

THE FIRST TWENTY EXERCISE TRAINING PROGRAM AND FIRE ACADEMY  
RECRUITS' FITNESS AND HEALTH

by

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## Abstract

Firefighting is an inherently dangerous occupation with high rates of injuries and fatalities, with the majority of line of duty fatalities due to cardiovascular events. Additionally, firefighters struggle with poor health and low levels of fitness, including very high (>80%) rates of overweight and obesity likely related to the culture of the fire service. Limited resources exist for fire departments that are sensitive to the culture and work requirements of these “tactical athletes”. Though there has been increasing interest in circuit-type high intensity exercise training programs, key research data are lacking for the firefighter population and few studies have focused on training firefighter recruits. **PURPOSE:** The purpose of this pilot investigation was to examine a novel physical training program on fire academy recruits’ health, fitness, and performance, in addition to examining the programs’ acceptability, feasibility, and future efficacy. **METHODS:** Thirteen participants were recruited from an entry level fire academy and were randomly assigned to either the control (CG, n=6) or intervention exercise group (TF20, n=7). Due to attrition within the first two weeks of the study, 10 male fire recruits (23±3 years) completed the study (CG, n=3, TF20, n=7). The CG were asked to continue their current exercise habits. TF20 were provided an online-based training program (The First 20) that included periodized workouts, nutritional information, and mental readiness education. All participants completed baseline and post-intervention assessments and 10-weeks of exercise training. Health assessments included resting and post-exercise heart rate and blood pressure and estimated  $VO_{2max}$ . Anthropometric measures included height, weight, % body fat, % lean mass, and BMI. Performance was measured using the Candidate Physical Ability Test (CPAT). Psychosocial measures were assessed by a short questionnaire. A feasibility analysis was also completed for those in TF20 group. Due to the small sample size and group differences at baseline, descriptive statistics were calculated and each participant was reviewed as an individual case study. The Wilcoxon Signed Rank Test was used to test for significance among TF20 group. **RESULTS:** This pilot investigation provided effect sizes and parameter estimates necessary for the design of a larger randomized controlled trial. Even with a small sample size, TF20 group showed improvement on numerous outcome measures including CPAT performance (40% passing at baseline to 86% passing post-intervention). Of five TF20 participants completing the CPAT at baseline and post-intervention, four improved their passing time. TF20 participants significantly increased estimated  $VO_{2max}$  ( $p=0.028$ ) and significantly improved body composition (decreased fat mass (kg) and % fat mass,  $p=0.028$ ). TF20 participants also significantly improved grip strength ( $p=0.018$ ). The CG saw no statistically significant differences from baseline to post-intervention. TF20 group completed approximately 75% of the assigned workouts. Participants reported enjoying the workouts and stated a program like this should be offered for fire academy recruits in the future.

**CONCLUSION:** While TF20 participants showed significant fitness gains, the small sample size limited comparisons to the control group or other covariates. TF20 program was well-received although there may be a better way to implement the intervention to increase participation. Participants mentioned they would like group workouts led by a certified strength and conditioning coach/peer fitness trainer as opposed to self-guided workouts. This investigation provides promising results for the efficacy of high-intensity training programs in firefighter recruits. Additionally, this study provides alternative guidance for exercise prescription designed specifically for the firefighter population.

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## **Dedication**

I would like to dedicate this work to my grandmother, Betty. She is the inspiration and drive behind all that I do. No accomplishment is as worthy as when she tells me how proud of me she is. This is for you, Gram.

# **Chapter 1 - Introduction**

## **Research Problem**

Firefighting is an inherently dangerous and physically demanding occupation (Abel, Sell, & Dennison, 2011). National firefighter injury and fatality rates have been well documented, though the literature presents little direction for training these tactical athletes and there are no standardized requirements for fitness in the fire service. Firefighters actually struggle with poor health and low levels of fitness, including very high (>80%) rates of overweight and obesity likely related to the culture of the fire service (Poston et al., 2011). Many firefighters experience significant weight gain over the course of their careers (Poston et al., 2011).

Comorbidities related to obesity are highly prevalent among the firefighter population (Poston et al., 2011). Evidence suggests that firefighters with a high body mass index (BMI) have impaired vascular function and greater risk for cardiovascular disease (CVD) (Poston et al., 2011). Cardiovascular disease remains the leading cause of firefighter line-of-duty death (LODD, i.e.: fatalities on the job), accounting for about 45% of all LODD since at least the late 1970s (Poston et al., 2011). It is well documented that physical fitness is related to job performance and the performance of simulated firefighting tasks such as pulling hose, carrying a ladder, and rescuing a victim (Abel, Palmer, & Trubee, 2015). Given the strenuous nature of firefighting and the dangers of overweight and obesity, it is imperative that firefighters develop and maintain adequate levels of fitness (Abel et al., 2011).

## **Significance**

A fire academy should instill the importance of physical activity in new firefighters as they begin a physically demanding career in the fire service. However, the current Fire Academy at Johnson County Community College (JCCC) and many other fire academies across the United

States do little to address the physical fitness of firefighter recruits other than the physical skills taught during coursework. The JCCC Fire Academy does not offer physical fitness training aside from instructing basic firefighter skills (i.e. climbing ladders, rescuing victims, search and rescue drills, etc.). The JCCC recruits are required to have previously taken or be concurrently enrolled in a one credit hour fitness class offered through JCCC. The Lifetime Fitness class introduces the student to basic fitness principles, physical activity and their relationship to a healthy lifestyle. The course is graded based on participation but is self-directed; the student must log hours at the JCCC Gym and pass an exam at the end of the course (JCCC, 2015). The student must spend at least 40 minutes in the gym for the session to count for credit; 36+ sessions constitutes an A, 35-32 a B, 31-28 a C, 27-20 a D, and 19 or less constitutes an F (the semester is 16 weeks long) (JCCC, 2015). This course may be waived at the discretion of the Fire Academy Director if the student can prove they have an active gym membership at a local gym facility. There is currently no firefighter-specific physical training program associated with the academy to prepare firefighter recruits for the physical tasks of firefighting.

The First Twenty (TF20) Tactical Fitness and Wellness Program© is an innovative computer based training program developed by firefighters specifically for firefighters that provides foundational educational principles around physical fitness, mental wellness, and nutrition. Using a functional approach combined with empirical evidence, TF20 is a comprehensive program that addresses firefighters' unique physiological challenges by simulating tasks performed on the fireground. Specifically, the program's goals are to optimize a firefighter's occupational performance, resilience to injury, stability, mobility, strength, and endurance through a series of high intensity circuits, focused on both resistance and endurance (TF20, 2016). TF20 online platform allows participants to apply and track these principles on a

daily basis and record their progress (TF20, 2016). This is the first study to document the effects of TF20 intervention. We aim to add to the literature by examining this novel training program at the fire academy recruit level.

## **Overview**

The JCCC recruits participate in highly physically demanding tasks as they learn the job of a firefighter. Part of the Fire Academy is spent indoors for lecture. The remainder is spent on the drill ground where the recruits learn basic firefighter skills such as donning bunker gear (personal protective equipment) and SCBA (self-contained breathing apparatus), navigating through dark search quarters, searching and removing a victim in a fire room, climbing ladders, cutting ventilation holes, and fighting live fire. The recruits are also required to take the CPAT (Candidate Physical Ability Test) during the Fire Academy. Fire recruits will need to have passed the CPAT in order to get a job in most fire departments. This enhances the importance of implementing a culture of fitness early in a firefighter's career. If fitness programs can be implemented at the fire academy level a culture of fitness becomes a habit for the young firefighter making it easier to maintain once on shift.

## **Defining Physical Fitness**

There are many different definitions of physical fitness; for this study, we defined physical fitness as “occupational efficiency, or the possession of adequate levels of strength, endurance, and mobility to provide for successful participation in occupational effort” (Kilgore & Rippetoe, 2007, p.5). We defined wellness as “an individual's state of mind as well as their physical state, balancing between health and physical, mental, emotional and spiritual fitness” (IAFF, 2007, p.7). The IAFF/IAFC WFI evaluates fitness by assessing five specific areas including body

composition, aerobic capacity, muscular strength and power, muscular endurance, and flexibility (IAFF, 2007). We incorporated these areas in our assessment protocol.

## **Purpose**

The purpose of this pilot investigation was to assess the performance outcomes, acceptability, feasibility, and the future efficacy of an innovative firefighter fitness and wellness program on firefighter recruit health, fitness, and performance. This study is the first to systematically document the outcomes of TF20 with fire service recruits. Study results will help establish effects of the exercise program and can provide effect sizes and parameter estimates necessary for the design of a larger randomized controlled trial. As well, this study provides guidance for exercise prescription designed specifically for the firefighter population. We hypothesized that recruits in the intervention (TF20) group would see greater improvements in their CPAT time, body composition, cardiovascular, and strength measures compared to the control group (CG). We also hypothesized that TF20 group would find the intervention acceptable and feasible at the recruit firefighter level.

## Chapter 2 - Background

Firefighting is a strenuous and physically demanding occupation (Abel, Sell, & Dennison, 2011). Firefighters perform dangerous tasks in varied and complex environments leading to an increased risk for injuries and fatalities (Haynes & Molis, 2015). The National Fire Protection Association (NFPA) estimates that 63,350 firefighter injuries occurred in the line of duty in 2014 (Haynes & Molis, 2015) and a total of 64 firefighters died in the line of duty (Fahy, LeBlanc, & Molis, 2015). The most common cause and type of injury was overexertion resulting in strain or sprain (Haynes & Molis, 2015).

Overall, sudden cardiac death is the number one cause of on-duty firefighter fatalities in the U.S. and with two exceptions (1984 and 2013), has accounted for the single largest share of firefighter deaths in any given year since at least the late 1970s (Fahy et al., 2015; Poston et al., 2011). As in most years, sudden cardiac death accounted for the largest share of on-duty deaths in 2014 (36 deaths, 56%) (Fahy et al., 2015). In addition, 905 nonfatal on-duty cardiovascular events were reported in 2014 (Haynes & Molis, 2015).

Firefighters struggle with poor health and low levels of fitness, as well as very high (> 80%) rates of overweight and obesity ( $\text{BMI} \geq 25.0 \text{ kg/m}^2$ ) likely related to personal, cultural, and occupational factors (Poston et al., 2011). Many firefighters experience significant weight gain over the course of their 25-year careers. Studies have found that firefighters can gain as much as 29-85 pounds over the course of their career (1.15-3.4 lbs/year) (Poston et al., 2011). Other studies have found average gains as high as 1.5-2.7 lbs/year (Elliot et al., 2007; Soteriades et al., 2012). As a firefighter's weight increases, his or her cardiorespiratory fitness plummets and the risk of cardiovascular disease (CVD) increases (Durand et al., 2011). Comorbidities related to overweight and obesity include heart disease, stroke, type 2 diabetes and certain types of cancer

which are highly prevalent among the firefighter population (CDC, 2015; Poston et al., 2011). Evidence suggests that firefighters with a high body mass index (BMI) have impaired vascular function and greater risk for CVD (Clark, Rene, Theurer, & Marschall, 2002; Fahs et al., 2009; Soteriades et al., 2012).

Several occupational risk factors have been posited to contribute to the increased cardiac risk among firefighters including the physiologic strain of firefighting tasks and common occupational-related health practices (Soteriades et al., 2012). The acute cardiovascular strain of firefighting begins with the sympathetic response of the initial alarm and continues through the physical work load necessary to complete firefighting tasks (Barnard & Duncan, 1975; Soteriades et al., 2012). In a study of firefighters' physiologic response, Barnard & Duncan (1975) found that the initial alarm resulted in an average heart rate increase of 30 beats/minute (bpm) in the 15-30 minutes post alarm and reached rates as high as 188 bpm during fire suppression activities in extreme heat wearing insulating bunker gear that can weigh more than 25kg. Evidence shows an increase in core temperature of 0.05°C/min among firefighters during fire suppression activities (Carter, Rayson, Wilkinson, Richmond, & Blacker, 2007; Smith & Petruzzello, 1998; Smith, Petruzzello, Chludzinski, Reed, & Woods, 2005). Dehydration also contributes to the strain as firefighters have been found to secrete between 1.2 and 1.9L of sweat per hour during fire suppression (Selkirk, McLellan, & Wong, 2004; Smith & Petruzzello, 1998; Smith, Manning, & Petruzzello, 2001). Kales and colleagues found the increased risk of death from coronary heart disease was between 12 and 136 times higher during fire suppression compared to non-emergency station duties (Kales, Soteriades, Christophi, & Christiani, 2007; Soteriades et al., 2012).



Firefighting presents a unique challenge for training because it requires optimizing multiple training goals simultaneously (Abel, Mortara, & Pettitt, 2011). Firefighting requires optimal levels of power, strength, muscular endurance, and anaerobic/aerobic endurance (Abel et al., 2011). The tasks also place substantial stress on the anaerobic and aerobic energy systems (Dennison, Mullineaux, Yates, & Abel, 2012). Research has indicated that firefighters produce relative heart rates of approximately 79–88% of maximum heart rate (HR<sub>max</sub>), peak blood lactate values of 6–13 mmol•L<sup>-1</sup>, and average VO<sub>2</sub> values of 41.5 ml/kg/min while performing tasks on the fire ground (Abel et al., 2011; Gledhill & Jamnik, 1992; Sheaff et al., 2010). Thus, inadequate fitness levels may reduce the occupational performance and increase the risk of overexertion injuries to the firefighter (Dennison et al., 2012). Increased firefighter physical fitness has shown to decrease injury/illness, reduce absenteeism, increase productivity, and increase work capacity (Abel et al., 2011). It is well documented that physical fitness is related to job performance and the performance of simulated firefighting tasks such as pulling hose, carrying a ladder, and rescuing a victim (Poston et al., 2011).

