THE HEALTH-RELATED CHARACTERISTICS OF CAREER FIREFIGHTERS PARTICIPATING IN A SIX YEAR WELLNESS SCREENING

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CHAPTER ONE

INTRODUCTION

Historically firefighters have been viewed with a certain amount of awe and glamour as larger than life heroes: America's bravest - powerful of mind, body and spirit. Firefighters today are the people who are ready, at a moments notice, to spring into action and put themselves on the line for the hope of saving the ones around them. The willingness to place themselves in harm's way in order to protect the lives and property of others, the shear spectacle of their oversized protective gear and the screaming sirens and huge red trucks required to fight fires perpetuates the perception that firefighters are larger than life. The events of September 11, 2001 have stirred new interest and intensified the vision of American firefighters as the champions of valiant and courageous deeds. On that fateful date, firefighters rushed into the collapsing structures and navigated through smoke and debris to rescue the frightened and grateful survivors. They rummaged through the wreckage of the Twin Towers for days on end hoping against all odds to find a glimpse of promise. Firefighters' jobs are gruesome, strenuous and extremely dangerous. The physical challenges of firefighting require continuous training and a level of fitness that allows them to exert their bodies and minds to the maximum limits of their capacity every day.

Fighting fires is a demanding and challenging occupation. The demands of firefighting requires that firefighters remain physically fit throughout their career due to

the physical demands of their career may remain high no matter what the firefighter's age (Lusa, Louhevarra, & Kinnunen, 1994). Which is why it is so important that firefighters need to sustain high fitness levels throughout their entire career, regardless of the firefighters age.

Throughout the United Sates, the general population's physical fitness levels decline with age, partly due to lifestyle choices. Not only do the physical fitness levels decline the general population they have also been observed in firefighters as well (Suape, Sothmann, & Jasenof, 1991). Along with physical fitness levels declining with age in the general population and firefighters, the incidence of cardiac risk factors increases with age as well (Swank, Adams, Barnard, Ottersbach & Bowerman, 2000). And because of the increased occupational stressors and responsibilities a career in firefighting demands, the reduction of preventable coronary risk factors is desirable and encouraged (Davis, Jankovitz & Rein, 2002). The purpose of this study was to determine and describe the health-related characteristics of selected firefighters in the Stillwater Fire Department over a six-year span and determine if there were any changes in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times and BMI's over the span of the study from 1997 – 2002.

STATEMENT OF PROBLEM

The problem of this study was two fold:

1.) Descriptive

- To describe and analyze the health-related characteristics of firefighters in the Stillwater Fire Department over a six year period.

2.) Comparative

- To compare the health-related characteristics of Stillwater firefighters who participated in a six year wellness screening spanning from 1997 to 2002.

PURPOSE OF THE STUDY

The purpose of this study was to determine and describe the health-related characteristics of selected firefighters in the Stillwater Fire Department over a six-year span and determine if there were any changes in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times and BMI's over the span of the study.

HYPOTHESIS

The following null hypotheses was examined:

Ho1

There will be no difference in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times or BMI's when comparing the years of 1997, 1999, and 2002.

DELIMITATIONS OF THE STUDY

This study had the following delimitations:

1. The subjects used in this study were career firefighters from the Stillwater Fire Department, who participated in the wellness program at the Seretean Wellness Center.
2. The only subjects used in this study were males.
3. Only data from the firefighters who evidenced data in 1997, 1999, and 2002 was used in this study.
4. For this study, the firefighters' information was collected at the Seretean Wellness Center.

LIMITATIONS OF THE STUDY

The research was limited by the following:

1. The subjects in this study were not randomly selected.
2. Some of the firefighters who participated in this study could not do all the exercise activities (push-ups and/or curl-ups) due to personal problems (shoulder injuries and lower back pains).
3. There were different testers and equipment used every year at the Wellness Center which could have caused a variance in the consistency of the readings.

ASSUMPTIONS

The following assumptions were made:

1. The subjects would put forth their best effort throughout all the exercises and activities.

2. The subjects would give honest answers to questions about themselves.

DEFINITIONS

Aerobic exercise – Rhythmic physical work using a steady supply of oxygen delivered to working muscles for a continuous period of not less than twenty minutes (Managing Stress: Principles and Strategies for Health and Wellbeing, pp. 466).

Aerobic fitness – Also known as cardiorespiratory fitness. It is related to the ability to perform large muscle, dynamic, moderate-to-high intensity exercise for prolonged periods (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 68).

Anaerobic exercise – Physical work done in the absence of oxygen; activity that is powerful and quick but does not last more than a few minutes (Managing Stress: Principles and Strategies for Health and Wellbeing, pp. 466).

Blood pressure – pressure exerted by blood: the pressure exerted by the blood against the walls of blood vessels. Blood pressure depends on the strength of the heartbeat, thickness and volume of the blood, the elasticity of the artery walls, and the healthiness of the individual. Ex) Blood pressure = Cardiac output X Total peripheral resistance (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 269).

BMI (Body Mass Index) – also known as Quetelet index, is used to assess weight relative to height and is calculated by dividing body weight in kilograms by height in meters

squared (kg/m^2) (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 63).

Career Firefighter – A person who puts out fires**:** someone who helps to control and extinguish fires and rescue people trapped by fire or in other dangerous situations as a chosen pursuit; a profession or occupation (www.dictionary.com).

