 1995: 12.05	Excellent Good Acceptable Mediocre Fair Poor	≤ 17.00 14.00 - 16.99 12.00 - 13.99 8.00 - 11.99 3.00 - 6.90 ≤ 3.00

Table 5.6 provides a breakdown of the August 1995 total score of body composition by category, number of individuals scoring within each category and the percent of the total population scoring in each category.

Table 5.6
Scores Of Body Composition By Category And Percentages
August 1995

Category	Number Scoring In Each Category	Percent Of Population
Excellent	6	28%
Good	4	19%
Acceptable	0	0%
Mediocre	5	24%
Fair	5	24%
Poor	1	5%
Total	21	100%

The mean score of body composition is categorized as "acceptable". It should be noted that although the mean is within the "acceptable" range no fire fighter scored in the "acceptable" category. The percent distribution reveals a type of bimodal scoring with 47% scoring above "acceptable" and 53% scoring below acceptable. Because body composition is correlated to cardiovascular fitness this is an area that is of concern, especially for those individuals in the mediocre, fair, and poor categories. Therefore, the evidence does not support the hypothesis.

Hypothesis Hlc: August 1995 scores of flexibility will meet or exceed acceptable standards.

The August 1995 means score of flexibility supported Hypothesis Hlc. The Mean score of flexibility is 13.69, which is categorized as "excellent". Fifteen individuals, 71%,

attained scores of **15** on the test. Table **5.7** summarizes the **mean** score of flexibility for **1995** by category and point range.

Table 5.7 Summary Of Mean Score Of Flexibility August 1995		
Component	Category	Point Range
Mean Score of **Flexibility** August 1995: **13.69**.....	**Excellent** **Good** Acceptable Mediocre Fair Poor	**≥ 12.75** 10.50 - 12.74 9.00 - 10.49 6.00 - 8.99 2.25 - 6.99 < 2.25

Table **5.8** provides a breakdown of the August **1995** scores of flexibility by category, number of individuals scoring within each category and the percent of the total population scoring within each category.

Table 5.8 Scores Of Flexibility **By Category And Percentages** **August 1995**		
Category	Number Scoring In **Each Category**	**Percent Of** **Population**
Excellent	15	71%
Good	0	0%
Acceptable	6	29%
Mediocre	0	0%
Fair	0	0%
Poor	0	0%
Total	21	100%

Hypothesis Hld: *August* ***1995*** *scores of* ***muscular endurance*** *will meet or exceed acceptable* ***standards***.

The August 1995 mean score for muscular endurance supports Hypothesis Hld. The mean score for muscular endurance is 18.00, which is categorized as "excellent". Table 5.9 summarizes the August 1995 mean score of flexibility by score, category. and point range.

Table 5.9
Summary Of Mean Score Of Muscular Endurance
August 1995

Component	Category	Points
Mean Score of **Muscular Endurance:** 18.00	**Excellent**	**≥ 17.00**
	Good	14.00 - 16.99
	Acceptable	12.00 - 13.99
	Mediocre	8.00 - 11.99
	Fair	3.00 - 6.90
	Poor	< 3.00

Table 5.10 provides a breakdown of the August 1995 scores of muscular endurance by category, number of individuals scoring in each category and percent of the population scoring in each category. Sixteen individuals (76%) attained scores in the "excellent" category and three individuals, (14%) attained scores in the "good" category. Only two individuals were below "acceptable".

Table 5.10 Scores Of Muscular Endurance By Category And Percentages August 1995		
Category	Number Scoring In Each Category	Percent Of Population
Excellent	16	76%
Good	3	14%
Acceptable	0	0%
Mediocre	1	5%
Fair	1	5%
Poor	0	0%
Total	21	100%

Hypothesis H1e: August 1995 scores of muscular strength will meet or exceed acceptable standards.

The data supports Hypothesis H1e. The August 1995 mean score of muscular strength is 19.43, which is categorized as "excellent". Table 5.11 summarizes the August 1995 mean score of muscular strength by score, category, and point range. The mode and the mean range are consistent.

Table 5.11 Summary Of Mean Score Of Muscular Strength August 1995		
Component	Category	Point Range
Mean Score of **Muscular Strength:** **19.43**.....	**Excellent** **Good** Acceptable Mediocre Fair Poor	**≥ 17.00** 14.00 - 16.99 12.00 - 13.99 8.00 - 11.99 3.00 - 6.90 ≤ 3.00

Table 5.12 provides a breakdown of the August 1995 scores of muscular strength by category, number of individuals scoring in each category and percent of the population scoring in each category.

Table 5.12
Scores Of Muscular Strength By Category And Percentages
August 1995

Category	Number Scoring In Each Category	Percent Of Population
Excellent	19	90%
Good	2	10%
Acceptable	0	0%
Mediocre	0	0%
Fair	0	0%
Poor	0	0%
Total	21	100%

Nineteen individuals (90%) attained scores of 20.00, categorized as "excellent". Two individuals attained scores of 14.00, which is categorized as "good". There were no scores below the top two categories. One hundred percent of the fire fighters scored above acceptable on score of muscular strength.

Hypothesis H1f: August 1995 scores on the combat test will meet or exceed acceptable standards.

The data supports Hypothesis H1f. The mean combat test score for August 1995 is 4:09.04 minutes and is categorized as "excellent". Excellent is any score equal to or less than 5:00.00 minutes. Table 5.13 summarizes the 1995 mean score on the combat test by category and point range.

Table 5.13 Summary Of Mean Score Of Combat Test August 1995		
Component	Category	Points
Mean Score of Combat Test : **4:09.04.....**	**Excellent** Acceptable Unacceptable	**≤ 5:00** Min. 7:00 - 7:30 Min. ≥ 7:31 Min.

Table 5.14 provides a breakdown of the August 1995 scores on the combat test by category, number of individuals scoring in each category and percent of the population scoring in each category.

Table 5.14 Combat Test Scores By Category And Percentages August 1995		
Category	Number Scoring In Each Category	Percent Of Population
Excellent	19	79%
Good	5	21%
Acceptable	0	0%
Mediocre	0	0%
Fair	0	0%
Poor	0	0%
Total	24	100%

The combat test is considered the "gold standard of physical fitness testing in the fire protection service. With 79% of the population scoring in the "excellent" category, 21% scoring in the "good" category, and none of the population scoring below "good", this population of the San Marcos fire department is in outstanding physical condition.

Summary of Data Analysis - Hypotheses H1

Overall the evidence supports Hypotheses H1 through H1f Based on the evidence criteria used the modal score is "good. However, the individual scores of H1a and H1b, have percent distributions that reveal a type of bimodal scoring. The bimodal scoring patterns suggest there are two groups of fire fighters in these categories - those who are very fit and those who are marginal or below either level. Since aerobic capacity and body composition indicate potential cardiovascular problems, it should be considered administratively significant. Table 5.15 summarizes the results of data analyses based upon these hypotheses.