Limited resources exist for fire departments that are sensitive to the culture and work requirements of these tactical athletes. There has been increasing interest in high-intensity exercise training programs, yet key research data are lacking for the firefighter population. The NFPA does have several standards that focus on the health risks of firefighters. For example, NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments, outlines the medical requirements that must be met by candidate firefighters. NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, calls for fire departments to establish a firefighter health and fitness program that meets NFPA 1583, Standard on Health-Related Fitness Programs for Fire Department Members, and requires that firefighters meet the

medical requirements of NFPA 1582 (Haynes & Molis, 2015). The NFPA recommends the following regarding establishing a departmental fitness program:

1. Assignment of qualified health and fitness coordinator
2. Periodic fitness assessment for all members
3. Exercise training program available to all members
4. Education & counseling regarding health promotion for all members
5. Process for collecting and maintaining health-related fitness program data.

While these guidelines exist, there are no nationally-enforced fitness or physical activity requirements for firefighters, which may lead to inconsistent physical fitness training within fire departments, substandard fitness levels, and greater obesity risk among firefighters (Haddock, Poston, & Jahnke, 2011). For example, one study found that only 38.7% of career and 23.6% of volunteer firefighters met the fitness threshold suggested by NFPA 1582 (a  $VO_{2max}$  of at least 42 ml/kg/min) (Haddock et al., 2011).

Some organizations have developed health and wellness programs such as the International Association of Fire Chiefs & International Association of Firefighters (IAFC/IAFF) Fire Service Joint Labor-Management Wellness-Fitness Initiative and the National Volunteer Fire Council's Heart-Healthy Firefighter Program. The Heart-Healthy Firefighter Program was launched in 2003 to address heart attack prevention for all firefighters and EMS personnel, through fitness, nutrition and health awareness (Haynes & Molis, 2015). The IAFC/IAFF Fire Service Joint Labor Management Wellness/Fitness Initiative (WFI) is dedicated to developing a stronger fire service through wellness programs and annual physical examinations. Information is collected from fire departments in the United States and Canada to determine best practices and programs for committing to a wellness-fitness program. Though this program has been

proven to increase firefighter fitness and wellness, programs like this one are expensive to implement and maintain. First year estimated implementation costs for the WFI are \$1,550,000 per department (average 1665 firefighters/department, ~\$931 per head) due to startup costs and capital expenditures. This was followed by an annual average cost of \$865,930 (~\$520 per head) for maintenance of the WFI program (IAFF, 2008).

## **Tactical Occupational Interventions**

Few studies have examined exercise interventions within tactical occupations, such as firefighters, military, and police. Even fewer have addressed firefighter-specific exercise interventions. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) study assessed two different behavior change strategies, a team-centered curriculum and motivational interviewing, both directed at promoting healthy lifestyles in the fire service (Elliot et al., 2007). The study focused on healthy eating habits, regular physical activity, and appropriate body weight but did not incorporate a physical training program. Both behavior change strategies positively impacted nutrition behaviors, were associated with less weight gain, and enhanced general well-being compared to a control group (Elliot et al., 2007). This study, however, did not include an exercise intervention.

Pawlak et al. examined the effects of a circuit training program on the physical fitness and occupational performance of firefighters (Pawlak, Clasey, Palmer, Symons, & Abel, 2015). The exercise program primarily used common firefighter equipment found in a fire station, including hoses, ladders, and self-contained breathing apparatuses (SCBA). The program incorporated a general warm-up, dynamic stretching, circuit training strength and endurance exercises, cardiovascular exercise, and static flexibility training and lasted approximately one hour. The findings from this study indicated the exercise intervention improved the completion

rate on a standardized firefighter test from 82% to 100% after the intervention (the control group declined from 78% to 56%) (Pawlak et al., 2015). Circuit Training also allowed multiple firefighters to train simultaneously in the same area and could be modified based on available equipment. However, Campos et al. found it may be important to incorporate sets with heavier loads (ie:  $\geq 85\%$  1RM) and longer recovery periods to enhance strength gains as a supplement to circuit training (Abel, Sell, & Dennison, 2011). Pawlak et al., used the Gerkin protocol for their estimated  $VO_{2max}$ , however Mier & Gibson (2004), found that the Gerkin protocol overestimates  $VO_{2max}$  and should not be used for predicting  $VO_{2max}$  in individual firefighters. In the present study, we use a StepMill protocol suggested by the WFI (IAFF, 2007) which may be a more accurate representation of the recruits' estimated  $VO_{2max}$ .

Peterson et al. examined two distinct, periodized resistance training interventions on fitness adaptations among firefighters. This study also assessed the degree of transfer to job-specific tasks. Two training models – undulation training (UT) and standard training control (STCo) were used to determine the differential affects for muscular fitness and transference to firefighter performance. The UT group experienced significantly greater improvements in their firefighter physical ability test (Grinder) performance than the STCo group. This study highlighted the importance of proper fluctuation in training variables to allow for sufficient recovery between similar sessions while preventing detraining (Peterson et al., 2008).

Abel et al., (2011) compared aerobic and anaerobic intensities of a circuit-based workout to physiological data previously reported on firefighters performing live fire suppression and rescue tasks. In general, they found that the circuit-based workouts produced a lower cardiovascular stress but a similar anaerobic stress as compared to performing firefighting tasks. Therefore, they suggest firefighters should supplement low-intensity circuit-training programs

with high-intensity cardiovascular and resistance exercises to adequately prepare for the variable physical demands of firefighting (Abel, 2011). More research is necessary to examine traditional periodized strength and conditioning programs to improve firefighter performance.

Jahnke et al. assessed self-reported health practices of male firefighters, specifically related to fitness and high intensity training (HIT) (Jahnke et al., 2015). They found that approximately one-third of participants reported participating in HIT and those who did were approximately half as likely to be in the obese range (based on body fat % and waist circumference) than those who did not, highlighting the importance of HIT in the fire service (Jahnke et al., 2015).

While not specific to the fire service, the military is a similar tactical occupational group that has been studied. Heinrich et al. compared a circuit-based fitness training program with traditional Army physical training in active duty Army personnel (Heinrich, Spencer, Fehl, & Poston, 2012). The Mission Essential Fitness (MEF) program focused on strength, power, speed, and agility and was designed to train the body in various planes of movement and at differing speeds. They found that MEF participants significantly improved their push-ups, two mile run times, step test heart rates, bench press strength, and flexibility as compared to participants engaging in APRT (Army physical readiness training) (Heinrich et al., 2012).

Although most studies that have examined exercise training programs in the fire service have not looked specifically at firefighter recruits, Roberts et al. 2002, examined firefighter recruits before and after a 16-week exercise training program. Drills and exercises were designed to mimic the movements of actual fire suppression duties. Each 1-hour workout consisted of warm-up and stretching, aerobic conditioning, upper/lower-body strengthening exercises, cool-down and abdominal and back strengthening exercises, and stretching (Roberts, O'Dea, Boyce,

& Mannix, 2002). This study noted a positive effect of the training on numerous aspects of physical fitness including improved  $VO_{2max}$ , increased muscular endurance and flexibility, increased lean tissue mass and decreased fat mass (Roberts et al., 2002). Though Roberts et al. demonstrated that a 16-week exercise program significantly improved fire recruits'  $VO_{2max}$ , muscle endurance, flexibility, and body composition, that study did not conduct a firefighter-specific ability test to evaluate occupational performance.

There is a debate regarding whether firefighters should engage in physical activity while on duty. The results from a study conducted by Dennison and associates (2012) suggest that the occupational efficiency of firefighters may decrease as a result of performing exercise while on duty. However, the long-term benefits of on-duty physical training (e.g., improved work tolerance, decreased risk of heart disease) may outweigh the acute decrements in firefighter performance (Dennison, Mullineaux, Yates, & Abel, 2012). Department officials may consider scheduling these training sessions during low call-volume times or near the end of the shift to minimize the likelihood of responding to an emergency during or immediately following an exercise session. Furthermore, Dennison et al. demonstrated that firefighters who trained regularly and possessed higher fitness levels tended to perform job-specific tasks more efficiently than untrained firefighters. The study further emphasized the importance of implementing an exercise program for firefighters (Dennison, Mullineaux, Yates, & Abel, 2012). Though multiple studies have examined circuit-training interventions, future research is necessary to evaluate the training adaptations produced by a periodized circuit training program for firefighters. Differences in training volume may be responsible for variable findings amongst studies. Research has established a need for wellness programs targeted to the unique needs and culture of the fire service as a means of improving readiness, decreasing injury, and preventing

line of duty deaths (LODD) related to cardiovascular disease (CVD). Therefore, the purpose of this pilot investigation was to assess the performance outcomes, acceptability, feasibility, and the future efficacy of The First Twenty firefighter fitness and wellness program on firefighter recruit health, fitness, and performance.

## Chapter 3 - Methods

### Subjects

We solicited volunteers for the study by visiting the JCCC Fire Academy class with permission from the Program Director. The institutional review boards (IRB) of Kansas State University (KSU), Johnson County Community College (JCCC), and the National Development and Research Institutes (NDRI) approved the study. All participants provided written consent prior to initiation of their involvement in research.

We distributed folders containing information for the study including informed consent, image acknowledgement, Physical Activity Readiness Questionnaire (PAR-Q), a baseline questionnaire, pre-participation instructions, participant contact information sheet, and an informational sheet detailing the study. We also orally explained the importance of the study and what the study entailed (expected time commitment, benefits, etc.) Selected participants had to be in good health and without physical limitations that prevented them from completing any of the required TF20 workouts and fitness assessments. Selected participants did not answer “yes” to any of the PAR-Q questions (*see Appendix B*). We initially enlisted thirteen participants, twelve males and one female; they were randomized into two groups (CG:  $n = 6$ , TF20:  $n = 7$ ) and completed baseline testing. The female participant (CG) dropped out of the JCCC Fire Academy and was therefore ineligible to complete the study. One male participant (CG) dropped out of the study due to time constraints and one male participant (CG) completed the 10 weeks of self-directed workouts but was unable to complete follow-up testing due to medical complications related to diabetes. All three of the subjects who dropped out of the study had already been assigned to the CG; this explains the subsequent uneven distribution of the groups.



Ten male fire recruits (aged 19-27 years) completed the study, including baseline and follow-up assessments (TF20 n=7, CG n=3). There were differences at baseline between the two groups including differences in average group BMI, estimated  $VO_{2max}$ , and other fitness and performance measures. In a full trial with a larger sample size, we would be able to control for these baseline differences. As stated previously, this is why each participant was an individual case study.

## **Procedures**

Every semester, JCCC Fire Academy recruits are required to have taken or be concurrently enrolled in a one credit hour gym class; this study took the place of that one credit hour physical requirement for study participants. The recruits were randomly assigned to one of two exercise groups: The First Twenty Tactical High Performance Program (TF20) or the Comparison Group (CG). Both groups completed baseline assessments, 10-weeks of either the exercise intervention or self-guided physical activity, and a post-test assessment.

The online infrastructure for TF20 was developed by Beagle Productions, Ltd. The program is primarily hosted by Joyent cloud-based services with secondary hosting by HostGator's servers. Data are backed up nightly and stored in a separate physical location. Hosting and storage are extremely secure, are PCI compliant/certified, and all user data storage and utilization are designed to be HIPPA compliant. The portal includes private account settings, health programs, fitness tracking with exercise and workout videos, nutrition tracking, health education, results tracking, and communication and social connection tools.

## **Measures**

During the initial and final weeks of the study, participants' health, strength, and performance were assessed. The mean scores from both groups were compared and each participant was observed as a case study to examine change over time.

### ***Body Composition***

Anthropometric measures included height, weight, and body fat percentage (%BF). Height was assessed with a Stadiometer (Invicta Plastics Limited). The Tanita 300 digital bioelectrical impedance/weight scale was used to estimate %BF, fat mass, muscle mass, and weight (to the nearest 0.1 kg). Participants were instructed to wear comfortable exercise clothing (shorts, t-shirt, socks, and tennis shoes) during testing. No shoes or socks were worn on the Stadiometer or the Tanita scale. Participants were asked to note their clothing choice for pre-testing so the same clothing could be worn during post-training assessments. The Tanita scale also calculated BMI by dividing body weight in kilograms by height in meters squared ( $\text{kg}\cdot\text{m}^{-2}$ ) (ACSM, 2014).

### ***Heart Rate, Blood Pressure, and Aerobic Capacity***

Resting and post-exercise blood pressure (BP) and heart rate (HR) were assessed using standardized methods with the Omron BP785 10 series monitors. The BP cuff was placed on the participant's left arm. Three resting measures were taken with at least five minutes rest in-between measures (ACSM, 2014). Blood pressure and heart rate were taken once, immediately after the CPAT (within 2 minutes of test completion). Mean arterial blood pressure (MAP) was then calculated. MAP is the average blood pressure in the arteries during one cardiac cycle. The traditional formula for the calculation of MAP is the following:  $(\text{SYS} + (2 * \text{DIA})) / 3$ , where SYS is systolic blood pressure and DIA is diastolic blood pressure (Cywinski, 1980). The

product of HR and systolic BP (rate pressure product [RPP]) is a reliable index of myocardial oxygen demand and can indicate the cardiovascular and metabolic stress placed on the heart during strenuous activity (Sheaff et al., 2010).

Maximal aerobic capacity ( $VO_{2max}$ ) was estimated from the linear relationship between heart rate (HR) and work rate during a submaximal graded exercise test using a StairMaster 7000PT (IAFF, 2008). This method is not commonly used in the literature but is relevant for firefighters as the StepMill is also part of the CPAT (IAFF, 2008). To assess HR, the participants wore a Polar H7 Heart Rate Sensor around their chest and a Polar V800 watch around their left wrist. HR was recorded from the output on the watch. The test was performed until the participant reached and maintained their target heart rate (THR, see equation below) for 15 seconds.  $VO_{2max}$  was extrapolated from the heart rate the candidate achieved, their body mass index (BMI), and their total test time using the following equation (IAFF, 2008):

$$VO_{2max} = 57.774 + (1.757 \times TT) - (0.904 \times BMI)$$

$$\text{Maximal Heart Rate (HRM)} = 220 - \text{age}$$

$$THR = .85 (HRM)$$

$$TT = \text{total test time (minutes)}$$

### ***Fitness***

Hand grip dynamometry was chosen because it has been shown to correlate well ( $r = 0.69$ ) with upper body strength (DeVries, 1980). The test-retest reliability for this method has been reported to be  $r = 0.90$  (Adams, 1988). Following verbal instruction, participants assumed a seated position and held the hand grip dynamometer (Takei Grip-A hand grip dynamometer, Tokyo, Japan) in the hand to be tested. The participant's elbow was positioned by their side and flexed to a right angle with neutral wrist position, the dynamometer handle position II, and

provisional support underneath the dynamometer. The participant's dominant hand was reported. The participant completed three attempts with each hand with 30 seconds rest between each attempt. The test was scored as the best score from each hand (dominant and non-dominant) and was recorded in kilograms (kg).