Cardiovascular performance – the ability to perform large muscle, dynamic, moderate-to-high intensity exercise for a prolonged period of time (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 68).

Cardiomegaly – an enlargement of the heart. Also called macrocardia and megalocardia (www.dictionary.com).

Cholesterol (total) – a combination of the various cholesterol fractions in the bloodstream. This is the cholesterol measurement that is given by the standard home cholesterol test kit. Less than 200 is desirable, 200 to 239 is considered borderline high, and over 240 is considered high (www.webmd.com).

Coronary risk factor – Some risk factors for coronary artery disease (CAD), such as sex, age, and family history, cannot be changed. Other risk factors for CAD that are related to lifestyle often can be changed. The chance of developing coronary artery disease increases with the number of risk factors one has (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 650 – 655).

Diastolic blood pressure – expansion of heart on each beat: the rhythmic expansion of the chambers of the heart at each heartbeat, during which they fill with blood. Diastolic blood pressure provides an indication of peripheral resistance or the ease with which blood flows from the arterioles into the capillaries (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 269 - 270).

Exercise stress test – also called a stress test, exercise electrocardiogram, treadmill test, graded exercise test or stress ECG, is a test used to describe the systematic use of exercise for two main purposes: (a) for ECG observations and (b) to evaluate the physiological adjustment to metabolic demands that exceed the resting requirements (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 656).

False positive – a test where a disorder is not present, but the test indicates that it is present (Developmental Psychology: The developing person through the life span, pp. 91).

Firefighter – a person who puts out fires**:** someone who helps to control and extinguish fires and rescue people trapped by fire or in other dangerous situations (www.dictionary.com).

Heart attack – also known as a myocardial infarction. It can be mild, and a more complete blockage can cause severe damage to the myocardium and could result in (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 280).

Heart rate - the number of heartbeats that occur within a specified length of time, (approximately 1 minute) (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 297).

Health physical – annual medical check-up, includes measures on blood pressure, body fat percentage, electrocardiograms, height, weight, blood cholesterol, etc. (www.webmd.com).

Physical activity – bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 4).

Physical fitness – a set of attributes that people have or achieve that relates to the ability to perform physical activity (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 4).

Systolic blood pressure – the contraction phase of the heart-pumping cycle of contraction and relaxation. Provides an estimate of the work of the heart and of the strain against the arterial walls during ventricular contraction (Exercise Physiology: Energy, Nutrition, and Human Performance, pp. 269).

Total time – the total amount of time spent on the treadmill during test: from start to finish.

Treadmill – exercise machine: a machine with an endless belt on which one can walk, jog, or run, used for exercise and stress testing (www.webmd.com).

VO2 – The rate at which oxygen is used by a tissue; microliters of oxygen stpd used per milligram of tissue per hour; the rate at which oxygen enters the blood from alveolar gas, equal in the steady state to the consumption of oxygen by tissue metabolism throughout the body (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 68 - 69).

VO2 max – also known as maximal oxygen uptake, is the criterion measure of cardiorespiratory fitness: the product of the maximal cardiac output and arterial-venous oxygen difference (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 68 - 69).

Wellness – The integration, balance, and harmony of mental, physical, emotional, and spiritual wellbeing through taking responsibility for one's own health; posits that the hole is greater than the sum of the parts (Managing Stress: Principles and Strategies for Health and Wellbeing, pp. 469).

CHAPTER TWO

REVIEW OF THE LITERATURE

INTRODUCTION

Numerous studies have been done on firefighters. This is due to the broad fascination with firefighter's long reputation of bravery, excellent physical fitness, firefighting and rescue operations experience, and likelihood of success with professional training. Many studies indicate that because the physical demands of firefighting are so high regardless of the firefighter's age, it is important that high levels of fitness be sustained throughout their careers (Lusa, Louhevaara, & Kinnunen 1994).

FATALITIES IN THE LINE OF DUTY

Of the approximately 100 firefighters a year who die in the line-of-duty (Leblanc and Fahy 2004), one of the main contributors to the deaths is heart attacks. Approximately 44% of all firefighter line-of-duty deaths (LODDS) are heart attacks (TriData Corporation 2002). Firefighters between the ages of 41 to 45 have a 50% chance of having a heart attack in the line of duty because of their impaired physical and cardiorespiratory fitness levels and because of the high physical demands of their jobs. When the National Fire Protection Association (NFPA) began studying the annual firefighter fatalities in 1977, the number of line-of-duty deaths due to cardiac complications was about 60 deaths a year and has decreased to around 40 to 50 since the 1990's (Fahy 2004).

According to the USFA, a fire department responds to a fire in America every 18 seconds, with an average of 95 firefighters dying every year (TriData Corporation 2002), due to heart complications, strokes and aneurysms (Fahy 2004). In 2002 the United States Fire Association (USFA) conducted a study on the statistics of firefighters and the various reasons for their deaths in the line-of-duty. Aside from heart attacks, the USFA found that firefighters today are dying from trauma (including internal and head injuries) accounting for about 27% of all line-of-duty deaths, and asphyxia and burns, which accounted for about 20% of the firefighters fatalities in 2003. Each year more firefighters die from trauma than from asphyxiation and burns combined (TriData Corporation 2002).