Data Analysis - Hypotheses H2

Hypotheses two (H2) and the sub-hypotheses (H2a-H2f) deal with fitness scores from the inception of the mandatory fitness program, October 1991, to January 1993. During this time period a structured mandatory exercise format was required. It is anticipated that there is a positive relationship between the structured exercise format and fitness scores in the seven categories of physical fitness. Data are analyzed by comparing 1991 mean scores in all physical fitness categories, (1992) for the combat test, to the 1992 mean scores in all physical fitness categories.

Standards - Hypothesis H2: During the period of time the structured mandatory exercise format was in place there is positive relationship between the structured exercise format and fitness scores.

Table 5.15
Hypotheses H1 Thru Hlf
Summary Of Results

Hypotheses	Statement of Hypotheses	Results	Mean Score	Points Range	Category
H1	August 1995 mean score of total fitness will meet of exceed acceptable standards	Exceeds	79.24	70 - 84	Good
Hla	August 1995 mean score of aerobic capacity will meet or exceed acceptable standards	?[18]	16.07	15.00 - 17.49	Acceptable?[18] Bimodal
Hl b	August 1995 mean score of body composition will meet or exceed acceptable standards	?[18]	12.05	12.00 - 13.99	Acceptable?[18] Bimodal
Hlc	August 1995 mean score of flexibility will meet or exceed acceptable standards	Exceeds	13.69	≥ 12.75	Excellent
Hld	August 1995 mean score of muscular endurance will meet or exceed acceptable standards	Exceeds	18.00	≥ 17.00	Excellent
Hle	August 1995 Mean score of muscular strength will meet or exceed acceptable standards	Exceeds	19.43	≥ 17.00	Excellent
Hlf	1995 mean combat test score will meet or exceed acceptable standards	Exceeds	4:09.04	≤ 5:00 Min.	Excellent

[18]The test is that there is consitency between the mean and the percent distribution. If over 50% score below the mean the hypothesis is not accepted.

Hypothesis H2: *There is a positive relationship between the structured mandatory exercise format and* ***total fitness.***

The data supports hypothesis H2. In October 1991 the mean score of total fimess as 64.46, which is categorized as "acceptable". In January 1991 the mean score of total fitness was 77.16 which is categorized as "good". From October 1991 to January 1991 the means score of total fimess increased (improved) 12.70 points, a 20% increase. There is a positive relationship between the structured exercise format and total fimess scores. Table 5.16 summarizes the data applicable to Hypothesis H2.

Table 5.16
Comparison Of Mean Scores Of Total Fitness During
The Structured Mandatory Exercise Format
Hypothesis H2 N=22

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
64.46	Acceptable	77.16	Good	12.70	+20%

Hypothesis H2a: *There is a positive relationship between the structured mandatory exercise format and* ***aerobic capacity.***

The data do not support hypothesis H2a. Aerobic capacity improved slightly but not enough to support hypothesis H2a. The mean score of aerobic capacity in October 1991 was 14.20, which is categorized as "mediocre". In January 1992 the mean score of aerobic capacity was 14.52, which, is categorized as "mediocre". Aerobic capacity increased .32 points or 2% during the time the structured mandatory exercise format was in place. The data suggests real change because the change is so small that it could be random variation. It is administratively significant that both the October 1991 and January 1993 mean scores of aerobic capacity were below an acceptable level. Table 5.17 summarizes the data applicable to Hypothesis H2a.

Table 5.17
Comparison Of Mean Scores Of Aerobic Capacity
During The Structured Mandatory Exercise Format
Hypothesis H2a N=21

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
14.20	Mediocre	14.52	Mediocre	+.32	+2%

Hypothesis H2b: *There is a positive relationship between the structured exercise format and* ***body composition.***

The data support hypothesis H2b. From October 1991 to January 1993 the mean score of body composition increased 3.13 points. Which represents a 43% improvement in the mean score of body composition. There is a positive relationship between the structured mandatory exercise format and body composition. Table 5.18 summarizes the data applicable to Hypothesis H2b.

Table 5.18
Comparison Of Mean Scores Of Body Composition
During The Structured Mandatory Exercise Format
Hypothesis H2b N=22

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
7.28	Mediocre	10.41	Mediocre	+3.13	+43%

Hypothesis H2c: *There is a positive relationship between the **mandatory** exercise format and **flexibility.***

The data support Hypothesis H2c. The October **1991** mean score of flexibility is **10.90** and the January **1991** mean score of flexibility is **14.80.** The mean score of flexibility increased **3.8** points **(36%)** from October **1991** to January **1993** and increased one category, from "good" to "excellent". Therefore, the **3.8 (36%)** point increase represents a positive relationship between the structured mandatory exercise format and flexibility. Table **5.19** summarizes Hypothesis H2c.

Table 5.19
comparison Of Mean Scores Of Flexibility During
The Structured Mandatory Exercise Format
Hypothesis H2c N=22

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
10.90	Good	14.80	Excellent	+3.9	+36%

Hypothesis H2d: *There is a positive relationship between the structured mandatory exercise format and **muscular endurance.***

The data support Hypothesis H2d. Muscular endurance increased **5.84** points **(46%)** from October **1991** to January **1993.** The October **1991** mean score of muscular endurance is **12.80,** categorized as "good". The January **1991** mean score of muscular endurance was **18.64,** which is categorized as "excellent". The **5.84 (46%)** increase in muscular endurance represents a positive change between the structured mandatory exercise format and muscular endurance. Table **5.20** summarizes the data relevant to Hypothesis H2d.

Table 5.20
Comparison Of Mean Scores Of Muscular Endurance
During The Structured Mandatory Exercise Format
Hypothesis H2d N=22

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
12.80	Good	18.64	Excellent	+5.84	+46%

Hypothesis H2e: *There is a positive relationship between the strucrured mandarory exercise format and* ***muscular strength.***

The data do not support Hypothesis H2e. Muscular strength increased only .17 points (.009%) from October 1991 to January 1993. The October 1991 mean score of muscular strength is 19.28, which is categorized as "excellent". The January 1993 mean score of muscular strength is 19.45, which is categorized as "excellent". Therefore, the data suggests no real change between the structured mandatory exercise format and muscular strength. The change is so small that it is not statistically or administratively significant and could, easily, be attributable to random variation or to small errors or variations in rounding or data collection. Such a slight change has no administrative significance because both scores *are* "excellent" and it is almost impossible to improve when scores are high initially. Table 5.21 summarizes the data relevant to Hypothesis H2e.