Dynamic explosive strength was measured by assessing each participant's vertical jump height using the Vertec measuring device. The tester adjusted the height of the stack of movable color-coded horizontal plastic vanes to be within the participant's standing reach height. The highest vane that could be reached and pushed forward with the dominant hand while the participant stood flat-footed determined the standing reach height. The vane stack was then raised so that the participant would not jump higher or lower than the set of vanes. Without a preparatory or stutter step, the participant performed a countermovement jump by quickly flexing the knees and hips, moving the trunk forward and downward, and swinging the arms backward. During the jump, the dominant arm reached upward while the non-dominant arm moved downward relative to the body. At the highest point of the jump the participant tapped the highest possible vane with the fingers of the dominant hand. The score was the vertical distance between the standing reach height and the vane tapped at the highest point of the jump. The best of three trials was recorded to the nearest 0.5 in.

Muscular endurance was assessed with a timed push-up test (ACSM, 2014). The test was administered with the participant starting in the standard "down" position (hands pointing forward and under the shoulder, back straight, head up, using toes as the pivotal point). The participant was required to raise the body by straightening the elbows and return to the "down" position until the chin touched the mat. The score was the maximal number of push-ups performed consecutively without rest in 2 minutes. The test was stopped when the participant

strained forcibly or was unable to maintain the appropriate technique for two consecutive repetitions or if the participant rested.

Core strength was assessed with a cadence curl-up (crunch) test (ACSM, 2014). Two strips of masking tape were placed on a mat on the floor at a distance of 12 cm (4.75 in) apart. The bottom position required participants lie in a supine position across the tape, knees bent at 90 degrees, with feet on the floor and arms extended to their sides, such that the fingertips touched the nearest strip of tape. To reach the top position, participants flexed their spine to 30 degrees, reaching their hands forward until their fingers touched the second strip of tape. Participants were allowed to have someone hold their feet. A metronome was set at 40 beats per minute. The participant was to hit the top and bottom positions on each beat of the metronome. Repetitions were counted each time the participant reached the bottom position. The test was concluded either when the participant reached 75 curl-ups or the cadence was broken (ACSM, 2014).

Agility was assessed with a timed T-test. The T-test requires the participant to move in a T-shaped pattern (*see Appendix F*). It requires forward, lateral, and backward running. This test requires locomotor fundamental motor skills. The individual is asked to run, shuffle, bend, and backpedal. The best time of two trials was recorded to the nearest 0.1 second (Brown, 2012).

Flexibility of the trunk was assessed using a standardized sit-and-reach box (Canadian Trunk Forward Flexion test) (ACSM, 2014). The participant sat without shoes and the soles of their feet flat against the flexometer (sit-and-reach box). The participant was instructed to slowly stretch forward with both hands as far as possible, holding the position approximately two seconds. The score was the most distant point (cm) reached with the fingertips. The best of two trials was recorded (ACSM, 2014).

## ***Performance***

The Candidate Physical Ability Test (CPAT) was used to measure changes in performance. The CPAT was chosen as an assessment in order to provide a traditional frame of reference to evaluate increases or decreases in physical fitness and to provide a firefighter-specific assessment. The CPAT consists of eight separate events that require the candidate to progress along a predetermined path from event to event in a continuous manner. It is a pass/fail test based on a maximum total test time of 10 minutes and 20 seconds. In all eight events, the candidate wore a 50-pound (22.68-kg) vest to simulate the weight of self-contained breathing apparatus (SCBA) and firefighter protective clothing. An additional 25 pounds (11.34 kg), using two 12.5-pound (5.67-kg) shoulder weights that simulate a high-rise pack (hose bundle), is added for the stair climb (first) event. Throughout all events, the candidate wore long pants, a hard hat with chin strap, work gloves and footwear with no open heel or toe. Watches and loose or restrictive jewelry were not permitted. All props were designed to simulate critical fire ground tasks and observe the candidate's physical ability (IAFF, 2007). The events were as follows: Stair Climb, Hose Drag, Equipment Carry, Ladder Raise and Extension, Forcible Entry, Search, Dummy Drag, and Ceiling Breach and Pull. (*See Appendix G*).

## ***Questionnaire and Feasibility Analysis***

A questionnaire was completed at baseline and post intervention (10-weeks). The questionnaire included demographics, health behaviors, diet, exercise history, and psychosocial measures such as exercise enjoyment and self-efficacy (*see Appendices D, E*). A feasibility analysis was completed to examine participant adherence, their reaction to the intervention (likes, dislikes), and suggestions for future physical training for the Fire Academy (*see Appendices K, L*).

## ***Intervention***

Both groups met weekly with a firefighter fitness trainer with current CPR and First Aid certifications (Firefighter/EMT, CPR/First Aid, TSAC-F certified). Weekly meetings ensured education on proper movements used in TF20 program, and discussion of proper progressions for movements. Any questions the participants had were also discussed.

TF20 Intervention Group workouts were part of an online training program that provided endurance and resistance exercises, nutritional information, and mental performance guidance. The original program was a 24 week periodized program which had to be condensed into a 10 week exercise program to accommodate the time frame of the fire academy. A Certified Strength and Conditioning Specialist (CSCS) and Tactical Strength and Conditioning Facilitator (TSAC-F) condensed the program but kept the same periodization scheme to mimic the longer cycle of workouts. The first mesocycle had the following goals: general physical preparedness (GPP), transmutation, realization, and active recovery. It began with developing an aerobic base, working on exercise technique, and included an “apparatus circuit” consisting of resistance training (RT) 2 d/wk and moderate intensity cardiovascular training (cardio) 2 d/wk in 20 min bouts, walking approximately 3 mph. The second mesocycle contained the following microcycle goals: transmutation, realization/tactical, and included active recovery. The “apparatus circuit” included RT: 2 d/wk; moderate intensity cardio: 2 d/wk in 30 min bouts, walking 3 mph; and 1 d/wk: walk with SCBA 20 min. The functional circuit consisted of RT: 2 d/wk; moderate intensity cardio: 1 d/wk in 30 min bouts of walking 3mph; and 1 d/wk: stair climb 10 min (2 min intervals; 1 min rest). Mesocycle three contained the following goals: metabolic conditioning, apparatus work, functional/performance, and recovery. The “apparatus circuit” contained: RT: 2 d/wk; moderate intensity cardio: 2 d/wk in 45 min bouts, walking 3 mph; and vigorous intensity

intervals: 1 d/wk walking with SCBA 25 min. The functional circuit contained RT: 2 d/wk; moderate intensity cardio: 2 d/wk in 45 min bouts, walking 3 mph; and vigorous intensity cardio: 1 d/wk climbing stairs with SCBA for 14 min (2 min work/1 min rest intervals). The fourth mesocycle contained the following goals: transmutation, realization/tactical, active recovery, and assessment. The “apparatus circuit” contained RT: 3 d/wk; moderate intensity cardio: 1 d/wk in 60 min bouts, walking 3 mph; and vigorous intensity intervals cardio: 1 d/wk walking with SCBA for 30 min. The functional circuit contained RT: 2 d/wk; moderate intensity cardio: 1 d/wk 60 min bout walking 3 mph; and 1 d/wk stair climb with SCBA for 20 min (2 min work/1 min rest). The final week of exercises included active recovery to allow participants to prepare for physical assessments (*see detailed periodization chart in Appendix M*).

The participants chose what days/times to complete the workouts and could utilize as little or as much of the online program as they saw fit. Their activity was tracked online and we assessed adherence to the workouts at the end of the intervention. Workouts contained a combination of aerobic (e.g., running, rowing, jumping), body weight (e.g., air squats, pushups, sit-ups), and weight lifting (e.g., presses, back squats, lunges) exercises with workouts designed to use equipment available in an exercise facility (e.g., weight racks, benches) or in a fire station/on the fire ground (equipment carry, dummy drag, etc.). Sixty-minute TF20 sessions included a warm-up, workout, and cool down. All completed workouts were logged in TF20 software program or listed in a diary format by the participants.

The Control Group (usual care) was asked to follow their regular workout routine for 10 weeks. Participants chose the time, duration, frequency, and type of any workouts completed. Participants were asked to log all exercise/workouts.



The benefit to the participants was that they were given two options to take the CPAT at no cost (once at the beginning of the semester and once at the end) instead of paying \$95 and only taking the test once during the semester as is normally required. This not only exposed study participants to the test at the beginning of the program, but it also allowed time to improve their physical performance on the test.

## **Analysis**

Microsoft Excel was used to generate the random allocation sequence to divide the participants into two groups (intervention and control). The Excel equation = RAND() assigned random numbers (0 and 1) to the participants; 0 = control, 1 = intervention. As mentioned before, there were initially 13 participants enrolled in this study and randomized to the two conditions (TF20=7, CG=6). Due to attrition, the CG lost three participants. The participants that completed the entire study were TF20 (n=7) and CG (n=3). The Primary Investigator and other investigators enrolled participants, generated the random allocation, and assigned participants to intervention groups. The statistician was blinded.

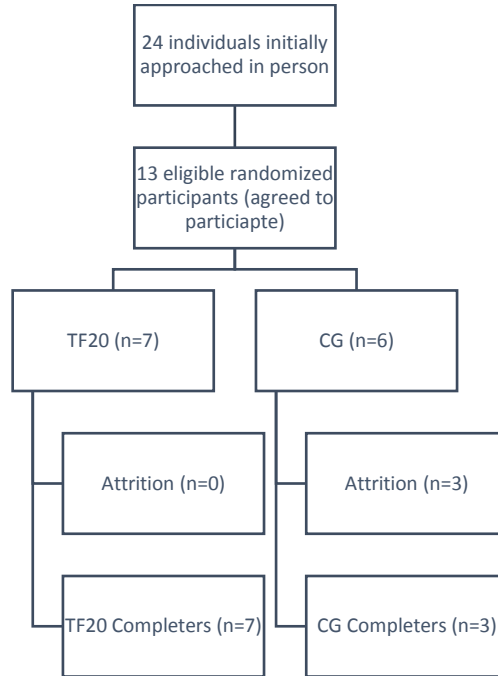
Microsoft Excel and SPSS Version 21 (Armonk, NY) were used for statistical analysis. Means and standard deviations were calculated for all variables. To account for small sample size, the Wilcoxon Signed Rank Test was used to compare repeated measures (pre and post intervention) for both groups. The Wilcoxon Signed Rank Test is designed for use with repeated measures and is a non-parametric alternative to the repeated measures t-test but instead of comparing the means, the Wilcoxon converts scores to ranks and compares them at Time 1 and Time 2 (Pallant, 2005).

Written responses to questionnaires (baseline, post-intervention, and follow-up) were analyzed qualitatively by coding and analyzing recurrent themes or arguments, areas of

consensus and convergence of opinions, experiences, and perceptions about the wellness program using a grounded theory approach (Patton, 2002). Data were then coded by identifying passages exemplifying key concepts or ideas related to the major themes using NVivo 10 (QSR International, 2016). A feasibility analysis was also completed to examine the relevance of offering this intervention in a fire academy. We examined adherence to the prescribed workouts for TF20 group and their feedback to the intervention in a follow-up questionnaire (*see Appendix K*).

## Chapter 4 - Results

The randomization and attrition of participants can be seen in Figure 1 below.



**Figure 1 Randomization of Eligible Participants** (TF20, The First Twenty intervention; CG, control group.)

Thirteen fire recruits (12 male, 1 female) completed baseline testing. Ten male fire recruits (aged 19-27 years) completed the study, including baseline and follow-up assessments and 10 weeks of either the intervention or self-guided exercise (TF20 n=7, CG n=3). There were differences at baseline between the two groups including differences in average group BMI, estimated  $VO_{2max}$ , and other fitness and performance measures. In a full trial with a larger sample size, we would be able to control for these baseline differences. As stated previously, this is why each participant was an individual case study. Baseline participant demographics are shown below in Table 1 with mean differences between groups shown in Table 2.

**Table 1 Individual Participant Demographics at Baseline**

<b>Participant</b>	<b>Age (years)</b>	<b>Weight (kg)</b>	<b>BMI (kg/m<sup>2</sup>)</b>	<b>VO<sub>2max</sub> (estimated) (ml/kg/min)</b>
CG-1	27	80.3	24.9	41.2
CG-2	25	74.7	24.4	45.3
CG-3	20	102.5	32.4	32.9
CG-4	21	56.5	20.0	42.6
CG-5	20	72.7	21.7	44.1
CG-6	28	47.8	19.9	47.6
<b>CG MEAN</b>	<b>24</b>	<b>72.4</b>	<b>23.9</b>	<b>42.3</b>
TF20-1	22	65.8	23.6	46.6
TF20-2	22	97.1	32.8	30.6
TF20-3	24	114.1	36.0	33.6
TF20-4	23	87.7	27.7	38.1
TF20-5	19	106.3	30.0	36.3
TF20-6	28	90.8	29.6	41.7
TF20-7	20	68.4	24.5	42.7
<b>TF20 MEAN</b>	<b>23</b>	<b>90.0</b>	<b>29.2</b>	<b>38.5</b>
<b>TOTAL MEAN</b>	<b>23</b>	<b>81.9</b>	<b>26.7</b>	<b>40.3</b>

CG = Control Group (n=3), TF20 = Intervention Group (n=7); BMI = Body Mass Index

**Table 2 Mean Participant Demographics**

	<b>TF20</b>	<b>CG</b>
<b>Gender (%)</b>	100% male	83% male
<b>Age (years)</b>	22.6±2.9	23.5±3.6
<b>Weight (kg)</b>	90.0±18.1	72.4±4.7
<b>BMI (kg/m<sup>2</sup>)</b>	29.2±4.4	23.9±4.7
<b>Estimated VO<sub>2max</sub></b>	38.5±5.5	42.3±5.1

All measures were examined from pre-intervention to post-intervention; Table 3 below shows TF20 results with significance level; statistically significant results are bolded and starred

(\*). Table 4 shows the CG data, none of the results were statistically significant (Pallant, 2005).