AGE AND FATALITIES

Firefighters need to be at the peak of their physical and mental abilities at all times because with the demands of a career in firefighting. The job does not get easier with age. From 1995 to 2004, the NFPA conducted a study on the types of firefighter death by age and found that of the 440 victims studied, three of the four victims under the age of 25 were reported to have existing heart problems, including one with cardiomegaly and another who had a heart value replacement (Fahy 2004). Firefighters under the age of 35 are more than likely to die from traumatic injuries than from heart attacks and strokes. On the other hand after the age of 35, deaths from traumatic injuries decrease, and the proportion of deaths due to medical causes, (heart attacks and strokes), rises steadily (TriData Corporation 2002). In 2004, the NFPA found that 60% of firefighters over the age of 40 who died in 2004, died due to heart attacks and other cardiac events (Leblanc and Fahy 2004). In 1992, L'Abbe and Tomlinson found that age plays a distinct role in the number of firefighters fatalities that occur each year. L'Abbe and Tomlinson found

that of all the firefighters 1992, only 46% of them were over the age of 40, but of that 46% they accounted for 60% of the fatalities. Even more interesting is that of all the firefighters today who choose the career, only 16% of them are over the age of 50 years old, yet they account for more than 30% of the fatalities that occur each year. Similarly, in 2004 the NFPA found that firefighters in their 30's have the lowest death rates, while firefighters over the age of 50, account for half of all the fatalities that occur each year (Leblanc and Fahy 2004).

CARDIORESPITORY DEMANDS OF FIREFIGHTING

Firefighting is a physically demanding occupation. Sothmann, Saupe, Jasenof, and Blaney (1992) found that during firefighting emergencies, firefighter heart rates were sustained at 88 +/- 6% of their maximum, which was estimated to be the equivalent to 63 +/- 14% of their VO2 maximum. Lusa, Louhevaara, Kivimaki, and Korhonen (1993) found that relative aerobic capacity varies from 41-101% of VO2 maximums and relative mean heart rates vary between 66 and 90% of their maximum during simulated rescues. Also O'Connell, Thomas, Cady, and Karwasky (1986) found that stair climbing at 60 steps per minute, in uniform while carrying firefighting equipment, required heart rates of 84-100% of maximum and a minimum VO2 of 63-97% of a firefighter's maximum.

CAREER VERSUS NON-CAREER FIREFIGHTERS

Statistics show that firefighting as a career is slightly more risky for career firefighters than non-career firefighting. Career firefighters only make up about 26 percent of America's fire service, yet career firefighters account for 33 percent of all the firefighting fatalities each year (TriData Corporation 2002). From 1977 to 2004 research by the NFPA on the fatalities among career versus volunteer firefighters has shown that

more fatalities occur among volunteer firefighters when compared with career firefighters. In 1993 fatalities among career firefighter was at an all time low of about 20, but in spite of a rise in deaths from 1993 to 1999, there has been a general downward trend since 1985. On the other hand, the data for volunteer firefighter fatalities has fluctuated since 1997 and has been higher than that of career firefighters. On average 60 volunteer firefighter deaths and 30 career firefighter deaths occur each year (TriData Corporation 2002). Firefighting is a dangerous profession and the USFA acknowledges that some of the forces and circumstances that cause the deaths of today's firefighters are out of human control. They also feel that through research, study, training, improved operations, development of new technologies, the appropriate use of staffing and other factors, that it is possible to significantly cut the number of firefighters that are killed each year (TriData Corporation 2002).

Since firefighting is a demanding job and because of the additional occupational stressors and responsibilities inherent in firefighting, the reduction of preventable coronary risk factors is desirable (Davis, Biersner, Barnard, & Schamadan 1982). Many fire departments like the Stillwater Fire Department have their firefighters undergo wellness evaluations and physicals every other year not only to know their overall fitness levels, but also for the safety of the firefighter, coworkers, and the community as well.

FIREFIGHTERS AND STRENGH

Today's firefighters maintain their physical fitness on duty due to the high physical levels that the job requires. Outside of their careers exercising and maintaining their fitness levels is relatively, completely up to them. There are programs such as the Fire Fighter Physical Fitness Maintenance Program (FFPFMP), the Search and Rescue

Technicians Physical Fitness Maintenance Program (SARTech MPFP) and the Land Force Command Physical Fitness Standards (LFCPFS), that are in place and offered to the fire departments in the United States and Canada, but these programs seem to be just job related.

In Fire Departments throughout the United States, they may have a gym or workout equipment in them, but the firefighter is not required to use the equipment and outside of a firefighters shift exercising seems to be at their own discretion. Research on firefighters and physical fitness is relatively nonexistent. The only things that are relatively available are exercise routines (Workout with Mike Stefano), designed to motivate the general population and motivate firefighters to exercise and increase their physical fitness levels. On the other hand, a lot of these programs are people without college degrees trying to make money on the internet packaging the programs as firefighting programs. Needless to say there is not enough data on firefighters and physical fitness comparisons to state what they are participating in to improve their physical fitness levels outside of their shifts.

SUMMARY

Professional firefighters are generally selected on the basis of excellent physical fitness, firefighting experience, and likelihood of success with professional training (Davis, Jankovitz, & Rein 2002). Yet there is considerable controversy on whether or not as a department they need to have minimal physical fitness standards and whether these requirements should vary for applicants and firefighters of different ages (Kenney & Landy 1998). It is important for firefighters to have an adequate physical fitness level, to meet and exceed the physical requirements of their occupation with an acceptable margin

of safety (Davis, Jankovitz, & Rein 2002). Not only because firefighters today are looked at as heroes, but they are the ones whose job it is to save and protect the ones around them while protecting themselves and each other.