Table 5.21
Comparison OF Mean Scores Of Muscular Strength
During The Structured Mandatory Exercise Format
Hypothesis H2e N=22

Total Score October 1991	Category	Total Score January 1993	Category	Point Change	Percent Change
19.28	Excellent	19.45	Excellent	+.17	+.009%

Hypothesis H2f: *There is a negative relationship between the structured mandatory exercise format and performance on the* ***combat test.***

The data do not support Hypothesis H2f. Since there were no combat scores available for 1991 the comparison is made for one year only. The mean combat test score in 1992 (the first time the combat test was run during the time period of the structured mandatory exercise format) was 4:15.97 minutes, categorized as "excellent". The mean score on the combat test in 1993 was 4:28.05 minutes, categorized as "excellent". The mean score on the combat test declined 00:12.08 seconds (5%) from 1992 to 1993. Therefore, there is a negative relationship between the structured mandatory exercise format and performance on the combat test. Table 5.22 summarizes the data applicable to Hypothesis H2f.

Table 5.22
Comparison Of Mean Scores On Combat Tests
During Structured Mandatory Exercise Format
Hypothesis H2f N=21

1992 Score	Category	1993 Score	Category	Change[19]	Percent[19] Change
4:15.97 Minutes	Excellent	4:28.05 Minutes	Excellent	+00:12.08 Seconds	+5%

Summary of Data Analysis - Hypotheses H2

Hypotheses H2, H2b, H2c, and H2d are all supported by the data. There is a positive relationship between the structured mandatory exercise format and total fitness, body composition, flexibility, and muscular endurance. Hypotheses H2a, H2e, and H2f are not supported by the data. There is a negative relationship between the structured

[19]The combat tesl is scored on time to complete. The faster completed the better the score. Therefore a positive number represents a decline in performance.

mandatory exercise format and scores of aerobic capacity, muscular strength, and the combat test. Table 5.23 provides a summary of Hypotheses H2 through H2f.

Table 5.23
Summary Of Results Hypotheses H2 Thru H2f
Effects Of The Structured Mandatory Fitness Format
Hypothesized: Positive Relationship Between Structured Format
And
Tests Of Physical Fitness

Hypothesis	Result[20]	1991 Mean Score	1991 Category	1993 Mean Score	1993 Category	Point Change	% Change
H2 Total Fimess	Yes	64.46	Acceptable	77.16	Good	+12.70	+20%
H2a Aerobic Capacity	No	14.20	Mediocre	14.52	Mediocre	+.32	+2%
H2b Body Composition	Yes	7.28	Mediocre	10.41	Mediocre	+3.13	+43%
H2c Flexibility	Yes	10.90	Good	14.80	Excellent	+3.0	+ 36%
H2d Muscular Endurance	Yes	12.80	Good	18.64	Excellent	+5.84	4 6 %
H2e Muscular Strength	No	19.28	Excellent	19.45	Excellent	+.17	+.009%
H2f Combat Test 1992 Scores	Yes	4:15.97 Minutes	Excellent	4:28.05 Minutes	Excellent	+0:12.08 Minutes[21]	+5%[21]

[20] Evidence supports (Yes) or fails to support (No) the hypothesis based on computing the percent change in in fitness scores.
[21] The combat test is scored on time to complete. The faster completed the better the score. Therefore a positive number represents a decline in performance.

Data Analysis - Hypotheses H3

The third hypothesis, H3, and respective sub-hypotheses, deal with the effects of elimination of the structured mandatory exercise format in exchange for a mandatory exercise format that allows the fire fighters to choose what type of exercise they will engage in, during the mandatory exercise period. The structured mandatory exercise format was eliminated in January 1993. Data analyzed are mean fitness scores from January 1991 and August 1995. It is hypothesized that there is a negative relationship between elimination of the structured mandatory exercise format fitness scores in each fitness category.

Standards - Hypothesis H3: Fitness scores will show a decline but remain within acceptable ranges after the elimination of the structured mandatory exercise format. Administrators should be pleased if the hypothesis is not supported because it means dropping the mandatory exercise format did not reduce fimess.

Hypothesis H3: There is a negative relationship between the elimination of the structured mandatory exercise format and total fitness.

The data does not support hypothesis H3. The October 1992 mean score of total fitness is 77.16, which is categorized as "good". The August 1995 score of total fitness is 79.24, also categorized as "good". The 1995 mean total fitness score increased by .28 points (.004%). There is an increase in scores of total fitness after elimination of the structured mandatory exercise format and score of total fitness. Table 5.24 summarizes that data applicable to Hypothesis H3.

Table 5.24
Comparison Of Mean Scores Of Total Fimess
After Elimination OF The Structured Mandatory Exercise Format
Hypothesis H3 N=21

Total Score January 1993	Category	Total Score August 1995	Category	Point Change	Percent Change
77.16	Good	79.24	Good	+2.08	+ 3%

Hypothesis H3a: *There is a negative relationship between elimination of the structured mandatory exercise format and* ***aerobic capacity.***

The data do not support Hypothesis H3a. The January 1993 mean score of aerobic capacity is 14.52, which is categorized as "mediocre". The August 1995 mean score of aerobic capacity is 16.07, which is categorized as "acceptable". Mean aerobic capacity increased 1.55 points after elimination of the structured mandatory exercise format. Therefore, there is a positive relationship between elimination of the structured mandatory exercise format and aerobic capacity. Table 5.25 summarizes the data applicable to hypothesis H3a.

Table 5.25
Comparison Of Mean Scores Of Aerobic Capacity
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3a N=21

Total Score January 1993	Category	Total Score August 1995	Category	Point Change	Percent Change
14.52	Mediocre	16.07	Acceptable	+1.55	+ 11%

Hypothesis H3b: There is a negative relationship between elimination of the structured mandatory exercise format and body composition.

The data do not support Hypothesis H3b. The August 1995 score of body composition is 12.05, which is categorized as "acceptable". This represents a 1.55 point increase over the January 1993 mean score of 10.41, which is categorized as "mediocre". Therefore, a positive relationship exists between elimination of the structured mandatory exercise format and body composition. Table 5.26 summarizes the data applicable to Hypothesis H3a.

Table 5.26
Comparison Of Mean Scores Of Body Composition
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3b N=21

Mean Score January 1993	Category	Mean Score August 1995	Category	Point Change	Percent Change
10.41	Mediocre	12.05	Acceptable	+1.64	+ 16%

Hypothesis H3c: There is a negative relationship between elimination of the structured mandatory exercise format andjlexibility.

The data supports Hypothesis H3c. There is a negative relationship between elimination of the structured mandatory exercise format and flexibility. Flexibility declined 1.11 points after elimination of the structured mandatory exercise format. The August 1995 mean score of flexibility was 13.69, which is categorized as "excellent". The January 1993 mean score of flexibility was 14.80 which was also categorized as "excellent". Table 5.27 summarizes the data applicable to Hypothesis H3c.