In TF20 group, there were statistically significant differences in body fat percentage, fat mass (kg), lean mass (kg), grip strength (adjusted and unadjusted), agility time, and estimated  $VO_{2max}$  from pre- to post-intervention.

**Table 3 Fitness and Performance Variables with Statistical Significance (TF20 group only)**

Variable	Mean Diff.	Std. Dev.	Significance
MAP (mmHg)	-6.48	11.0	0.237
RESTING HR (bpm)	0.29	9.30	0.799
POST CPAT RPP	-635	9.30	0.138
WEIGHT (kg)	-0.39	2.91	1.000
<b>% FAT</b>	<b>-2.09</b>	<b>1.08</b>	<b>0.018*</b>
<b>FAT MASS (FM, kg)</b>	<b>-1.93</b>	<b>1.19</b>	<b>0.018*</b>
<b>LEAN MASS (FFM, kg)</b>	<b>5.19</b>	<b>4.00</b>	<b>0.028*</b>
BMI ( $kg/m^2$ )	-0.03	0.92	0.933
<b>GRIP STRENGTH (unadj.)</b>	<b>5.96</b>	<b>4.69</b>	<b>0.018*</b>
<b>GRIP STRENGTH (adj.)</b>	<b>0.08</b>	<b>0.06</b>	<b>0.018*</b>
SIT & REACH (cm)	2.96	3.02	0.063
VERTICAL JUMP (cm)	-0.40	2.68	0.684
PUSH-UPS	4.43	11.0	0.249
SIT-UPS	6.86	22.0	0.176
<b>AGILITY (sec)</b>	<b>-0.57</b>	<b>0.58</b>	<b>0.028*</b>
<b><math>VO_{2max}</math> (ml/kg/min)</b>	<b>2.47</b>	<b>1.14</b>	<b>0.028*</b>

MAP = Mean Arterial Pressure; %FAT = % fat; FM = fat mass; FFM = fat free mass; BMI = Body Mass Index; Raw and Adjusted (weight in kg) scores are shown for Grip Strength;  $VO_{2max}$  = estimated  $VO_{2max}$ ; Mean Diff = Mean Difference in scores, St. Dev. = Standard Deviation.

\*Statistically significant ( $p \leq 0.05$ )

**Table 4 Fitness and Performance Variables with Statistical Significance (CG only)**

Variable	Mean Diff.	Std. Dev.	Significance
MAP (mmHg)	-0.89	10.8	1.000
RESTING HR (bpm)	10.8	8.80	0.109
POST CPAT RPP	1311	901	0.109
WEIGHT (kg)	-1.10	1.28	0.180
% FAT	-3.03	0.85	0.109
FAT MASS (FM, kg)	-2.83	1.10	0.109
LEAN MASS (FFM, kg)	6.47	3.17	0.109
BMI (kg/m <sup>2</sup> )	-0.73	0.21	0.109
GRIP STRENGTH (unadj.)	7.40	2.77	0.109
GRIP STRENGTH (adj.)	0.09	0.02	0.109
SIT & REACH (cm)	2.42	4.91	0.593
VERTICAL JUMP (cm)	-0.67	2.08	0.655
PUSH-UPS	1.33	3.06	0.414
SIT-UPS	13.5	17.7	0.180
AGILITY (sec)	0.08	0.08	0.180
VO <sub>2max</sub> (ml/kg/min)	3.98	0.57	0.109

MAP = Mean Arterial Pressure; %FAT = % fat; FM = fat mass; FFM = fat free mass; BMI = Body Mass Index; Raw and Adjusted (weight in kg) scores are shown for Grip Strength; VO<sub>2max</sub> = estimated VO<sub>2max</sub>; Mean Diff = Mean Difference in scores, St. Dev. = Standard Deviation. \*Statistically significant ( $p \leq 0.05$ )

Overall, the participants were less physically active than expected at baseline. Of the 8 that filled out a baseline questionnaire regarding current exercise behavior (over the past 30 days), only three met the current Physical Activity Guidelines (PAG) for moderate physical activity ( $\geq 150$  min/week). Four of eight respondents reported enough vigorous activity to meet guidelines ( $\geq 75$  min/week). Four participants reported completing 1-2 days of strength

training/week; one reported 3-4 days/week, one reported 5-6 days/week, and one reported completing strength training on more than 6 days/week. The current PAG recommend at least 2 days of strength training per week in addition to aerobic training (CDC, 2016). 67% of the CG met either moderate or vigorous PAG and 80% of TF20 group met the guidelines at baseline.

Absolute mean values for both groups pre- and post-intervention are listed in Table 5 below. Average change scores for both groups for all measures are reported in Table 6. Both are discussed in detail following Table 6.

**Table 5 Absolute Means for Both Groups**

	<b>TF20</b>		<b>CG</b>	
	PRE	POST	PRE	POST
<b>MAP (mmHg)</b>	95.7 ± 10.2	89.2 ± 5.3	89.2 ± 6.2	93.0 ± 11.1
<b>Resting HR (bpm)</b>	74.7 ± 12.7	75.0 ± 15.2	78.9 ± 15.3	88.0 ± 9.5
<b>Post CPAT RPP</b>	17247 ± 4625	21477 ± 2961	19997 ± 3672	23517 ± 3496
<b>Weight (kg)</b>	90.0 ± 18.1	89.6 ± 16.7	72.4 ± 19.1	84.7 ± 15.8
<b>Fat %</b>	24.2 ± 5.7	22.2 ± 6.2	18.3 ± 8.4	20.6 ± 7.2
<b>Fat Mass (kg)</b>	22.6 ± 8.7	20.6 ± 8.7	14.2 ± 10.3	18.2 ± 9.9
<b>FFM (kg)</b>	67.5 ± 10.4	72.7 ± 9.5	58.2 ± 11.1	71.2 ± 6.9
<b>BMI</b>	29.2 ± 4.4	29.1 ± 4.1	23.9 ± 4.7	26.5 ± 4.4
<b>Grip Strength (adj)</b>	0.60 ± 0.1	0.67 ± 0.1	0.60 ± 0.1	0.66 ± 0.1
<b>Grip Strength (un)</b>	53.0 ± 8.8	58.9 ± 6.6	41.9 ± 7.3	54.6 ± 0.9
<b>Sit &amp; Reach</b>	14.3 ± 3.8	17.3 ± 5.6	9.06 ± 4.7	13.0 ± 4.8
<b>Vertical Jump (m)</b>	2.88 ± 0.15	2.90 ± 0.1	2.90 ± 0.2	2.93 ± 0.1
<b>Push-Ups</b>	29.3 ± 13.5	33.7 ± 20.7	27.3 ± 16.0	28.7 ± 18.6
<b>Sit-Ups</b>	38.3 ± 22.1	45.1 ± 22.6	25.7 ± 8.5	38.3 ± 20.6
<b>Agility</b>	11.7 ± 0.6	11.0 ± 0.9	11.0 ± 0.8	11.0 ± 1.01
<b>Estimated VO<sub>2max</sub></b>	38.5 ± 5.5	41.1 ± 5.6	42.3 ± 5.1	43.8 ± 6.4

**Table 6 Average Change Scores for Both Groups**

	<b>TF20</b>	<b>Control Group</b>
<b>MAP (mmHg)</b>	-6.48 ± 11	-0.89 ± 10.8
<b>Resting HR (bpm)</b>	0.29 ± 9.3	10.78 ± 8.8
<b>Post CPAT RPP</b>	-634.8 ± 9.3	1310.8 ± 901
<b>Weight (kg)</b>	-0.39 ± 2.9	-1.10 ± 1.3
<b>Fat %</b>	-2.09 ± 1.1	-3.03 ± 0.9
<b>Fat Mass (kg)</b>	-1.93 ± 1.2	-2.83 ± 1.1
<b>FFM (kg)</b>	5.19 ± 4	6.47 ± 3.2
<b>BMI</b>	-0.03 ± 0.9	-0.73 ± 0.2
<b>Grip Strength (adj)</b>	0.08 ± 0.1	0.09 ± 0.0
<b>Sit &amp; Reach</b>	2.96 ± 3.0	2.42 ± 4.9
<b>Vertical Jump (in)</b>	-0.40 ± 2.7	-0.67 ± 2.1
<b>Push-ups</b>	4.43 ± 11	1.33 ± 3.1
<b>Sit-ups</b>	6.86 ± 22	13.5 ± 17.7
<b>Agility (T-Test)</b>	-0.57 ± 0.6	0.08 ± 0.1
<b>Est. VO2max (ml/kg/min)</b>	2.47 ± 1.1	3.98 ± 0.6

## Performance

### *Candidate Physical Ability Test (CPAT)*

We ran McNemar's Test (the nonparametric equivalent of a paired t-test for proportions for within subjects change) and found that neither group showed statistically significant differences in CPAT pass (P) rates from pre- to post-intervention, however the p-value for the CG was 1.000 (no change) and was 0.500 for TF20; with a larger sample size we may have seen a statistically significant difference in TF20 group. The average P rate for the Control Group at baseline was 50% and remained 50% post-intervention, this assumes those that were lost to



attrition failed post-intervention using an “intention to treat” model. The average P rate for TF20 group at baseline was 40% and improved to 86% after the intervention. The individual pass/fail rates and times for the CPAT are listed in Table 7 below. Though the CPAT is a timed test with a time limit of 10 minutes and 20 seconds we encouraged the participants to go through the entire course and we recorded their time (even above 10:20). This allowed us to observe improvements in time to completion, even if the candidate did not improve from a failing time to a passing time. We did have one participant who, though he had a failing time, completed the test at baseline. However, at post-intervention testing, the candidate chose not to complete the entire CPAT course after failing on the first event. Three participants were unable to take the CPAT test at baseline due to scheduling conflicts, two remained in the study and their post-intervention scores are listed; the other participant without a baseline CPAT score dropped the study shortly after baseline fitness testing.

**Table 7 CPAT PASS/FAIL SCORES & TIMES**

Participant	PASS/FAIL (BL)	TIME (BL)	PASS/FAIL (PT)	TIME (PT)
<b>CG-1</b>	P	8:57	P	8:21
<b>CG-2</b>	P	8:13	P	7:46
<b>CG-3</b>	P	9:39	P	8:31
<b>CG-4</b>	F	2:15	--	--
<b>CG-5</b>	--	--	--	--
<b>CG-6</b>	F	21:58	--	--
<b>TF20-1</b>	P	10:04	P	9:07
<b>TF20-2</b>	F	11:54	F	2:34
<b>TF20-3</b>	P	8:36	P	8:19
<b>TF20-4</b>	F	11:01	P	9:33
<b>TF20-5</b>	--	--	P	9:20

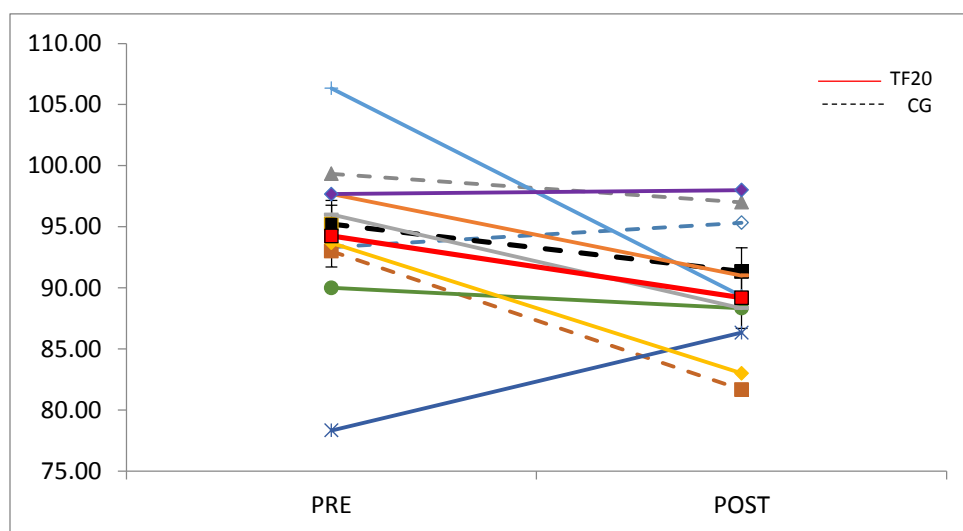
<b>TF20-6</b>	--	--	P	7:36
<b>TF20-7</b>	F	12:32	P	10:20

P=Pass; F=Fail; BL = baseline; PT = post intervention.

## Cardiovascular Measures

### *Mean Arterial Pressure (MAP)*

For all figures that follow, TF20 is shown with solid lines, TF20 mean is a red solid line; the CG is shown in dashed lines, the CG mean is a black dashed line. Both TF20 and the CG means show standard error. Individual responses are shown in Figure 2 below. The mean MAP decreased 0.89 ( $\pm 10.82$ ) mmHg in the Control Group (CG) and decreased 6.48 ( $\pm 10.97$ ) mmHg in TF20; neither of these differences in MAP were statistically significant.