CHAPTER THREE

METHODS AND PROCEDURES

INTRODUCTION

The purpose of this study was to examine the health related characteristics of career firefighters. The data for this study were obtained from the annual fitness evaluation data of firefighters at the Stillwater Fire Department collected at the Seretean Wellness Center at Oklahoma State University during the years of 1997-2003.

Every year the Stillwater Fire Department firefighters undergo fitness evaluations at the Seretean Wellness Center. The firefighters are given annual fitness evaluations at the Wellness Center by the center's nurses, graduate assistants and on site doctor. During the fitness evaluations the firefighters are given a maximal stress test on a treadmill using a 12 lead electrocardiogram, blood pressure readings (before, during and after treadmill stress test), pulse readings (before, during and after treadmill stress test), total blood cholesterol readings, and body fat percentage readings. All tests and protocols are given using the American College of Sports Medicine guidelines.

All the data for this study were compiled from 20 firefighters from Seretean Wellness Center over a six year period and delivered without any names, that is, coded by subject numbers. The study was approved by the Institutional Review Board (IRB) at Oklahoma State University before data was collected.

SUBJECTS

The subjects in this study were all males who were at between the ages of 21 to 49 years and were career firefighters for the Stillwater Fire Department. To qualify for this study, each subject had to participate in the annual screenings for the Stillwater Fire Department at the Seretean Wellness Center at least three times from 1997 - 2003. For this study, there were a total of 20 subjects who participated. The data for this study was conducted at the Seretean Wellness Center over a six year span, with each fitness screening session lasting approximately one – three hours for each participant, depending on how many tests they could participate in because of personal injuries, such as shoulder, knee and lower back pains.

TESTING PROTOCOLS

For this study all the tests and protocols performed by the Stillwater Firefighters were administered by the graduate assistants, nurses, and the on site doctor of the Seretean Wellness Center, using the American College of Sports Medicine guidelines (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition). When the participants reported to the Seretean Wellness Center, they came in groups of 10 – 15 at a time for a week on Monday, Wednesday or Friday, when their time or shift permitted, and they signed in at the front desk. After signing in and filling out their paperwork, each participant proceeded into the testing laboratory one by one to have their height, weight and BMI (kg/m^2) recorded, then their body fat percentage and cholesterol levels were taken and calculated along with their resting blood pressures and heart rates. Subsequently each participant was then prepped and instructed on the treadmill test

instructions. After being instructed on the test, the participants then began and completed the test to the best of their abilities.

BODY FAT PERCENTAGE CALCULATION

The body fat percentage, also known as a skinfold measurement (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 63-65), readings for the firefighters were administered by the graduate assistants and nurses of the Seretean Wellness Center. Each firefighter was given a 7 site skinfold test, using a skinfold caliper. For this test the measurements were taken at the abdomen, tricep, chest/pectoral, midaxillary, subscapular, suprailiac, and thigh areas on the right side of the body. For each measurement, the assistant placed the caliper approximately 1 cm away from the thumb and finger, perpendicular to the skinfold, and halfway between the crest and the base of the fold.

TREADMILL PROTOCOL

During the treadmill testing section of the fitness evaluations, the firefighters were given a maximal stress test, known as the Bruce Protocol (ACSM's Guidelines for Exercise Testing and Prescription, 6th Edition, pp. 97), on a treadmill using a 12 lead electrocardiogram. For the Bruce Protocol the participants start the test at 1.7 mph at a zero percent grade for three minutes. After three minutes the grade on the treadmill moves up to five percent for three minutes and then to 10% for three more minutes. After that the speed of the treadmill goes to 2.5 mph and the grade to 12% for three minutes, then to 3.4 mph at a 14% grade for three minutes, then to a speed of 4.2 at a grade of 16% for three minutes, then a speed of 5.0 mph at 18% grade, and finally to a speed of 5.5 mph at a grade of 20% for three minutes. Before each test is administered participants

have their blood pressure and pulse/heart rate measured and recorded, by one of the nurses administering the test. Measurements were taken and recorded during each three minute stage on the treadmill, immediately after the test, and after a three to five minute rest period after the test has been terminated. During each three minute stage of this test, the participants were asked to rate their perceived exertion (RPE) from a scale of six to twenty, six being like a slow stroll on the beach and twenty being the hardest thing they have ever done in their lives.

While the firefighters were rating their perceived exertion they were also asked if they had any degree of chest pain, burning, discomfort, dizziness, or leg discomfort and/or pain. This test was terminated by the firefighter if they wished not to proceed or if the doctor administering the test felt it in the best interest of the firefighter's health.

CHAPTER FOUR

RESULTS AND DISCUSSION

INTRODUCTION AND DESCRIPTIVE DATA

This chapter reports on the data analysis of the study and then discusses the results in relationship to the stated hypotheses. The intended purpose of this study was to describe the health-related characteristics of selected firefighters in the Stillwater Fire Department over a six-year span and determine if there were any changes in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times and BMI's over the span of the. This study focuses on the health related characteristics of the firefighters who make up the Stillwater Fire Department. This study observes their physical make-up (weight and height), demographics (age), and overall fitness level (strength, endurance, body fat percentage, etc.) over the past six years.