Table 5.27
Comparison Of Mean Scores Of Flexibility
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3c N=21

Mean Score January 1993	Category	Mean Score August 1995	Category	Point Change	Percent Change
14.80	Excellent	13.69	Excellent	-1.11	- 8%

Hypothesis H3d: *There is a negative relationship between the elimination of the structured exercise format and* ***muscular endurance.***

The data give weak support for Hypothesis H3d. The August 1995 mean score of muscular endurance declined only .64 points (3%). The August 1995 mean score of muscular endurance was 18.00, which is categorized as "excellent". The January 1993 mean score of muscular endurance is 18.64, which is categorized as "excellent". Therefore, there is a negative relationship between the elimination of the structured mandatory exercise format and muscular endurance. Because of the small point decline and because both 1991 and 1993 scores are in the "excellent" category these results are not administratively significant nor cause for concern. It is feasible that the decline is attributable to small errors and/or variations in rounding and data collection. Table 5.28 summarizes the data applicable to Hypothesis H3d.

Table 5.28
Comparison Of Mean Scores Of Muscular Endurance
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3d N=21

Mean Score January 1993	Category	Mean Score August 1995	Category	Point Change	Percent Change
18.64	Excellent	18.00	Excellent	-.64	-3%

Hypothesis H3e: *There is a negative relationship between elimination of the structured mandatory exercise format and* ***muscular strength.***

The data do not support Hypothesis H3e. The August 1995 mean score of muscular strength declined .02 points. The August 1995 mean score of muscular strength is 19.43, which is categorized as "excellent". The January 1993 mean score of muscular strength is 19.45, which is also categorized as "excellent". The percent change is too small to be administratively significant or cause for concern. Again, the change could be the result of small errors and/or variations in rounding and data collection. Table 5.29 summarizes the data applicable to Hypothesis H3e.

Table 5.29
Comparison Of Mean Scores Of Muscular Strength
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3e N=21

Mean Score January 1993	Category	Mean Score August 1995	Category	Point Change	Percent Change
19.45	Excellent	19.43	Excellent	-.02	-.001%

Hypothesis H3f: *There is a negative relationship between elimination of the structured mandatory exercise format and performance on the* ***combat test.***

The data do not support Hypothesis H3f. The August 1995 mean score on the combat test was 4:09.04 minutes, which is categorized as "excellent". The mean score on the January 1993 combat test is 4:28.05, which is categorized as "excellent". Performance on the combat test improved by 19.01 seconds in August 1995. Therefore, there is a positive relationship between elimination of the structured mandatory exercise format and performance on the combat test. Table 5.30 summarizes the data applicable to Hypothesis H3f.

Table 5.30
Comparison Of Mean Scores Of The Combat Test
After Elimination Of The Structured Mandatory Exercise Format
Hypothesis H3f N=24

Mean Score January 1993	Category	Mean Score August 1995	Category	Point[22] Change	Percent[22] Change
4:28.05 Minutes	Excellent	4:09.04 Minutes	Excellent	-00.19.01	-7%

Summary of Data Analysis - Hypotheses H3

Table 5.31 summarizes the affects of the elimination of the structured mandatory exercise format in all fitness categories. Elimination of the structured mandatory exercise format produced negative effects in flexibility, muscular endurance, and muscular strength. However, the negative impacts are minimal because scores in all three categories remain in the "excellent" category. The largest decline was in flexibility. The structured mandatory exercise format included a period of stretching exercises. It appears that some individuals may have eliminated or reduced stretching routines from their exercise program. Because high flexibility is an important contributor to the prevention of musculoskeletal injuries this decline should be considered administratively significant.

[22]The combat test is scored on time to complete. The faster completed the better the score. Therefore a negative number represents an improvement in performance.

Table 5.31
Summary Of Hypotheses H3 Thru H3f
Effects Of The Structured Mandatory Fimess Format
Hypothesized: Negative Relationship Between Elimination Of The Structured Format
And
Tests Of Physical Fitness

Hypothesis	Result[23]	1993 Mean Score	1993 Category	1995 Mean Score	1995 Category	Point Change	% Change
H3 Total Fitness	No	77.16	*Good*	79.24	Good	+2.08	+3%
H3a Aerobic Capacity	No	14.52	Mediocre	16.07	Acceptable	+1.55	+11%
H3b Body Composition	No	10.41	Mediocre	12.05	Acceptable	+1.64	+16%
H3c Flexibility	Yes	14.80	Excellent	13.69	Excellent	-1.11	-8%
H3d Muscular Endurance	Yes	18.64	Excellent	18.00	Excellent	-.64	-3%
H3e Muscular Strength	No[24]	19.45	Excellent	19.43	Excellent	-.02	-1%
H3f Combat Test	N	4:28.05 Minutes	Excellent	4:09.04 Minutes	Excellent	-0:19.01 Minutes [25]	-7%[25]

[23]Evidence supports (Yes) or fails to support (No) the hypothesis based on computing the percent change in fitness scores.
[24]Results do not support the hypothesis because the change is so small that it is not administratively significant.
[25]The combat test is scored on time to complete. The faster completed the better the score. Therefore a negative number represents an improvement in performance.

Summary

Overall the firefighters appear to be in good physical condition based upon the 1995 fitness scores. The mean scores, however, are somewhat deceiving. Patterns of a type of bimodal scoring are seen in scores of aerobic capacity and body composition. In each of these categories no individual scored within the mean category. The fire fighters appear to be either in very good condition or less than acceptable condition in regard to aerobic capacity and body composition. Aerobic capacity and body composition are directly related to cardiovascular fitness and it appears that many of the fire fighters are not in good cardiovascular condition. Because cardiovascular failure is the primary cause of death in fire fighters there is reason for concern due to the bimodal pattern of these scores.

The implementation of the structured mandatory exercise format resulted in improvements in every fimess category with the exception of the combat test which declined 5%. The most notable improvements were in body composition (43%), flexibility (36%), muscular endurance (46%), and total fitness (20%). Two fimess categories, aerobic capacity and muscular strength, experienced improvements that were too small to be considered administratively significant. However, there was improvement in these two categories. Overall , the implementation of the mandatory exercise format has improved the physical fitness of the fire fighters.

The elimination of the structured mandatory exercise format did not negatively impact fimess scores. Improvements occurred in body composition (16%), aerobic capacity (11%), combat test (7%), and total fitness (3%). The only administratively significant decline occurred in flexibility (8%). Muscular endurance (35%) declined and muscular strength declined (1%) neither of which are administratively significant.

The results, presented in this chapter, will be discussed, conclusions drawn relative to the fire fighting profession, and suggestions will be presented in Chapter Six - Summary and Recommendations.

Chapter Six - Summary & Recommendations

Introduction

The importance of physical fitness requirements for fire fighters is apparent. Previous chapters established the importance of physical fimess requirements not only for fire fighters but to the public they serve. Physical fitness requirements for fire fighters have important implications for fire fighters, taxpayers, and the public they serve. There are also important implications from a public administration perspective.