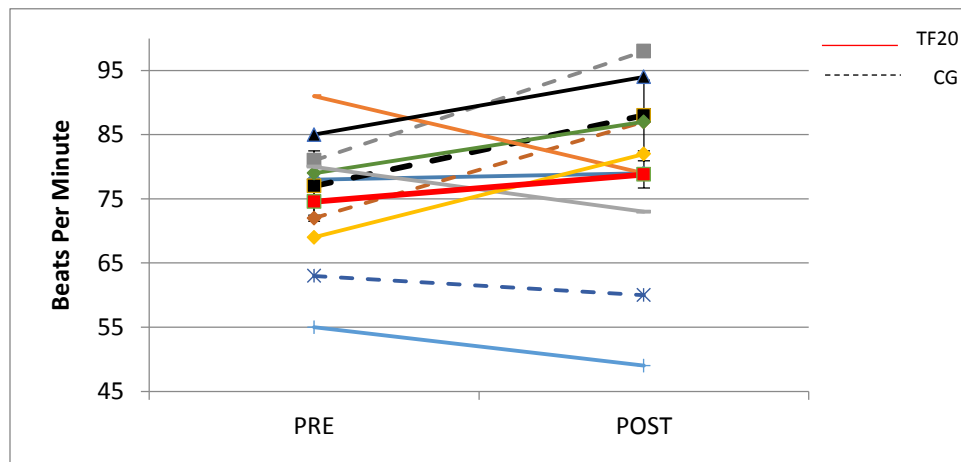


**Figure 2 Mean Arterial Pressure (MAP)**

### *RESTING HR*

Individual heart rate responses and group means are shown in Figure 3 below. Overall, the average resting heart rate (RHR) increased 10.78 ( $\pm 8.80$ ) bpm in the CG and increased 0.29 ( $\pm 9.30$ ) bpm in TF20. The differences in resting heart rate were not significant for either group.

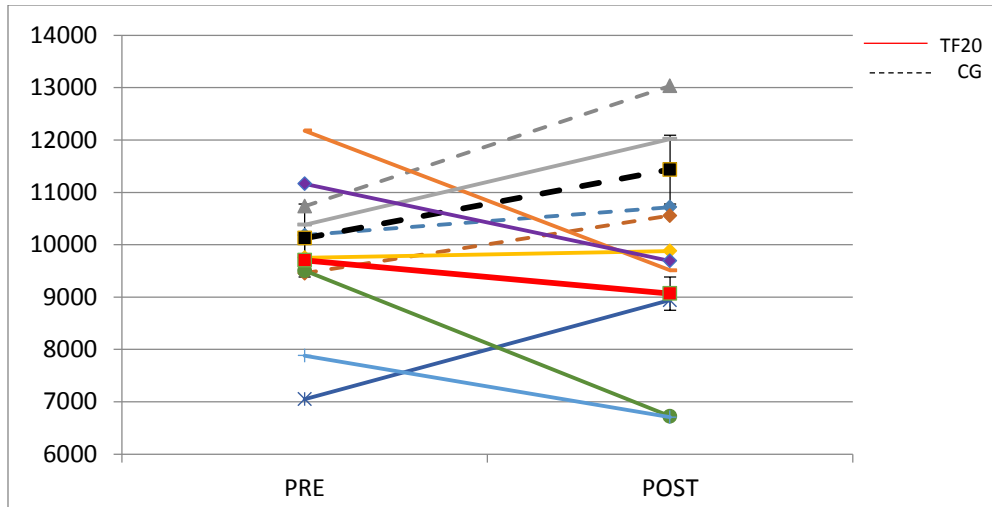
and could be explained by testing time of day, time since the participant's last meal, and recent physical activity level.



**Figure 3 Resting Heart Rate**

### ***RESTING RPP***

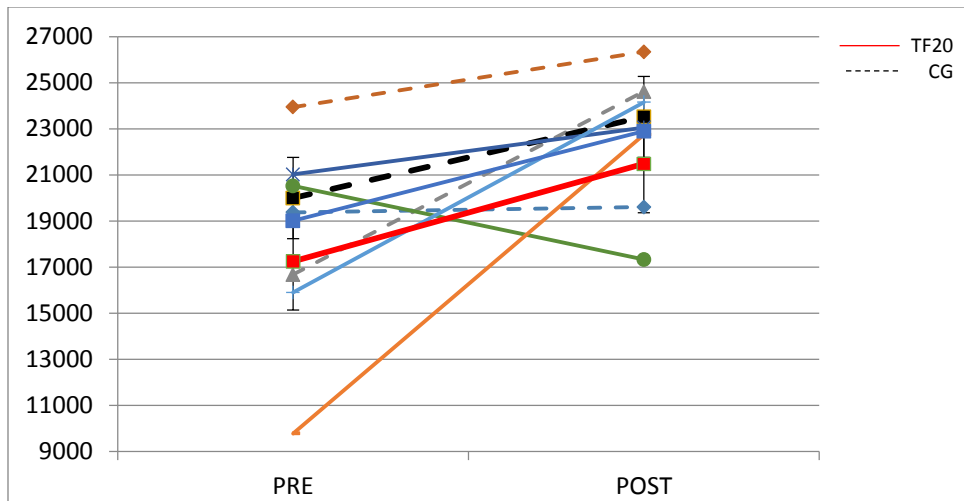
Individual resting RPP changes and group means are shown in Figure 4 below. As is expected, resting rate pressure product (RPP) was lower for all subjects than post-CPAT RPP. However, the only statistically significant difference was between TF20 groups' resting and post-CPAT RPP at post-intervention ( $p < 0.05$ ). The Control Group (CG) showed an average increase in resting RPP ( $+1310.78 \pm 900.53$  mmHg\*bpm) from pre- to post-intervention. TF20 group showed an overall mean decrease in resting RPP ( $-634.75 \pm 1132.05$  mmHg\*bpm) from pre- to post-intervention. This decrease in resting RPP suggests at rest there is a lower myocardial workload for those in TF20.



**Figure 4 Resting Rate Pressure Product (RPP)**

### ***POST CPAT RPP***

Individual post-exercise (post-CPAT) RPP responses and group means are shown in Figure 5 below. As mentioned before, post-exercise (post-CPAT) rate pressure product (RPP) were higher for all subjects than their resting RPP. Again, the only significant difference was between TF20 group's post-intervention resting and post-CPAT RPP ( $p < 0.05$ ). The Control Group (CG) showed an overall mean increase in post-CPAT RPP ( $+1310.78 \pm 900.53$  mmHg\*bpm) from pre- to post-intervention. TF20 group also showed an overall mean decrease in RPP ( $-634.75 \pm 1132.05$  mmHg\*bpm) from pre- to post-intervention, suggesting even at intense work rates, myocardial workload is reduced.

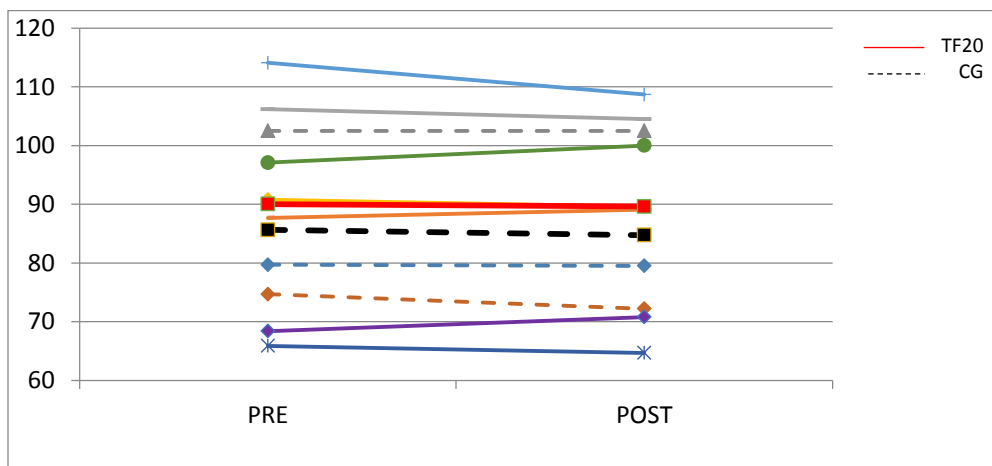


**Figure 5 Post-CPAT Rate Pressure Product (RPP)**

## Anthropometric Measures

### *WEIGHT*

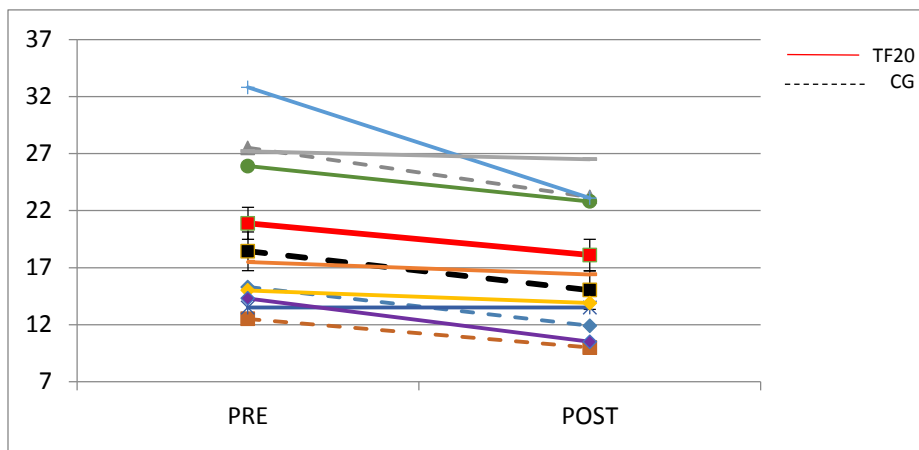
Individual weight changes and group mean differences are shown in Figure 6 below. On average, the Control Group participants' weight decreased 1.10 ( $\pm 1.28$ ) kg; the TF20 participants' average weight decreased 0.39 ( $\pm 2.91$ ) kg. We may not see statistically significant differences in body weight from pre- to post-intervention in TF20 group due to significant decreases in fat mass (kg) and a significant increase in lean tissue mass (kg) which may offset an overall change in body weight.



**Figure 6 Weight (kg)**

## ***FAT %***

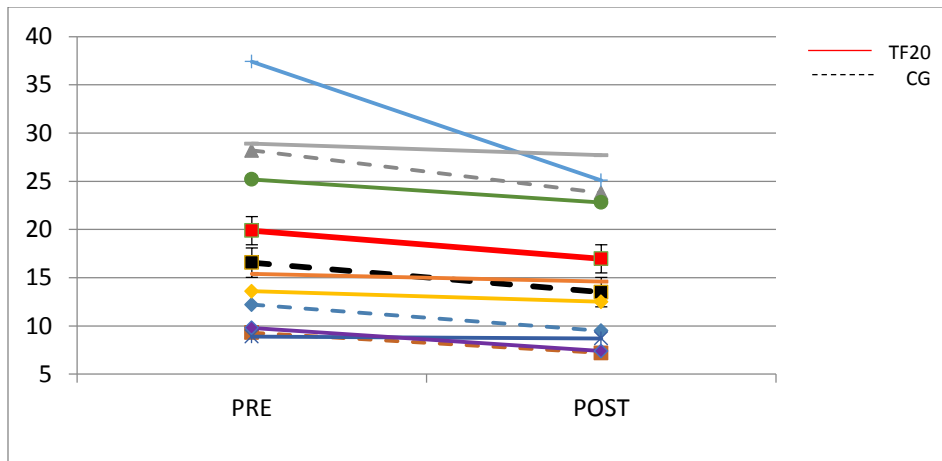
Individual body fat percentage responses and group means are shown in Figure 7 below. The Control Group showed an overall mean decrease of 3.03% in body fat percentage (Table 4). As shown in Table 3 above, TF20 showed a statistically significant decrease in body fat percentage of 2.09% ( $p = 0.018$ ).



**Figure 7 Percent Fat**

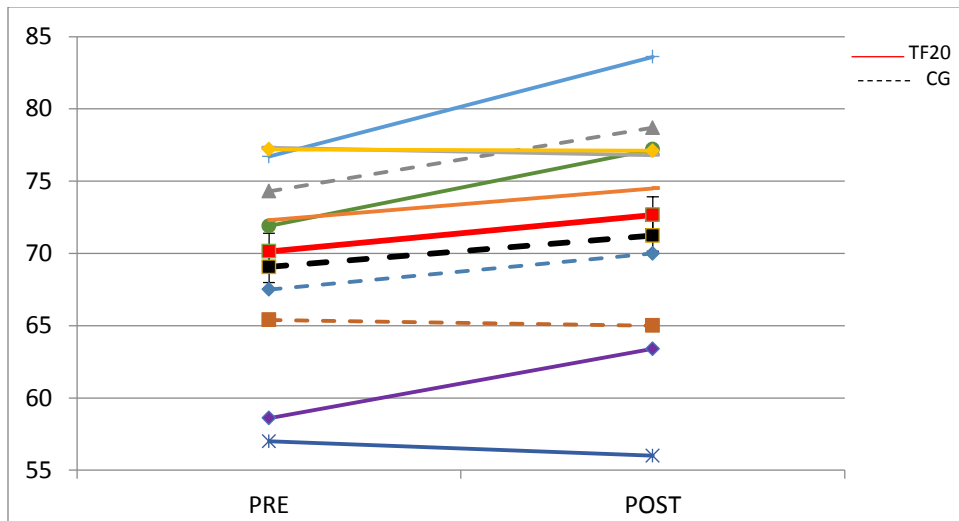
## ***FAT MASS KG***

Individual and group mean changes in fat mass are shown in Figure 8 below. The Control Group showed an overall mean decrease in fat mass of 2.83 ( $\pm 1.10$ ) kg (Table 4). As shown in Table 3 above, TF20 showed a statistically significant decrease in fat mass of 1.93 ( $\pm 1.19$ ) kg ( $p = 0.018$ ).



**Figure 8 Fat Mass (kg)**  
***FFM KG***

Individual and group mean changes are shown below in Figure 9 below. The Control Group showed an overall mean increase in fat free mass (FFM) of 6.47 ( $\pm 3.17$ ) kg. As shown in Table 3 above, TF20 showed a statistically significant increase in fat free (lean tissue) mass of 5.19 ( $\pm 4.00$ ) kg ( $p = 0.028$ ).