DESCRIPTIVE STATISTICAL ANALYSIS

This section contains the tables and related charts for analysis for the Stillwater firefighters who participated in this study. All analyses were performed on SPSS 11.0 and a .05 level of significance for all statistical tests. Using a oneway repeated measures ANOVA, the Stillwater firefighter's weight, percent body fat, cholesterol, resting systolic blood pressure, resting diastolic blood pressure, resting heart rate, maximum systolic

blood pressure, maximum diastolic blood pressure, total treadmill/step test time, and BMI were examined. If a significant F value was obtained, mean comparison tests were used to explore the results.

INFERENTIAL STATISTICAL ANALYSIS

This section contains the tables for analysis for the Stillwater Firefighters who participated in this study. Tables I – XI below are the analysis of each data point observed and correlated with the Stillwater firefighters who participated in this study from 1997, 1999 and 2002.

TABLE I

Weight

Descriptive statistics for weight (lbs.)

Year	Mean	Standard Deviation
1997	182.0[a]	19.08
1999	186.1	19.24
2002	191.2[a]	21.97

* Means with like superscripts are significantly different.

Repeated measures ANOVA for weight (lbs.)

Source	SS	df	MS	F
Time	850.43	2	425.22	6.46*
Error	2502.23	38	65.85	

* Statistically significant at the .05 level.

Chart I illustrates that the mean weight of the Stillwater Firefighters who participated in this study, increased from 1997 to 1999, as well as from 1999 to 2002. From this data on the weight of the Stillwater Firefighters, it can be concluded that the null hypothesis for this study was rejected. There was a difference in the firefighter's weight when comparing the years of 1997, 1999 and 2002. From this data it can be

concluded that as a whole, the firefighters who participated in this study have gained weight from 1997 – 2002.

TABLE II

Percent Body Fat

Descriptive statistics for percent body fat.

Year	Mean	Standard Deviation
1997	14.4[a,b]	5.05
1999	16.7[a]	5.65
2002	16.6[b]	4.51

* Means with like superscripts are significantly different.

Repeated measures ANOVA for percent body fat.

Source	SS	df	MS	F
Time	69.07	2	34.54	6.32*
Error	207.65	38	5.46	

* Statistically significant at the .05 level.

Chart II illustrates that the mean percent body fat of the Stillwater Firefighters who participated in this study, increased from 1997 to 1999, but slightly decreased from 1999 to 2002. From this data on the percent body fat of the Stillwater Firefighters, it can be concluded that the null hypothesis for this study was rejected. There was a difference in the firefighter's percent body fat when comparing the years of 1997, 1999 and 2002. From this data it can be concluded that the mean percent body fat of the Stillwater Fire Department has increased from 1997 – 2002.

TABLE III

Cholesterol

Descriptive statistics for cholesterol (mg/dL)

Year	Mean	Standard Deviation
1997	190.8	35.13
1999	190.4	37.06
2002	183.8	31.85

Repeated measures ANOVA for cholesterol (mg/dL)

Source	SS	df	MS	F
Time	622.30	2	311.15	0.81
Error	14629.70	38	384.99	

* Statistically significant at the .05 level.

Chart III illustrates that the mean cholesterol levels of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the cholesterol levels of the Stillwater Firefighters, it can be concluded that the null hypothesis for this study was accepted. There were no differences in the firefighter's cholesterol levels when comparing the years of 1997, 1999 and 2002. It can be concluded that the department is maintaining a healthy lifestyle state of cholesterol levels. This can be concluded because a cholesterol level less than 200 (mg/dL) is desirable, 200 to 239 is considered borderline high, and over 240 is considered high, and the mean cholesterol levels of the Stillwater Firefighters are all below 200 mg/dL.

TABLE IV

Resting Systolic Blood Pressure

Descriptive statistics for resting systolic blood pressure (mmHg).

Year	Mean	Standard Deviation
1997	128.6	14.30
1999	129.3	13.83
2002	128.3	13.86

Repeated measures ANOVA for resting systolic blood pressure (mmHg).

Source	SS	df	MS	F
Time	10.53	2	5.27	0.05
Error	4042.13	38	106.37	

Chart IV illustrates that the overall mean resting systolic blood pressure of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the resting systolic blood pressure of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was accepted. There was no difference in the firefighter's resting systolic blood pressure when comparing the years of 1997, 1999 and 2002. From this data it can be concluded that the Stillwater Fire Department has maintained a consistent resting systolic blood pressure from 1997 – 2002.

TABLE V

Resting Diastolic Blood Pressure

Descriptive statistics for resting diastolic blood pressure (mmHg)

Year	Mean	Standard Deviation
1997	77.0	8.45
1999	75.1	9.19
2002	79.0	6.76

Repeated measures ANOVA for resting diastolic blood pressure (mmHg)

Source	SS	df	MS	F
Time	152.10	2	76.05	1.40
Error	2063.90	38	54.31	

Chart V illustrates that the overall mean resting diastolic blood pressure of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the resting systolic blood of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was accepted. Even though there was a slight difference in the firefighter's resting diastolic blood pressure when comparing the years of 1997, 1999 and 2002 it was not significant enough to conclude that there was a change in the data. From this data it can be concluded that the Stillwater Fire Department has maintained their overall resting diastolic blood pressure from 1997 – 2002.

TABLE VI

Resting Heart Rate

Descriptive statistics for resting heart rate (b/min)

Year	Mean	Standard Deviation
1997	70.0[a]	8.77
1999	67.2[b]	9.88
2002	75.4[a,b]	11.51

* Means with like superscripts are significantly different.