Fire fighters who are physically fit work more efficiently, effectively, and with lower injury and death rates than those who are not physically fit. Increased efficiency and effectiveness and lower injury and death rates translate into monetary savings. In addition, it is ethically the right thing to do. Money is saved as a result of declines in cost of health care, injuries, absences due to illness and injury, and disability related rehabilitation and retirements. Fire and rescue responses may be quicker and more effective because of physical fitness standards resulting in the saving of more lives and property. Money and time are important, but the fire fighter and those they protect and rescue are more important. There is one important thing to remember about the savings accrued from physically fit fire fighters - it is not possible to place a dollar value on an individual's Life.

Fire fighters work in the most dangerous profession in the United States and they provide critical life saving services. They are responsible for protecting the lives and property of the public and each other. Grieve (1993, p. 17) commented, as follows. on the importance of physical fimess for fire fighters, "...a review of national statistics indicates that the majority of firefighters deaths and injuries are caused not by dangerous conditions or poor equipment but by the poor physical fitness levels of the fire fighters themselves." Ornberg (1982, p. 86) makes a similar statement, "According to fitness experts, however,

a significant number of line-of-duty and job related deaths could be eliminated by the fire-fighter himself through the maintenance of his own physical fimess."

The purpose of this research was to evaluate the fitness of the San Marcos fire fighters based upon 1995 fimess scores, to analyze the effects of the structured mandatory exercise participation and fimess standards program on fitness scores, and to analyze the impact of the elimination of the structured component of the mandatory exercise format upon fitness scores.

Summary of Findings

Based upon the 1995 test of physical fitness the San Marcos fire fighters are fit to fight fires. Table 5.15 provides a summary of the 1995 fitness scores. The 1995 mean score of total fitness is categorized as "good as is the mean score of flexibility. The 1995 mean scores of muscular endurance, muscular strength, and the combat test are all categorized as "excellent". Aerobic capacity and body composition are categorized as "acceptable". While the 1995 mean fitness scores indicate that the San Marcos fire fighters are fit to fight fires there is reason for administrative concern. The 1995 percent distribution of scores in aerobic capacity and body composition reveal a type of bimodal scoring.

The 1995 scores of aerobic capacity were bimodal (Table 5.4). The mean score of aerobic capacity is categorized as "acceptable" but 62% of the scores were above "acceptable" and 38% of the scores were below "acceptable". There are no scores in the "acceptable" range. The 1995 mean score of body composition is categorized as "acceptable" but the percent distribution is bimodal (Table 5.6). Forty-seven percent of these scores were above "acceptable" and 53% are below "acceptable" with no scores in the "acceptable" category. The bimodal scoring patterns in aerobic capacity and body composition are reason for concern and are administratively significant. Aerobic capacity

and body composition are correlated to cardiovascular fitness. Cardiovascular failure is the primary cause of death in fire fighters. With regard to aerobic capacity and body composition, it appears there are two groups of fire fighters - those who are in very good condition and those who are in less than acceptable condition.

Cardiovascular fitness receives a lot of attention in the media and it is general knowledge that cardiovascular fitness is important in the prevention of cardiovascular failure. Body composition is discussed less often but it is important to physical fitness and is especially important for fire fighters, for several reasons. Davis (1995, pp. 20 & 22) discusses the importance of body composition as follows:

> Aside from the known relationship between sudden death and obesity, there are a number of other deleterious effects of being too fat. These include hypertension, diabetes and increased risk of low back injury as well as a host of other orthopedic problems. Increased amounts of body fat impedes physical performance by adding to the amount of mass that must be moved, increasing the workload of the heart and interfering with the dissipation of heat due to the insulating effects of subcutaneous (under the skin) fat.

Fire fighters work in extremely hot environments (700° to 800°F) and must wear safety equipment, safety clothing, and SCBA that weighs approximately 60 lbs. Any additional weight poses a threat to their safety during fire ground activities. Because of the nature of the fire fighting profession these risks are magnified due to the significant physiological demands routinely experienced by fire fighters. Those who do not score well on body composition should be of concern to fire department administration.

The second purpose of this research is to determine the effect the structured mandatory exercise format had on fitness scores. Table 5.23 summarizes the effects of the structured mandatory exercise format on fimess scores. Scores of total fitness, body composition, flexibility and muscular endurance improved. Scores of aerobic capacity and muscular strength reflected slight improvement but not enough to be considered

administratively significant or to support the hypothesis. Scores on the combat test declined. Because the combat test is the "gold standard" of physical fitness for fire fighters this is administratively significant. It is possible that this could be attributed to the lack of significant improvement in aerobic capacity and muscular strength. However, since both the 1992 scores and the 1993 score are categorized as "excellent" this decline should not mgger administrative concern.

The third purpose of this research is to determine the effect of the elimination of the structured mandatory exercise format and the implementation of a mandatory exercise format that allows personal freedom in choice of exercise. Table 5.31 summarizes the results of elimination of the structured mandatory exercise format. Elimination of the structured mandatory exercise format resulted in improved scores in tests of four physiological components: total fitness, aerobic capacity, body composition, and the combat test. Scores declined in flexibility, muscular endurance, and muscular strength. The decline in muscular strength is too small (1%) to be considered administratively significant. The largest decline (11%) is in flexibility. The structured mandatory exercise format included exercises that were designed to increase flexibility. Analysis of individual scores of flexibility (Table B-35) shows 6 individuals (29%) experienced a decline, 1 improved, 12 remained the same, and 4 could not be compared due to missing data. It appears that 29% of the fire fighters have not incorporated flexibility exercises into their routines or they aren't spending enough time on flexibility exercises. Even though the 1993 and 1995 mean scores of flexibility are categorized as "excellent" the decline is administratively significant because of the association of good flexibility with the prevention of musculoskeletal injuries in fire fighters. Muscular endurance, which is explosive strength, declined marginally (3%).

Overall the fire fighters are in good physical condition with some areas that need attention. The following suggestions are derived from the literature and information

gleaned from conversations with fire department administration. These suggestions are intended to be unbiased and to provide an administrative basis for addressing the problem areas.

Suggestions

1. Provide individualized assessment and exercise routines for those individuals who have marginal or unacceptable scores. Reevaluation of these individuals should be done periodically and adjustments made as necessary.

2. Provide more training in physical conditioning, diet and nutrition.[26] Perferably, the training will be done one-on-one allowing for personal interaction so that individual concerns and requirements can be addressed.

3. Missing data presented a problem in this project For a variety of reasons, data is not available on all individuals. The problems associated with missing data should be addressed so that an uninterrupted track on the fitness of each individual can be maintained.

4. Hire well - incorporate fitness standards into the minimum requirements for employment. Don't hire those who are not physically fit to fight fires.

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[26] Responses to the survey, Appendix B, support this suggestion. Fifty-eight percent of the fire fighters agreed that more education in nutrition would make a significant difference in their fitness levels. Eighty-seven percent indicated that more training in physical conditioning would make a significnat difference in their fitness levels.