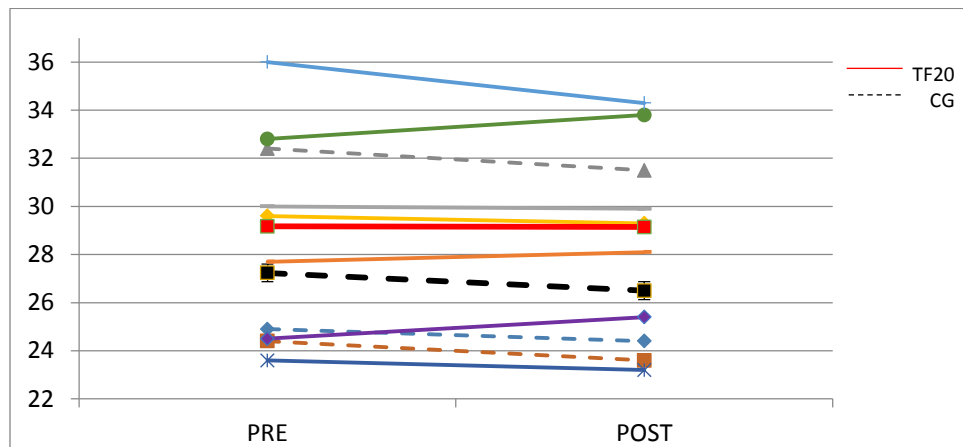


**Figure 9 Fat Free Mass (kg)**

### ***BMI***

Individual and group mean changes in BMI are shown below in Figure 9. The Control Group showed an overall mean decrease in Body Mass Index (BMI) of 0.73 ( $\pm 0.21$ ) kg/m<sup>2</sup>

(Table 4). The TF20 showed an overall mean decrease in BMI of  $0.03 (\pm 0.92) \text{ kg/m}^2$ . Similar to body weight, the reason we do not see statistically significant changes in BMI could be due to the fact that with a significant increase in lean mass and a significant decrease in fat mass, weight stayed relatively the same.



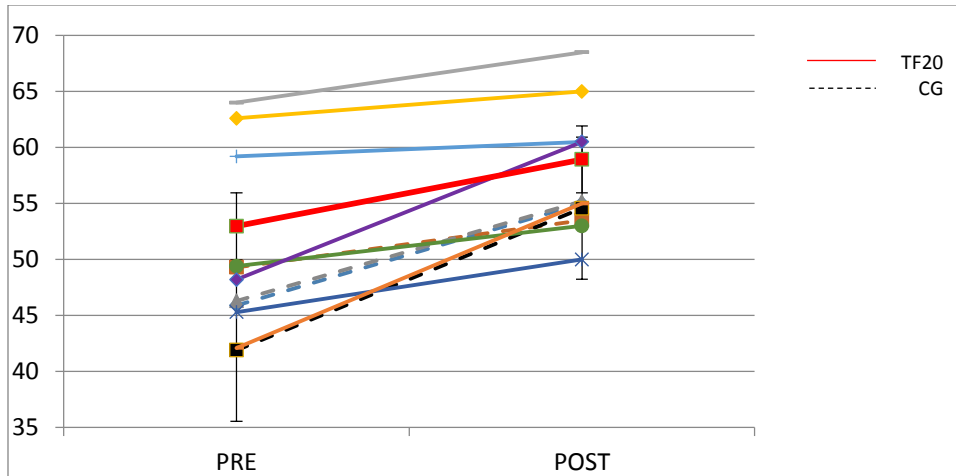
**Figure 10 Body Mass Index (BMI)**

## **Fitness Measures**

### ***GRIP STRENGTH – UNADJUSTED***

Individual and group mean changed in unadjusted grip strength are shown in Figure 11 below. The Control Group showed an overall mean increase in unadjusted grip strength of  $7.4 \pm 2.77 \text{ kg}$ . The TF20 showed a statistically significant increase of  $5.96 \pm 4.69 \text{ kg}$  ( $p = 0.018$ , see Table 3).

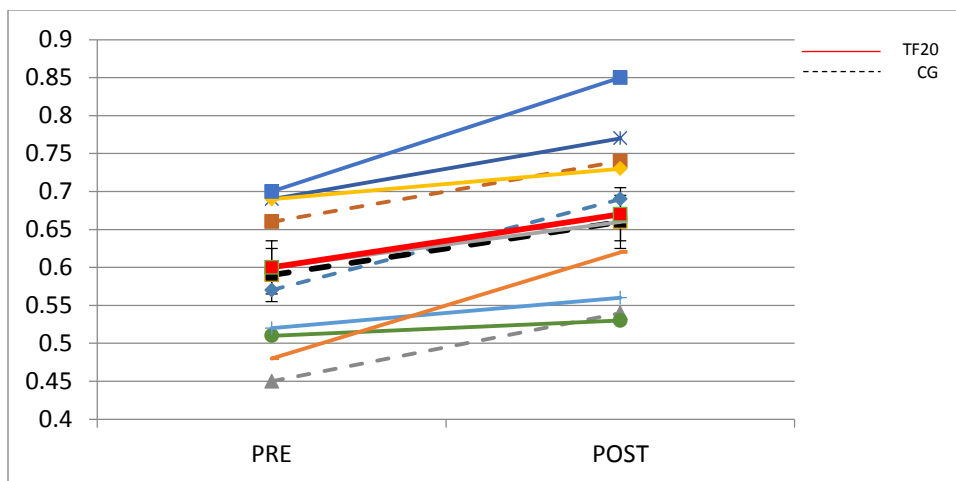




**Figure 11 Grip Strength (Unadjusted)**

### ***GRIP STRENGTH – ADJUSTED***

The individual and group changes in adjusted grip strength are shown in Figure 12 below. The Control Group showed an overall mean increase of  $0.09 \pm 0.02$  kg. The TF20 showed a statistically significant increase of  $0.08 \pm 0.06$  kg ( $p = 0.018$ , see Table 3).

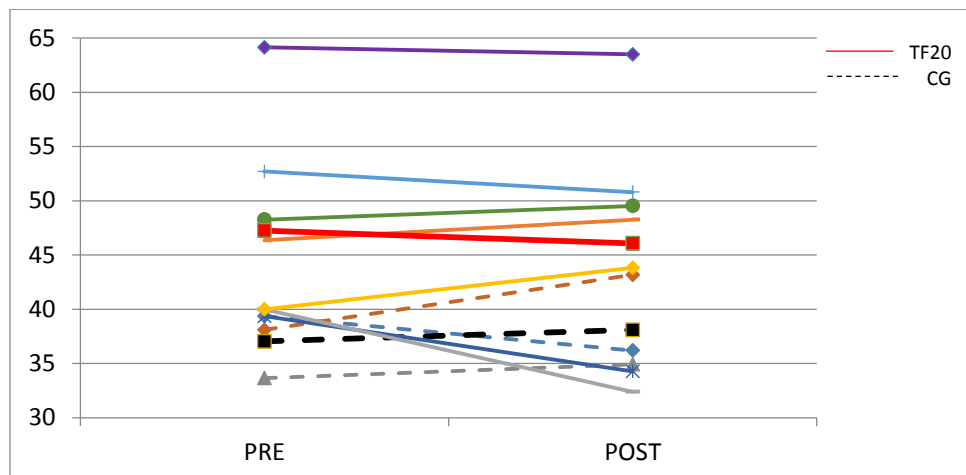


**Figure 12 Grip Strength (Adjusted)**

### ***SIT & REACH (cm)***

Individual and group mean changes in flexibility are shown in Figure 13 below. The Control Group showed an average increase in flexibility of  $2.42 (\pm 4.91)$  cm. The TF20 showed

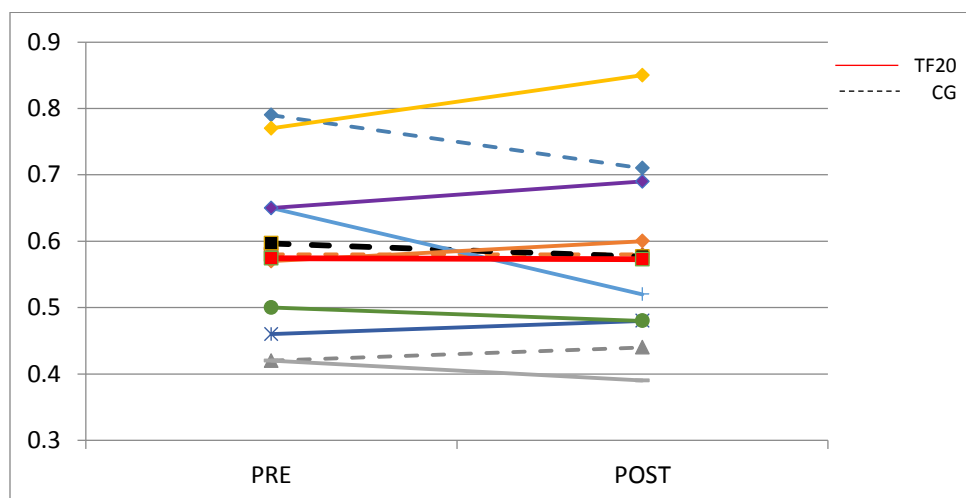
an average increase in flexibility of  $2.96 (\pm 3.02)$  cm; neither group showed statistically significant differences.



**Figure 13 Sit & Reach (cm)**

### ***VERTICAL JUMP (m)***

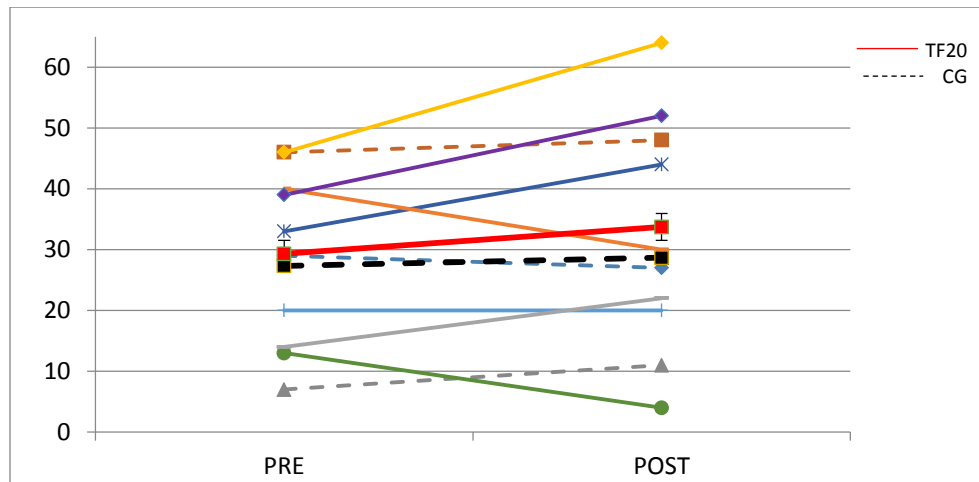
Individual scores and group means for the vertical jump (m) are shown in Figure 14 below. Neither the CG nor TF20 group showed changes in their vertical jump height from pre- to post-intervention.



**Figure 14 Vertical Jump (m)**

## ***PUSH-UPS***

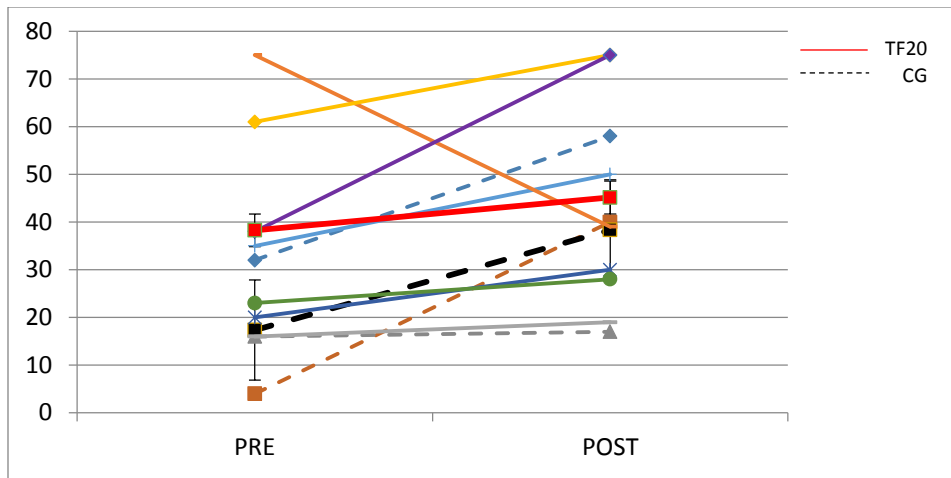
Individual and group mean changes in push-ups are shown in Figure 15 below. The Control Group showed an overall mean increase of 1.33 ( $\pm 3.06$ ) push-up repetitions (reps). The TF20 showed an overall mean increase of 4.43 ( $\pm 10.97$ ) reps. Neither group showed statistically significant changes from pre- to post-intervention.



**Figure 15 Push-Ups**

## ***SIT-UPS***

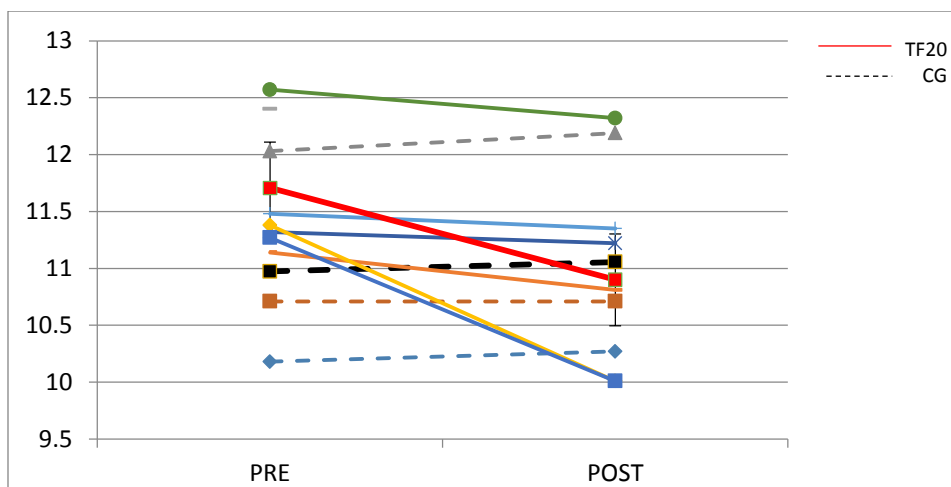
Individual and group mean changes in sit-ups are shown in Figure 16 below. The Control Group showed an overall mean increase in sit-ups of 21 reps. The TF20 showed an overall mean increase of 7 reps; neither group significantly changed from pre- to post-intervention.