Repeated measures ANOVA for resting heart rate (b/min)

Source	SS	df	MS	F
Time	685.90	2	342.95	5.02*
Error	2594.10	38	68.27	

* Statistically significant at the .05 level.

Chart VI illustrates that the overall mean resting heart rate of the Stillwater Firefighters who participated in this study, decreased from 1997 to 1999, but increased from 1999 to 2002. From this data on the resting heart rate of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was rejected. There was a difference in the firefighter's resting heart rate when comparing the years of 1997, 1999 and 2002. From this data it can be concluded that the overall resting heart rates of the Stillwater Fire Department has increased from 1997 – 2002.

TABLE VII

Maximum Heart Rate

Descriptive statistics for maximum heart rate (b/min)

Year	Mean	Standard Deviation
1997	185.2	6.90
1999	184.2	10.28
2002	184.0	12.08

Repeated measures ANOVA for maximum heart rate (b/min)

Source	SS	df	MS	F
Time	18.53	2	9.27	0.24
Error	1440.80	38	37.92	

Chart VII illustrates that the overall mean maximum heart rate of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the maximum heart rate of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was accepted. Even though there was a very slight difference in the firefighter's resting diastolic blood pressure when comparing the years of 1997, 1999 and 2002, it was not significant enough to conclude that there was a significant change when comparing the data. From this data it can be

concluded that the Stillwater Fire Department has maintained a consistent overall maximum heart rate when comparing the data from 1997 - 2002.

TABLE VIII

Maximum Systolic Blood Pressure

Descriptive statistics for maximum systolic blood pressure (mmHg)

Year	Mean	Standard Deviation
1997	188.4	18.86
1999	192.4	25.02
2002	191.6	16.44

Repeated measures ANOVA for maximum systolic blood pressure (mmHg)

Source	SS	df	MS	F
Time	184.03	2	92.02	0.34
Error	10325.97	38	271.74	

Chart VIII illustrates that the overall mean maximum systolic blood pressure of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the maximum systolic blood pressure of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was accepted. Even though there was a very slight difference in the firefighter's maximum systolic blood pressure when comparing the years of 1997, 1999 and 2002, it was not significant enough to conclude that there was a significant change when comparing the data. From this data it can be concluded that the Stillwater Fire Department has maintained a consistent overall maximum systolic blood pressure level when comparing data from 1997 – 2002.

TABLE IX

Maximum Diastolic Blood Pressure

Descriptive statistics for maximum diastolic blood pressure (mmHg)

Year	Mean	Standard Deviation
1997	78.1	11.66
1999	78.8	9.18
2002	78.6	9.51

Repeated measures ANOVA for maximum diastolic blood pressure (mmHg)

Source	SS	df	MS	F
Time	4.63	2	2.32	0.03
Error	3220.70	38	84.76	

Chart IX illustrates that the overall mean maximum diastolic blood pressure of the Stillwater Firefighters who participated in this study did not change during the six year period under investigation. From this data on the maximum diastolic blood pressure of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was accepted. Even though there was a very slight difference in the firefighter's maximum diastolic blood pressure when comparing the years of 1997, 1999 and 2002, it was not significant enough to conclude that there was any significant change when comparing the data. From this data it can be concluded that the Stillwater Fire Department has maintained a consistent overall maximum systolic blood pressure level when comparing the data from 1997 – 2002.

TABLE X

Treadmill Times

Descriptive statistics for time on treadmill test (min)

Year	Mean	Standard Deviation
1997	11.8[a]	1.34
1999	12.6[a]	1.38
2002	12.21	1.18

* Means with like superscripts are significantly different.

Repeated measures ANOVA for time on treadmill test (min)

Source	SS	df	MS	F
Time	6.67	2	3.34	4.52*
Error	28.08	38	0.74	

* Statistically significant at the .05 level.

Chart X illustrates that the overall mean treadmill test times of the Stillwater Firefighters who participated in this study, increased from 1997 to 1999, and decreased when comparing the data of 1999 to 2002. From this data on the treadmill test times of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was rejected. There was a difference in the firefighter's treadmill test times when comparing the years of 1997, 1999 and 2002. From this data it can be concluded that the Stillwater Fire Department has improved it's overall cardiovascular endurance and strength by increasing the mean treadmill test times of the firefighters' when comparing the data from 1997 – 2002.

TABLE XI

Body Mass Index (BMI)

Descriptive statistics for body mass index

Year	Mean	Standard Deviation
1997	25.1[a]	3.15
1999	25.7	3.13
2002	26.3[a]	3.20

* Means with like superscripts are significantly different.

Repeated measures ANOVA body mass index

Source	SS	df	MS	F
Time	15.20	2	7.60	6.49*
Error	44.48	38	1.17	

* Statistically significant at the .05 level

Chart XI illustrates that the overall mean body mass indexes of the Stillwater Firefighters who participated in this study, relatively stayed the same when comparing the data from 1997 to 1999, but slightly increased when comparing the data of 1999 to 2002. From this data on the body mass indexes of the Stillwater Firefighters it can be concluded that the null hypothesis for this study was rejected. There was a difference in the firefighter's body mass indexes when comparing the years of 1997, 1999 and 2002. From this data it can be concluded that the Stillwater Fire Department has increased it's overall body mass index when comparing the data from 1997 – 2002.