Conclusion

Mandatory exercise and fimess requirements within fire departments provide many benefits to the organization and to the publics they serve. The organization can be strengthened by an increase in physical fimess and performance. The work environment is safer and more efficient. Injury, sickness, and death rates decline. Savings are realized from a decline in health care costs directly and indirectly. Physically fit fire fighters are more efficient at their work - property loss declines. The public is confident that fire fighters are competent to provide the best in f i e and rescue services.

Fire departments provide critical public services. To render these services requires fire fighters who are in excellent physical condition. F i e departments should strive to maintain levels of fimess that can be categorized as "excellent". Mandatory exercise and fitness requirement programs make this possible.

Implications for Further Research

The most significant implication for further research would be to conduct a true experimental design, using a control group, true independent variables, and using a *t* test. By using a true experimental design, it will be possible to determine if the mandatory exercise and fitness program has produced a statistically significant difference in the physical fimess of the fire fighters.

Correlation studies could yield information on how the dependent variables affect each other. For example, does being aerobically fit correlate with good body composition? Other implications for further studies would be to compare illness and injury rates of this population before and after the implementation of the mandatory exercise and physical fitness program. Knowledge of the types of injuries and illnesses that are occurring could provide valuable information regarding the types of exercise and education that are needed for the fitness program. It could provide a mechanism to "fine-tune" the mandatory exercise and fimess program format.

A cost benefit analysis could be useful to administrative personnel. A comparison of savings realized in the costs of health care, workman's compensation, sick leave, and disability to the costs of providing the mandatory exercise and fitness program could yield valuable information for administrative personnel at both the Departmental and the City levels.

Appendix A

Survey - Results

Total Number of Respondents = 31

Beside each of the statements presented below. please indicale whether you Strongly Agree (SA). Agree (A). Disagree (D). Strongly Disagree (SD). or are Undecided (U).

		SA	A	D	SD	U
1.	Mandatory fitness programs are necessary requirements for professional fire fighters.....	45.16%	32.26%	9.68%	6.45	6.45%
2.	The competitive nature of the Combat Test is unrealistic.....	16.13%	32.26%	22.58%	9.68%	19.35%
3.	I enjoy exercising.....	58.06%	38.71%	3.23%	0.00%	0.00%
4.	I compete with myself in the Combat Test.....	22.58%	32.26%	25.81%	16.13%	3.23%
5.	Mandatory physical fitness requirements should be eliminated	3.23%	9.68%	19.35%	58.06%	9.68%
6.	The Combat Test threatens my job security.....	32.26%	16.13%	19.35%	25.81%	6.45%
7.	I routinely exercise more than three times a week.....	32.26%	32.26%	35.48%	0.00%	0.00%
8.	My friends and family have more respect for fire fighters who can pass the Combat Test,.....	9.69%	32.26%	19.35%	19.35%	19.35%
9.	More training in physical conditioning would make a significant difference in my fitness level.....	22.58%	64.52%	6.45%	0.00%	6.45%
10.	The Combat Test is a good measure of physical fitness.....	9.68%	45.16%	22.58%	19.35%	3.23%
11.	More training in nutrition would make a significant difference in my fitness level.....	12.90%	45.16%	25.81%	9.68%	6.45%
12.	I have an obligation to the public to keep myself in good physical condition.....	45.15%	48.39%	3.23%	3.23%	0.00%
13.	I fear I will be injured in the Combat Test.....	12.90%	29.03%	32.26%	16.13%	9.68%
14.	I exercise when I am not on duty.....	25.81%	51.61%	22.58%	0.00%	0.00%
15.	Young & old should have different fitness standards.....	35.48%	22.58%	16.13%	22.58%	3.23%
16.	I feel better when I exercise regularly.....	51.61%	48.39%	0.00%	0.00%	0.00%
17.	The Combat Test makes me anxious.....	48.39%	32.26%	16.12%	3.23%	0.00%

		SA	A	D	SD	U
18.	Mandatory fitness requirements make me a better fire fighter...	29.03%	35.48%	19.35%	9.69%	6.45%
19.	Different ranks should have different fitness standards.....	3.23%	12.90%	12.90%	61.29%	9.68%
20.	I enjoy the Combat Test.....	3.23%	29.02%	41.94%	25.81%	0.00%
21.	I read food labels to determine fat content.....	13.33%	36.68%	23.33%	23.33%	3.33%
22.	I have an obligation to my colleagues to keep myself in good physical condition.....	3.23%	29.02%	41.94%	25.81%	0.00%
23.	Males and females should have different fitness standards.....	3.22%	6.45%	9.68%	70.97%	9.68%
24.	I feel proud of the fact that I can pass the Combat Test.....	25.81%	41.94%	16.12%	6.45%	9.68%
25.	A low fat diet contributes to good health.....	54.84%	29.03%	3.23%	0.00%	12.90%
26.	Mandatory physical fitness requirements should be more strict..	16.13%	25.81%	32.25%	16.13%	9.68%
27.	The Combat Test in not representative of an actual fire suppression situation.....	38.71%	16.13%	29.03%	12.90%	3.23%
28.	I avoid fat in my diet.....	9.68%	32.26%	45.15%	9.68%	3.23%
29.	I avoid foods that are high in calories & low in nutrition.....	9.68%	32.25%	38.71%	9.68%	9.68%
30.	I compete with others in the Combat Test.....	16.13%	22.58%	32.26%	19.35%	9.68%

31. I routinely engage in the following exercises:

Activity	Responses
Aerobics	2
Basketball	19
Bicycling	10
Drinking Beer	8
Hiking	7
Jogging	11
Lifting Weights	21
Physical Labor	3
Racquetball	13
Sex	1
Soccer	3
Stair climbing	2
Stairmaster	4
Swimming	5
Tennis	2
Volleyball	1
Walking	13

32. I would like to see the following eliminated from the mandatory physical fitness program:

Combat test.

Combat Test - there is other ways of measuring physical fitness - I don't believe that pushing ones body past its aerobic capacity is necessary to determine ones strength & endurance.

Football

Less bitching & bickering about what to do & where. Just do it!!

Slack in the rules

Better rule enforcement.

I agree that fitness is important. But I feel that the combat should be voluntary.

Too much free time. Make it more smct.

Combat Test.

Sporting events such as basketball which have caused injuries and not conmbuted to overall fitness level.

Sunday's should be voluntary.

None

I feel we should have more time for PT.

I would like to see more of all types of physical fitness programs.

Comb at test. The cops don't have to get shot with their pistols with bullet proof vest's every 6 months so why do we have to do something equally or more stupid.

I feel the people who need it the most are the ones who don't work out hard. Therefore the program is fine but needs to be harder on certain people.

Combat testing.

Combat test.

Combat test.

33. I tend to score as follows on the On-Target fitness assessment: (Circle One)

Category		Responses
Gold	=	11
Gold/Silver	=	2
Silver	=	11
Silver/Acceptable	=	1
Acceptable	=	3
Mediocre	=	3
Fair	=	0
Poor	=	0
Total Responses	=	31

34. I would like to see the following added to the mandatory physical fitness program:

Stairmaster or treadmill endurance & maybe body fat comp. test.