**Figure 16 Sit-Ups**

### ***AGILITY (T-TEST)***

Individual and group mean changes in agility times are shown in Figure 17 below, and a summary table (Table 8) is provided with each participant's time at pre- and post-intervention. The Control Group showed an overall mean increase in t-test time of 0.08 sec. The TF20 showed a statistically significant decrease in t-test time (average -0.57 sec.,  $p = 0.028$ , see Table 3).



**Figure 17 Agility T-Test**

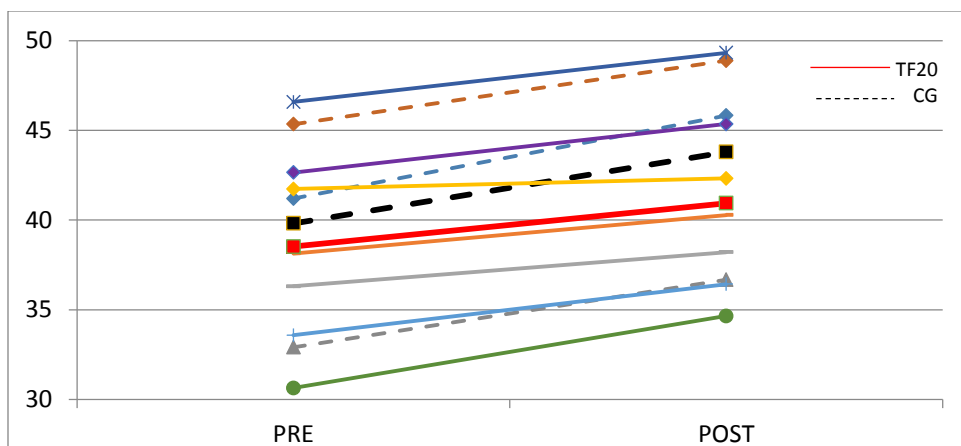
**Table 8 Agility (T-Test)**

<b>Participant</b>	<b>PRE (ss:hh)</b>	<b>POST (ss:hh)</b>
<b>CG-1</b>	10:18	10:27
<b>CG-2</b>	10:71	10:71
<b>CG-3</b>	12:03	12:19
<b>CG MEAN</b>	10:97	11:06
<b>TF20-1</b>	11:32	11:22
<b>TF20-2</b>	12:57	12:32
<b>TF20-3</b>	11:48	11:35
<b>TF20-4</b>	11:14	10:81
<b>TF20-5</b>	12:40	--
<b>TF20-6</b>	11:38	10:01
<b>TF20-7</b>	11:27	10:01
<b>TF20 MEAN</b>	11.65	10.95

***EST. VO<sub>2max</sub> (ml/kg/min)***

Individual and mean group changes in estimated VO<sub>2max</sub> are shown in Figure 18 below.

The Control Group showed an overall mean increase in VO<sub>2max</sub> by 3.98 ml/kg/min. The TF20 showed a statistically significant increase in VO<sub>2max</sub> of 2.42 ml/kg/min (p = 0.028, see Table 3).



**Figure 18 Estimated  $VO_{2max}$**

## Feasibility Analysis

In order to examine the strengths and weaknesses of The First Twenty intervention, a feasibility analysis was conducted with TF20 participants. Participants were asked about adherence, if they found the workouts challenging, any issues they faced, and suggestions for future exercise interventions offered at the Fire Academy. TF20 participants completed approximately 75% of the assigned workouts, accounting for all workouts participants completed, including those the system did not log. Participants noted experiencing difficulties logging into the application (app) on their mobile device. They reported that sometimes the app would correctly reflect that they had completed and logged a workout and sometimes the system did not keep their progress saved after they logged out of the application. Participants also noted it was difficult to maintain a workout regimen during the intense 12 credit hour Fire Academy. Although the exercise program was designed to be flexible so participants could complete workouts virtually anywhere, numerous participants noted they had a hard time completing the workouts without access to a gym or fire station. This study differs from other firefighter studies because the recruits were actually going through a structured fire academy (4 days/week); they

had course work, class hours, homework, tests, etc. to focus on in addition to physical fitness.

Also, the current Fire Academy does not account for time to exercise/train physically during the course. Multiple participants noted that having a structured exercise program with a trained individual to lead them through a workout may be more beneficial than participants trying to work out on their own.

## Chapter 5 - Discussion

During this pilot study, we examined the feasibility of offering TF20 training program at the fire academy (entry firefighter) level. This study examined the program's effectiveness in "real world conditions" to determine if this training was relevant to physically training firefighter recruits as they progressed through a fire academy. The purpose of this study was to determine whether a novel training program would improve the physical fitness and performance of recruit firefighters. The findings from this study indicated TF20 was not detrimental to performance, but in a small sample of the population it was difficult to determine if TF20 improved recruit fitness and performance or if improvements could be attributed to the physical nature of the Fire Academy or other covariates. However, even accounting for a small sample size, we were able to show multiple measures of health and fitness significantly improved in TF20 group (see Table 3 of Results) compared to the CG.

It is interesting to note that prior to participation in the training program, the firefighter recruits in this study (both groups) possessed an aerobic capacity below that deemed essential for safe and effective fireground operations. Previous reports have stated that the most demanding firefighter tasks, which were also the most commonly encountered, demanded a mean  $\text{VO}_2$  of 41.5 ml/kg/min (range of 36.6-44.0 ml/kg/min) (Gledhill & Jamnik, 1992). The WFI recommends maximal oxygen uptake of at least 42 ml/kg/min in order to meet the aerobic demands of the job (IAFF, 2007). Prior to training, fire recruits in this study possessed an estimated average  $\text{VO}_{2\text{max}}$  of 38.91 ml/kg/min (CG mean = 39.82ml/kg/min, TF20 mean = 38.52 ml/kg/min). After the 10-week intervention the CG showed a mean estimated  $\text{VO}_{2\text{max}}$  of 43.79 ml/kg/min and TF20 group showed a mean estimated  $\text{VO}_{2\text{max}}$  of 40.94 ml/kg/min. The ACSM classifies  $\text{VO}_{2\text{max}}$  values between 38.0-41.0 ml/kg/min in the "poor" range for males between the



ages of 20-29 years, clearly showing a need to better prepare firefighter recruits for the physical demands of firefighting (ACSM, 2014). This also shows that the general public may not be as fit as they should be, thereby effectively lessening those qualified for physically demanding jobs such as firefighting and other tactical occupations (military and police).

The CDC has recommended guidelines for aerobic and strength training for substantial health benefits (CDC, 2016). The recommendations for adults ( $\geq 18$  years) are: at least 150 minutes/week of moderate physical activity or at least 75 minutes of vigorous physical activity (or a combination of both) in addition to at least two days/week muscle strengthening activities (CDC, 2016). At baseline, 67% of the CG reported meeting moderate/vigorous Physical Activity Guidelines; 80% of TF20 group reported meeting the guidelines. After the intervention, 100% of the participants in both groups ( $n=10$ ) reported meeting/exceeding Physical Activity Guidelines including strength training. This may be due, in part, to the physically demanding nature of the Fire Academy. The questionnaire asked about recent physical activity and exercise (within the past 30 days) and described the categories as follows: moderate physical activity: exertion that raises the heart rate and breathing, but you should be able to carry on a conversation comfortably during the activity. Vigorous physical activity was defined as exertion that is high enough that you would find it difficult to carry on a conversation during the activity. Fire ground activities may fit into either of these categories so the nature of the Fire Academy itself, may be the reason for the increase in apparent guideline adherence.

Body composition has been shown to be significantly related to firefighting performance (Michaelides, Parpa, Henry, Thompson, & Brown, 2011). Similar to Roberts and associates, (2002), body composition improved overall after the 10-week intervention (See Tables 3 and 4). Both groups in this study decreased weight and percent fat mass (Tables 3 & 4). Fat free mass

(FFM), or lean mass, increased in both groups (Tables 3 & 4). Though BMI did not significantly change, it did decrease in both groups (Tables 3 & 4). Increases in lean mass and decreases in fat mass may have offset a change in total body weight; however this change in body composition may allow the recruits to function more safely and efficiently on the fire ground. Changes in body composition may also be due to the physically demanding nature of the Fire Academy considering both groups saw improvements, however TF20 saw statistically significant improvements in body composition where the CG did not (See Tables 3 & 4).

Systolic BP is a risk factor for coronary artery disease and stroke and hypertension is a strong predictor of on-duty coronary events in firefighters (Geibe et al., 2008; Kannel et al., 1981). Fahs et al., (2009) found that obese firefighters had greater arterial stiffness, which is associated with the presence of atherosclerosis (Fahs et al., 2009). Both groups showed an overall decrease in their mean arterial pressure (MAP), therefor lowering their potential risk for CVD.

The product of heart rate (HR) and systolic blood pressure (rate pressure product [RPP]) offers a reliable index of myocardial oxygen demand and serves as an indicator of the cardiovascular and metabolic stress placed on the heart during strenuous activity (Sheaff et al., 2010). While the CG showed an increase in resting RPP from pre- to post-intervention (+1311 mmHg\*bpm), TF20 group showed an overall mean decrease in resting RPP (-635 mmHg\*bpm) from pre- to post-intervention, indicating that they may have a lower risk of CVD. Post-exercise (post-CPAT) RPP actually increased in both the CG and TF20 from pre- to post-intervention. This increase may be due to a higher level of effort on the final CPAT; therefore a higher heart rate and blood pressure were noted post-test, indicating they can tolerate an increased intensity.

Strength and muscular endurance are important factors for firefighters as they must be able to possess high levels of strength to be able to lift and carry heavy equipment or rescue a victim, often for prolonged periods of time (Michaelides et al., 2011). Grip strength significantly improved in the TF20 group, even after being adjusted for body weight. Though other strength measures assessed in this study did not reach statistical significance, improvements may be greater with a longer duration intervention (ie: a 16-week long intervention). Roberts et al., 2002, found improved muscular endurance and flexibility at the end of a 16-week training program (Roberts et al., 2002).

The CPAT is a critical performance measure to examine. In order to become a firefighter, most departments across the United States require the candidate to pass the CPAT or a similar physical agility test. Any firefighter physical fitness program must specifically prepare firefighters to safely and efficiently complete fireground tasks and the CPAT is a valid and reliable way to examine their ability to do so (IAFF, 2007). The CG (n=3) had a 100% pass rate on the CPAT at baseline and post-intervention. TF20 training group (n=7) showed marked improvement on their CPAT (40% passing at baseline to 86% passing post-intervention). The CG improved their time by an average of 43.67 seconds; TF20 group improved their time by an average of 73.50 seconds (1 min, 13.5 sec.). There were three TF20 group participants who failed to complete the test in under 10 minutes and 20 seconds at baseline, however post-intervention, only one participant failed the test (\*fail time of 2:34, participant could not complete Event 1 - Stair climb). As previously shown, physical ability tests are related to several fitness and body composition parameters (Michaelides et al., 2011). Improvement on fitness, performance, and strength measures are correlated to improvements on physical tests such as the CPAT.

Firefighting is an extremely dangerous and physically demanding job requiring high levels of fitness to perform safely and efficiently (Michaelides et al., 2011). Results from this study can guide development of a fire academy-specific training program to begin instilling the importance of a fit fire service early in the firefighter's career. Findings from this and other fitness intervention studies support the development and implementation of physical training programs for firefighters (Abel et al., 2011; Roberts et al., 2002). This study shows that a longer intervention (> 10 weeks) may be beneficial as the current 10-week intervention did not show as many improvements as some 16-week interventions (Abel et al., 2011; Roberts et al., 2002). However, Heinrich et al. saw fitness improvements in only 8-weeks of trainer-led circuit-based training (Heinrich et al., 2012). This emphasizes how the intervention is delivered (i.e. structured workouts delivered by a strength and conditioning coach versus self-directed workouts) is crucial to its success. Study results can also help establish effects of TF20 exercise program and can provide effect sizes and parameter estimates necessary for the design of a larger randomized controlled trial. TF20 program must be examined in a larger population to determine if the program significantly impacts the fitness and performance of firefighter recruits as well as career and volunteer firefighters.

## **Limitations**

### ***Analysis***

This study was designed primarily as a feasibility pilot study, with the goals of testing the feasibility of implementing the intervention, carrying out the assessment protocol, and deriving parameter estimates for the primary outcomes and attrition. Thus, this study was never envisioned as a full-scale and optimally powered randomized controlled trial. Given the pilot nature of this study, there are several limitations that should be noted. First, the study was limited

by the small initial sample size ( $n=13$ ), which limited power to detect potentially important intervention effects. Participants were recruited from a fire academy over two hours away because there were no local fire academies and most states have limited numbers of fire academies. In addition, the fire academy from which we recruited only had a very small initial group from which we could recruit ( $n=24$ ), thus limited our starting sample size.

Second, because this was a pilot study with minimal funding and participants were recruited from a fire academy several hours away, we were limited in the amount of contact we could provide participants and were unable to offer any incentives, which is common practice in exercise studies. This resulted in a second study limitation, which was high and differential attrition in the control group (50%) vs. 0% in TF20 group. This high attrition in the control group and the small initial sample led to an even smaller post-treatment sample size for the completers analysis (and further limited power to detect group differences in outcomes), as well as negatively impacting our ability to address missing data using common imputation methods for intention-to-treat analysis as suggested in the CONSORT Guidelines for clinical trials.