DISCUSSION

The Stillwater Firefighters who participated in this study, have increased in weight and body fat, and their resting heart rates, treadmill times and BMI when comparing their data from 1997, 1999 and 2002. On the other hand, as a whole, the

firefighters have maintained consistent cholesterol levels, resting systolic and diastolic blood pressures, and maximum systolic and diastolic blood pressures, when comparing the same data over the same time period.

During the duration of this study, the firefighters who participated in this study gained an average of 9 pounds from 1997 - 2002. This could be due to the fact that they have gained more lean muscle mass, but this is disproved by the fact that their overall body fat percentage and BMI increased over the study as well. This could be explained by the fact that the firefighters who participated in this study were not engaging in activities such as resistance training, other than that brought upon by their career as a firefighter and its everyday duties. Yet as a whole there total treadmill times had a significant increase from 11.8 minutes in 1997 to 12.21 minutes in 2002. This is significant because it could be explained by the firefighters who participated in this study are engaging in cardiovascular strengthening activities, such as running, jogging or walking outside of their careers or by just becoming more adapt to stressful situation such as the maximal treadmill stress test, brought about by their careers in firefighting.

On the other hand, the firefighter's overall mean cholesterol levels, resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates all relatively stayed the same when comparing the data of 1997, 1999 and 2002. Overall, from this data it can be derived that the department is maintaining the overall necessary health related characteristics necessary for a career in firefighting. Of the Firefighters who participated in this study, their total cholesterol level was lower than 200 (mg/dL), which means that the firefighters who participated in this study are watching what they eat and consume inside and outside of their shifts and careers as

firefighters. On the other hand the firefighters in this study do not seem to be practicing in cardiovascular activities outside of work because of the fact that the data presented shows a consistent level of resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates all remain constant when comparing the data of 1997, 1999 and 2002.

The tables in this section disprove the original null hypothesis that no changes occurred in firefighters weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times and BMI's during the duration of this study. This observation is further reinforced in the Graphic Statistical Analysis Section that is provided in this section as well.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATINONS

SUMMARY OF FINDINGS

During this study the firefighters of the Stillwater Fire Department underwent fitness evaluations at the Seretean Wellness Center over a six year span from 1997-2002. The purpose of this study was to look at the health-related characteristics of 20 selected firefighters in the Stillwater Fire Department from 1997, 1999 and 2002, and determine if there were any changes in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times and BMI's over the span of the study. During the period of 1997-2002, the firefighters were given annual fitness evaluations at the Wellness Center by the center's nurses and on site doctor. During the fitness evaluations the firefighters height and weight were recorded along with their BMI (kg/m^2), they were given a maximal stress test on a treadmill using a 12-lead electrocardiogram, blood pressure readings (before, during and after treadmill stress test), pulse readings (before, during and after treadmill stress test), total blood cholesterol readings, and body fat percentage readings. All tests and protocols were given using the American College of Sports Medicine guidelines.

FINDINGS

It was hypothesized that there would be no difference in the firefighter's weight, body fat percentages, cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, maximal systolic and diastolic blood pressures, treadmill times or BMI's when comparing the years of 1997, 1999, and 2002. These hypotheses were rejected due to the fact that there were differences in the firefighter's health-related characteristics when comparing the years of 1997-1999 and 2002.

During the duration of this study, the firefighters who participated in this study gained an average of 9 pounds from 1997 - 2002. The Department has also increased their total BMI's over a percent from 1997 – 2002, respectfully. On the other hand even though the Stillwater Firefighters who participated in this study were heavier and did have a higher BMI than when they started in 1997, they had steadily increased their total treadmill times from 11.8 minutes in 1997 to 12.21 minutes in 2002.

On the other hand, the firefighter's overall mean cholesterol levels, resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates all stayed relatively the same when comparing the data of 1997, 1999 and 2002. Overall, from this data it can be derived that the department is maintaining the overall necessary health related characteristics necessary for a career in firefighting. Of the Firefighters who participated in this study, their total cholesterol levels were lower than 200 (mg/dL), which means that the firefighters who participated in this study were watching what they ate and consumed inside and outside of their shifts and careers as firefighters. On the other hand the firefighters in this study did not seem to be participating in cardiovascular activities outside of work because of the fact that the data

presented shows a consistent level of resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates all remain constant when comparing the data of 1997, 1999 and 2002.

CONCLUSIONS

Overall the Stillwater Firefighters who participated in this study have not undergone substantial lifestyle changes throughout the duration of this study. The firefighters' BMI and weight increased which shows that they are heavier now than when they started the program in 1997. The negative aspect of this data is that they do not seem to be gaining lean muscle mass due to the fact that from 1997 – 2002 the Firefighter's percent body fat increased about 2 percent. Yet even though the firefighters have gained weight and body fat, they have managed to increase their cardiovascular health due to the fact that their total time on the treadmill significantly increased from 1997 - 2002.

On the other hand, the data shows that the firefighters are maintaining a consistent level of resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates. This indicates that they have not increased or decreased their cardiovascular health, besides the fact that they have increased their total time on the treadmill, when comparing the years of 1997, 1999 to 2002.

The data presented in this study also indicated that the Stillwater Firefighter who participated in this study have maintained relatively consistent cholesterol levels, resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates when comparing the data of 1997, 1999 and 2002.