Stricter rules and guide lines for ?? & group activities which everyone must participate.

Other departments should have mandatory fitness programs.

Greater variety of sports.

Greater variety of sports.

Rule enforcement.

More activities done as a shift not just one company at a time. I feel that would build us, not only physically but also mentally towards being a better team.

A specific number of hours per shift.

More standards.

More time allotted for working out and less interruptions. This time should have priority over anything else except emergency calls. Vehicle maintenance should wait until after work outs. I'm tired of getting my work out interrupted by less important duties. This needs to be rectified.

Organized warm ups and stretching, occasional whole group activities where the shift performs in unison.

Training tower would be very useful for practice.

Racquetball tournament.

Tennis

More aerobic activity.

34. Continued

More time.

Anything which will improve the systems!

More routine for the people who need it but don't do it.

A place to practice the combat test = at training tower.

Having the combat test monthly.

The department giving more incentives for better or improving scores.

A timed run, possibly shorten time requirements on combat test.

Stress test for all employees.

35. 1 would like to see the following changes to the mandatory physical fitness program:

A weight to height ???

Get rid of the Combat Test and replace it with other exercises that measure the same strength & endurance over several different test to reduce injuries.

More structured toward specific activities. If the aerobic portion of the work-out is left up to the individual it tends not to be done.

Rule enforcement.

Everyone should be required to do weight training and some form of aerobic activity. We are getting too many people hurt playing racquetball and basketball and this is costing the city unneeded expenses and inconveniences. Besides, these activities are not contributing to fitness levels.

I would be useful to have the officers, especially captains well trained as fitness leaders to be sure the program is monitored.

Announce any rewards for superior performance in advance of testing.

Get rid of the Combat Test. It does not do a damn bit of good.

The combat test done once a year but more opportunities to practice.

Add swimming.

Shorten time requirement on combat test.

Add a timed run.

We need a physical test as a prerequisite to being employed with the fire department.

Bring in fitness trainer to instruct each person on his/her needs.

36. 1 Consume_____alcoholic drinks per week.

Drinks Per Week		Responses
0	=	10
Oto 1/2	=	1
1/2 to 1	=	1
1	=	3
1 to 2	=	1
2	=	1
3 to 4	=	1
5	=	2
6 to 8	=	1
10	=	2
12	=	3
Some	=	1
Don't Count Them	=	1
No Response	=	3
Total Responses	=	31

37. Other comments:

I enjoy the Combat Test, but I feel other tests could be implemented to test our physical fitness. I feel it is probably too stressful on some people, although it does get people to exercise.

I think if we made exercising mandatory instead of the combat test, we would be more productive as a department.

We need equipment - reversible jerseys, sports equipment, decent free weight equipment for all stations, stairmaster for all stations, a washing machine & dryer for central fire station.

I'm glad I have a job that gives me time & equipment to get a good workout.

I feel that our jobs should not depend on one test alone.

Leave me alone and let me do my workout. We have too many people that are too unfit and this is unhealthy and affects me and the general public. We need to get our guys to lose their pot bellies and put on more muscle. We don't look like firemen, we look like a bunch of Santa Clauses and wimps.

Tennis.

I have a deep fear that the combat test may cost me my job as a firefighter, which I value very much.

If the combat test is the standard that we are measured by then why don't we use it as a entrance test? Could it be that women would not pass it!

I would like for us to have a good gym in house to work out at different hours.

37. Continued

I believe the combat times should be adjusted for age.

The combat test strength and burst power. If a timed run were added then the test would cover endurance.

I liked the combat test because it's the only real physical requirement we have at SMFD. The problem we have is, when we hire new people we will pay them, employ them, must rely on them (our lives in their hands at times) for an entire year regardless of how weak or out of shape they are. We hire people, they can't pass the combat test, but we keep paying them. We need, like all other paid fire departments have, a physical test which must be passed prior to being employed!!!!

Go team

Get rid of the combat test, and to stress test, if I don't have a problem doing my job then leave me alone.

The on target assessment is a joke! It doesn't take into consideration individual factors that can influence the scores, i.e. slightly larger or smaller heart, arthritic hands or knees, not to mention that the methods required for doing sit ups is considered wrong by most fitness experts.

A person should be deemed physically fit prior to being hired.

38. My current age is:

20 - 25 yrs	=	5 Individuals
26 - 30 yrs	=	5 Individuals
31 - 40 yrs	=	10 Individuals
41 - 45 yrs	=	8 Individuals
46 - 50 yrs	=	2 Individuals
No Response	=	1 Individual
Total Responses		31 Individuals

Appendix B

Table B-32
Individual Scores Of Total Fitness
1991, 1993 & 1995

Case	October, 1991	January, 1993	August, 1995
Case 1	53.50	70.50	76.50
Case 2	76.50	73.50	73.50
Case 3	57.50	82.50	78.00
Case 4	88.00	92.50	82.00
Case 5	61.00	80.50	86.50
Case 6	43.00	NA	NA
Case 7	92.50	87.50	87.50
Case 8	82.50	94.00	100.00
Case 9	92.50	75.00	87.50
Case 10	71.50	72.50	72.50
Case 11	72.50	82.50	92.50
Case 12	54.00	NA	61.50
Case 13	62.00	72.50	69.50
Case 14	39.00	47.00	NA
Case 15	51.00	NA	72.00
Case 16	64.00	79.50	86.00
Case 17	43.00	63.00	NA
Case 18	47.00	72.50	74.00
Case 19	92.50	92.50	81.50
Case 20	60.00	78.50	82.50
Case 21	74.00	82.50	92.50
Case 22	42.50	67.50	NA
Case 23	38.00	57.50	36.50
Case 24	67.50	73.50	77.50
Case 25	86.00	100.00	**94.00**
MEAN	**64.46**	**77.16**	**79.24**

Appendix B

Table B-33 Scores Of Aerobic Capacity 1991, 1993, & 1995			
Case	October 1991	January 1993	August 1995
Case 1	12.50	7.50	17.50
Case 2	17.50	12.50	12.50
Case 3	17.50	17.50	17.50
Case 4	17.50	17.50	17.50
Case 5	12.50	17.50	17.50
Case 6	12.50	NA	NA
Case 7	17.50	12.50	12.50
Case 8	17.50	25.00	25.00
Case 9	17.50	NA	12.50
Case 10	12.50	7.50	17.50
Case 11	17.50	17.50	17.50
Case 12	7.50	NA	12.50
Case 13	17.50	17.50	12.50
Case 14	7.50	0.00	NA
Case 15	12.50	NA	17.50
Case 16	7.50	12.50	25.00
Case 17	12.50	12.50	NA
Case 18	12.50	17.50	17.50
Case 19	17.50	12.50	12.50
Case 20	17.50	17.50	17.50
Case 21	17.50	17.50	17.50
Case 22	7.50	12.50	NA
Case 23	7.50	12.50	0.00
Case 24	12.50	12.50	12.50
Case 25	**25.00**	**25.00**	**25.00**
Mean	**14.20**	**14.52**	**16.07**

Appendix B

Table B-34 Individual Scores Of Body Composition Scores 1991, 1993, & 1995			
Case	October 1991	January 1993	August 1995
Case 1	6.00	14.00	15.00
Case 2	10.00	6.00	6.00
Case 3	6.00	10.00	10.00
Case 4	20.00	20.00	14.00
Case 5	14.00	14.00	20.00
Case 6	0.00	NA	NA
Case 7	20.00	20.00	20.00
Case 8	10.00	14.00	20.00
Case 9	20.00	20.00	20.00
Case 10	10.00	10.00	10.00
Case 11	10.00	10.00	20.00
Case 12	6.00	NA	6.00
Case 13	0.00	0.00	2.00
Case 14	0.00	6.00	NA
Case 15	0.00	NA	10.00
Case 16	6.00	17.00	6.00
Case 17	0.00	0.00	NA
Case 18	0.00	0.00	6.00
Case 19	20.00	20.00	14.00
Case 20	6.00	6.00	10.00
Case 21	6.00	10.00	20.00
Case 22	6.00	6.00	NA
Case 23	0.00	0.00	0.00
Case 24	0.00	6.00	10.00
Case 25	**6.00**	**20.00**	**14.00**
Mean	**7.28**	**10.41**	**12.05**

Appendix B

Table B-35 Individual Scores Of Flexibility 1991, 1993, & 1995			
Case	October 1991	January 1993	August 1995
Case 1	15.00	15.00	10.00
Case 2	15.00	15.00	15.00
Case 3	0.00	15.00	10.50
Case 4	10.50	15.00	10.50
Case 5	4.50	15.00	15.00
Case 6	10.50	NA	NA
Case 7	15.00	15.00	15.00
Case 8	15.00	15.00	15.00
Case 9	15.00	15.00	15.00
Case 10	15.00	15.00	15.00
Case 11	15.00	15.00	15.00
Case 12	10.50	NA	15.00
Case 13	10.50	15.00	15.00
Case 14	11.50	15.00	NA
Case 15	4.50	NA	10.50
Case 16	10.50	10.00	15.00
Case 17	4.50	10.50	NA
Case 18	4.50	15.00	10.50
Case 19	15.00	20.00	15.00
Case 20	10.50	15.00	15.00
Case 21	10.50	15.00	15.00
Case 22	15.00	15.00	NA
Case 23	4.50	15.00	10.50
Case 24	15.00	15.00	15.00
Case 25	15.00	15.00	15.00
Mean	10.90	14.80	13.69

Appendix B

Table B-36 Scores Of Muscular Endurance 1991 1993 & 1995			
Case	October 1991	January 1993	August 1995
Case 1	14.00	14.00	14.00
Case 2	14.00	20.00	20.00
Case 3	20.00	20.00	20.00
Case 4	20.00	20.00	20.00
Case 5	20.00	20.00	20.00
Case 6	20.00	NA	NA
Case 7	20.00	20.00	20.00
Case 8	20.00	20.00	20.00
Case 9	20.00	20.00	20.00
Case 10	20.00	20.00	20.00
Case 11	20.00	20.00	20.00
Case 12	20.00	NA	14.00
Case 13	20.00	20.00	20.00
Case 14	20.00	20.00	NA
Case 15	20.00	NA	20.00
Case 16	20.00	20.00	20.00
Case 17	20.00	20.00	NA
Case 18	20.00	20.00	20.00
Case 19	20.00	20.00	20.00
Case 20	20.00	20.00	20.00
Case 21	20.00	20.00	20.00
Case 22	14.00	14.00	NA
Case 23	20.00	20.00	20.00
Case 24	20.00	20.00	20.00
Case 25	20.00	20.00	20.00
MEAN	19.28	19.45	19.43

Appendix B

Table B-37 **Scores Of Muscular Strength** 1991, 1993, & 1995			
Case	October 1991	January 1993	August 1995
Case 1	6.00	20.00	20.00
Case 2	20.00	20.00	20.00
Case 3	14.00	20.00	20.00
Case 4	20.00	20.00	20.00
Case 5	10.00	14.00	14.00
Case 6	0.00	NA	NA
Case 7	20.00	20.00	20.00
Case 8	20.00	20.00	20.00
Case 9	20.00	20.00	20.00
Case 10	14.00	20.00	10.00
Case 11	10.00	20.00	20.00
Case 12	10.00	NA	14.00
Case 13	14.00	20.00	20.00
Case 14	0.00	6.00	NA
Case 15	14.00	NA	14.00
Case 16	20.00	20.00	20.00
Case 17	6.00	20.00	NA
Case 18	10.00	20.00	20.00
Case 19	20.00	20.00	20.00
Case 20	6.00	20.00	20.00
Case 21	20.00	20.00	20.00
Case 22	0.00	20.00	NA
Case 23	6.00	10.00	6.00
Case 24	20.00	20.00	20.00
Case 25	20.00	20.00	20.00
Mean	**12.80**	**18.64**	**18.00**

Appendix B

Table B-38 Combat Test Scores 1992, 1993, & 1995			
Case	1992	1993	1995
Case 1	4:53.47	5:10.51	5:01.00
Case 2	4:54.19	3:53.98	3:32.00
Case 3	3:53.37	3:57.22	3:53.00
Case 4	3:09.94	3:03.49	2:28.00
Case 5	3.53.83	3:40.05	4:02.00
Case 6	4:22.15	4:48.96	4:03.00
Case 7	4:05.92	3:45.55	4:10.00
Case 8	3:51.46	3:18.93	2:59.00
Case 9	3:29.64	4:26.00	3:06.00
Case 10	3:54.22	4:49.90	5:02.00
Case 11	4:35.74	3:40.14	3:31.00
Case 12	4:42.26	3:59.77	5:56.00
Case 13	3:51.73	4:11.16	3:40.00
Case 14	6:10.36	6:41.48	6:30.00
Case 15	4:12.00	4:27.53	4:03.00
Case 16	4:05.00	4:28.83	4:58.00
Case 17	NA	NA	NA
Case 18	3:59.41	4:01.29	4:16.00
Case 19	4:41.17	NA	3:48.00
Case 20	4:44.68	7:17.85	4:29.00
Case 21	3:49.52	NA	3:45.00
Case 22	4:22.15	5:25.96	4:56.00
Case 23	5:00.00	4:53.37	5:06.00
Case 24	3:37.00	NA	3:06.00
Case 25	3:41.89	3:47.00	3:17.00
Mean	**4:15.97**	**4:28.05**	**4:09.04**

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