From this data it can be derived that the department is maintaining a consistent level of health related characteristics necessary for a career in firefighting. As a whole

their cholesterol levels are in the recommended range of less than 200 mg/dL, which shows that they are watching what they eat on a daily basis.

On the other hand the firefighters in this study do not seem to be participating in cardiovascular activities outside of work because of the fact that the data presented shows a consistent level of resting systolic and diastolic blood pressures, maximal systolic and diastolic blood pressures and maximal heart rates all remain constant when comparing the data of 1997, 1999 and 2002. The firefighters may be at risk of not participating in activities such as running and resistance training outside of work, which could increase the overall health that a career in firefighting demands.

RECOMMENDATIONS FOR FURTHER STUDY

This particular study showed that the Stillwater firefighters who participated in this study over the six year period, had some lifestyle changes, whether for their own good or worse. The research that has been done on firefighters in the past seems to be focused on the fitness aspects and line of duty death statistics associated with a career in firefighting. That type of research focus may need to be altered for us to save the lives of the ones who are saving ours. Listed below are some recommendations and ideas for future research on firefighters:

1. A study of the career firefighters mental health as well as their physical health.
2. A study needs to be conducted on a two groups of firefighters over time to determine if diet and exercise are a factor in their health related characteristics: a control group of firefighters who must go through a daily workout and diet regimen, the another group doing nothing different in their lives.

3. A similar study that tests firefighters, similar to this particular study, but in a different part of the United States. For example, New York or Los Angeles, somewhere where the demands on their career and a big city are very stressful.
4. A longitudinal study on veteran firefighters and new firefighters to determine the physical, mental and intelligence demands of their careers.

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Oklahoma State University Institutional Review Board

Date:	Friday, October 08, 2004
IRB Application No	EDO528
Proposal Title:	Health Related Characteristics of Career Firefighters
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 10/7/2005

Principal Investigator(s

Thomas Navin	Steven Edwards
432 Willard Hall	432 Willard Hall
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent ,with the IRB requirements as outlined in section 45 CFR 46.

- The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.

2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.

3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and

4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact me in 415 Whitehurst (phone: 405-744-1676, colson@okstate.edu).

Sincerely.

Carol Olson, Chair Institutional Review Board

VITA

Thomas Joseph Navin VII

Candidate for the Degree of

Master of Science

Thesis: The Health-related Characteristics of Career Firefighters Participating In A Six Year Wellness Screening

Major Field: Health and Human Performance

Biographical:

Personal Data: Born in Houston, Texas, On January 17, 1977, the son of Thomas and Cindy Navin.

Education: Graduated from Scarborough High School, Houston, Texas in June 1995; received Associate degree in Arts and Sciences from Eastfield Community College in May 1998 and a Bachelor of Science degree in Health Promotion, from Oklahoma State University, Stillwater, Oklahoma in December 2001, respectively. Completed the requirements for the Master of Science degree in Health and Human Performance with an emphasis in Applied Exercise Science at Oklahoma State University in December 2005.

Experience: Worked as an intern at The Wardenburg Student Health Center in Boulder, Colorado as a Student Wellness Coordinator in the Fall semester of 2000. Then for worked for the S.H.A.R.E. the Wealth Program and the Seretean Wellness at Oklahoma State University as a Peer Health Educator, weight room staff, personal trainer, and a graduate assistant from 2001 to 2003. Moved to Dallas, Texas and worked as a Health/Fitness Specialist and personal trainer for MediFIT Corporate Services in 2003 to 2004. Now work as a loan officer for Centex Home Equity.

Professional Membership: Lambda Chi Alpha Fraternity, Oklahoma State University, Stillwater, Oklahoma.

Name: Thomas Joseph Navin VII Date of Degree: December 2005

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: The Health-related Characteristics of Career Firefighters Participating In A Six Year Wellness Screening

Pages in Study: 40 Candidate for the Degree of Master of Science

Scope and Method of Study: The purpose of this study was to examine the health-related characteristics of selected firefighters in the Stillwater Fire Department over a six-year span and determine if the department and its firefighters were maintaining the appropriate fitness levels that a career in firefighting demands. This study used the annual fitness evaluation data of 20 firefighters at the Stillwater Fire Department collected at the Seretean Wellness Center at Oklahoma State University from 1997 - 2002. Every year at the Seretean Wellness Center, the firefighters have been given annual fitness evaluations by the Seretean Wellness Center's graduate assistants, and the on site nurses and doctor. During the fitness evaluations the firefighters who participated in this study were given a maximal stress test on a treadmill using a 12 lead electrocardiogram, blood pressure readings (before, during and after treadmill stress test), pulse readings (before, during and after treadmill stress test), total blood cholesterol readings, and body fat percentage readings. Since this study's purpose was to examine the health related characteristics of career firefighters, only data from the Stillwater Firefighters who had at least three data points (visits) during the entire six years of testing at the Seretean Wellness Center was used.

Finding and Conclusions: Overall there were differences observed in the Stillwater firefighters who participated in this study. The firefighter's BMI, weight, body fat percentage and total time on the treadmill test all increased when comparing the years of 1997, 1999, and 2002. On the other hand their cholesterol levels, resting systolic and diastolic blood pressures, resting and maximal heart rates, and maximal systolic and diastolic blood pressures all stayed relatively the same when comparing the same years. Which indicates that there was a difference in the Stillwater firefighters health-related characteristics when comparing the years of 1997, 1999, and 2002.

Advisor's Approval: _____

Dr. Steven Edwards