A third study limitation that was also impacted by the small initial sample size was the fact that the groups were not equivalent at the beginning of the study even though we randomized participants to conditions. As noted in Table 1, at baseline, TF20 participants were substantially heavier (over  $5.3 \text{ kg/m}^2$  BMI units, which is roughly equivalent to 38 lbs. heavier) and had substantially lower estimated  $\text{VO}_{2\text{max}}$  (i.e. almost  $4 \text{ ml/kg/min}$  lower) than those assigned to the CG. While these differences were not statistically significant, this is likely only because of the small initial sample size, but the magnitude of these differences is substantial and should not be discounted. Thus, given the non-equivalence of the groups with respect to these factors that could potentially impact any outcomes analyses because of their association with

primary outcomes like CPAT times and completion, strength, agility, and muscle and aerobic endurance (Michaelides et al., 2008), it would be necessary for all outcomes analyses to be adjusted for the group differences by using ANCOVA for all continuous outcomes and logistic regression for CPAT passing percentage. However, the small sample size at study completion would have resulted in virtually all outcomes showing no significant group differences simply because of the sample size.

As an example of this problem, we conducted power analyses and estimated sample sizes needed to detect important performance differences between groups based on previous studies (e.g. Roberts et al., 2002; Pawlak et al., 2015). For example, based on these studies, we determined that a difference of 4-5 pushups between TF20 and CG participants would be a clinically meaningful difference given that both groups were involved in an active exercise program. In order to detect a difference of that magnitude using the variance estimates derived from study participants, we would have needed a post-intervention sample size of 30/group ( $n=60$ ) to detect this difference with power set to 80%. Similarly, to detect a difference of 1.5 ml/kg/min in estimated  $VO_{2max}$  given the variance estimates in this sample, we would have needed a final post-treatment sample size of 16 (8/group). Thus, given that the sample size limited the likelihood of finding statistically significant differences between TF20 and CG groups, it seemed prudent to focus on a descriptive analytic approach and only conduct inferential tests within TF20 group to document pre-test, post-test changes.

### ***Feasibility***

Research done in a “field” setting is not as controlled as a laboratory setting. This workout intervention was designed to be independent so we relied on self-reported data for workout completion. The participants were asked to log all their activity online as they accomplished

it to avoid recall bias, however some participants did not record their activity as they progressed through, instead waited until the end of the intervention to recall what they had completed. It was also difficult conducting research away from our laboratory. As mentioned above, the two hour distance from our lab to the JCCC Fire Academy caused scheduling conflicts as we had to schedule the participants in large groups rather than allowing them to come into the lab whenever they were available. This resulted in some data not being collected from some participants.

### ***Self-report Bias***

Participants, knowing they were supposed to report activity, may have logged more activity than they actually completed or may have worked out more than they would have if they did not have to report activity.

### ***Recruitment***

As mentioned above, this was not a fully powered trial; the analysis we are using is based on a small sample size. We could run more thorough statistical analysis if we had a larger participant pool, which is the next step.

### ***Selection Bias***

Making the two groups (control and intervention) as homogenous as possible was difficult with a small sample size and though the groups started out nearly equal in size, due to drop-outs the groups ended up rather unequal (n=3 and n=7).

## **Chapter 6 - Conclusion**

The purpose of this pilot investigation was to examine the effects of The First Twenty Exercise Training Program on fire academy recruits' health, fitness, and performance. This study is the first to systematically document the effects of TF20 and is one of few to examine firefighter recruits specifically. This investigation provides promising results for the efficacy of high-intensity training programs designed for the fire service. This study provides effect sizes and parameter estimates necessary for the design of a larger randomized controlled trial and provides alternative guidance for exercise prescription specifically for firefighters.

Firefighting is an extremely dangerous and physically demanding occupation. Fire recruits aiming to enhance aerobic capacity, muscular strength, body composition, and performance may benefit from TF20 Program. TF20 significantly improved aerobic fitness, body composition, strength, and agility among fire academy recruits.

Results from this study can guide development of a fire academy-specific training program to begin instilling the importance of a fit fire service early in the firefighter's career. Findings from this and other fitness interventions support the development and implementation of physical training programs for firefighters. This study shows that a longer intervention (>10 weeks) may be beneficial as the current 10-week intervention did not show as many improvements as some 16-week interventions. However, Heinrich et. al. saw fitness improvements in only 8-weeks of trainer-led circuit-based training. This emphasizes how the intervention is delivered (i.e. structured workouts delivered by a strength and conditioning coach versus self-directed workouts) is crucial to its success.

Further investigation is necessary with a larger sample population to examine different types of physical training and its effect on the firefighter population, specifically firefighter



recruits. The First Twenty intervention is currently being examined in a national sample of volunteer firefighters as well. The intervention is being tailored for use in a clinic-based setting. The synergy created by linking the TF20 intervention components, feedback to volunteer firefighters from their medical exam, and health messages from their physician is predicted to maximize the impact of the intervention.

## Chapter 7 - References

- Abel, M.G., Mortara, A.J., Pettitt, R.W. (2011). Evaluation of circuit-training intensity for firefighters. *Journal of Strength and Conditioning Research*, 25(10), 2895-2901.
- Abel, M. G., Palmer, T. G., & Trubee, N. (2015). Exercise program design for structural firefighters. *National Strength and Conditioning Association*, 37(4), 2895-2901.
- Abel, M. G., Sell, K., & Dennison, K. (2011). Design and implementation of fitness program for firefighters. *Journal of Strength and Conditioning*, 31-42.
- Adams, G. M. (1988). *Exercise physiology, laboratory manual* (3rd Ed. ed.). Boston: McGraw-Hill.
- American College of Sports Medicine (ACSM). (2001). *ACSM's Guidelines for exercise testing and prescription*. Baltimore, MD: Lippincott, Williams, & Wilkins.
- Barnard, R. J., & Duncan, H. W. (1975). Heart rate and ECG responses of fire fighters. . *Journal of Occupational Medicine*, 17(4), 247-250.
- Brown, L. E. (2012). Assessing agility using the T test, 5-10-5 shuttle, and Illinois test. *NSCA's guide to program design*, 40.
- Carter, J., Rayson, M., Wilkinson, D., Richmond, V., & Blacker, S. (2007). Strategies to combat heat strain during and after firefighting. *Journal of Thermal Biology*, 32(2), 109-116.
- Centers for Disease Control and Prevention (CDC). (2015). *Adult obesity facts*. Retrieved from <http://www.cdc.gov/obesity/data/adult.html>.
- Clark, S., Rene, A., Theurer, W. M., & Marschall, M. (2002). Association between body mass index and health status in firefighters. *Journal of Occupational and Environmental Medicine*, 44, 940-946.
- Dennison, K. J., Mullineaux, D. R., Yates, J. W., & Abel, M. G. (2012). The effect of fatigue and training status on firefighter performance. *Journal of Strength and Conditioning Research*, 1101-1109.
- DeVries, H. A. (1980). *Physiology of exercise in physical education and athletics*. (2nd ed.). Dubuque, IA: William C. Brown.
- Durand, G., Tsismenakis, A. J., Jahnke, S. A., Baur, D. M., Christophi, C. A., & Kales, S. A. (2011). Firefighters physical activity: Relation to fitness and cardiovascular disease risk. *Medicine & Science in Sports & Exercise*, 43(9), 1752-1759. doi:10.1249/MSS.0b013e318215cf25.
- Elliot, D., Goldberg, L., Kuehl, K., Moe, E., Breger, R., & Pickering, M. (2007). The PHLAME (promoting healthy lifestyles: Alternative models' effects) firefighter study: Outcomes of

two models of behavior change. *Journal of Occupation Environmental Medicine*, 49(2), 204-213.

Fahs, C. A., Smith, D. L., Horn, G. P., Agiovlasitis, S., Rossow, L. M., Echols, G.,...Fernhall, B. (2009). Impact of excess body weight on arterial structure, function, and blood pressure in firefighters. *American Journal of Cardiology*, 104, 1441-1445.

Fahy, R. F., LeBlanc, R. P., & Molis, J. L. (2015). Firefighter fatalities in the united states-2014. *National Fire Protection Association Fire Analysis and Research Division*.

Geibe, J. R., Holder, J., Peeples, L., Kinney, A. M., Burress, J. W., & Kales, S. N. (2008). Predictors of on-duty coronary events in male firefighters in the United States. *American Journal of Cardiology*, 101, 585-589.

Gledhill, N., & Jamnik, V. (1992). Characterization of the physical demands of firefighting. *Canadian Journal of Sport Sciences*, 207-213.

Haddock, C. K., Poston, W. S. C. & Jahnke, S. A. (2011). *Addressing the epidemic of obesity in the united states fire service: A report prepared for the national volunteer fire council*. Retrieved from [http://www.nvfc.org/files/documents/Obesity\\_Study.pdf](http://www.nvfc.org/files/documents/Obesity_Study.pdf).

Haynes, H. J. G., & Molis, J. L. (2015). U.S. firefighter injuries: 2014. *National Fire Protection Association Fire Analysis and Research Division*.

Heinrich, K. M., Spencer, V., Fehl, N., & Poston, W. C. S. (2012). Mission essential fitness: Comparison of functional circuit training to traditional army physical training for active duty military. *Military Medicine*, 10(177), 1125-1130.

International Association of Firefighters (IAFF). (2007). *The fire service joint labor management wellness-fitness initiative candidate physical ability test, 2<sup>nd</sup> edition*. Retrieved from <https://www.iaff.org>.

International Association of Firefighters (IAFF). (2008). *The fire service joint labor management wellness-fitness initiative*. Retrieved from <https://www.iaff.org>.

Jahnke, S. A., Hyder, M. L., Haddock, C. K., Jitnarin, N., Day, R. S., & Poston, W. S. C. (2015). High-intensity fitness training among a national sample of male career firefighters. *Safety and Health at Work*, (6), 71-74.

Kales, S., Soteriades, E., Christophi, C., & Christiani, D. (2007). Emergency duties and deaths from heart disease among firefighters in the United States. *National England Journal of Medicine*, 356(12), 1207-1215.

Kannel, W. B., Wolf, P. A., McGee, D. L., Dawber, T. R., McNamara, P., & Castelli, W. P. (1981). Systolic blood pressure, arterial rigidity, and risk of stroke: The Framingham study. *Journal of the American Medical Association*, 245, 1225-1229.

- Mier, C.M., & Gibson, A.L. (2004). Evaluation of a treadmill test for predicting the aerobic capacity of firefighters. *Occupational Medicine*, 54:373–378. doi:10.1093/occmed/kqh008.
- Michaelides, M. A., Parpa, K. M., Henry, L. J., Thompson, G. B., & Brown, B. S. (2011). Assessment of physical fitness aspects and their relationship to firefighters' job abilities. *Journal of Strength and Conditioning Research*, 25(4), 956-965.
- Pallant, J. (Ed.). (2005). *SPSS survival manual: A step by step guide to data analysis using SPSS for Windows (version 12)* (2nd ed.). Australia: Allen & Unwin.
- Patton, M. (2002). *Qualitative research and evaluation methods*. Thousand Oaks, CA.: SAGE.
- Pawlak, R., Clasey, J. L., Palmer, T., Symons, T. B., & Abel, M. G. (2015). The effect of a novel tactical training program on physical fitness and occupational performance in firefighters. *Journal of Strength and Conditioning*, 29(3), 578-588.
- Peterson, M.D., Dodd, D.J., Alvar, B.A., Rhea, M.R., & Favre, M. (2008). Undulation training for development of hierarchical fitness and improved firefighter job performance. *Journal of Strength and Conditioning Research*, 22(5), 1683-1695.
- Poston, W. S., Haddock, C. K., Jahnke, S. A., Jitnarin, N., Tuley, B. C., & Kales, S. N. (2011). The prevalence of overweight, obesity, and substandard fitness in a population-based firefighter cohort. *Journal of Occupational and Environmental Medicine*, 53(3), 266-273.
- Roberts, M. A., O'Dea, J., Boyce, A., & Mannix, E. (2002). Fitness levels of firefighter recruits before and after a supervised exercise training program. *Journal of Strength and Conditioning Research*, 16(2), 271-277.
- Selkirk, G., McLellan, T., & Wong, J. (2004). Active versus passive cooling during work in warm environments while wearing firefighting protective clothing. *Journal of Occupational and Environmental Hygiene*, 1(8), 521-531.
- Sheaff, A. K., Bennett, A., Hanson, E. D., Kim, Y., Hsu, J., Shim, J. K.,... Hurley, B. F. (2010). Physiological determinants of the candidate physical ability test in firefighters. *Journal of Strength and Conditioning Research*, 24(11), 3112-3122.
- Smith, D., Manning, T., & Petruzzello, S. (2001). Effect of strenuous live-fire drills on cardiovascular and psychological responses of recruit firefighters. *Ergonomics*, 44(3), 244-254.
- Smith, D., & Petruzzello, S. (1998). Selected physiological and psychological responses to live-fire drills in different configurations of firefighting gear. *Ergonomics*, 41(8), 1141-1154.
- Smith, D., Petruzzello, S., Chludzinski, M., Reed, J., & Woods, J. (2005). Selected hormonal and immunological responses to strenuous live-fire firefighting drills. *Ergonomics*, 48(1), 55-65.

Soteriades, E. S., Hauser, R., Kawachi, I., Liarokapis, D., Christiani, D. C., & Kales, S. N. (2012). Obesity and cardiovascular disease risk factors in firefighters: A prospective cohort study. *Descriptive Epidemiology*, 13(10), 1756-1763.

## Appendix A - Physical Activity Readiness Questionnaire (PAR-Q)

# PAR-Q & YOU

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

- 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
- 2. Do you feel pain in your chest when you do physical activity?**
- 3. In the past month, have you had chest pain when you were not doing physical activity?**
- 4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
- 5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
- 6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
- 7. Do you know of any other reason why you should not do physical activity?**

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.



**PLEASE NOTE:** If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

CONSENT

## **Appendix B - Informed Consent**

### **KANSAS STATE UNIVERSITY**

#### **INFORMED CONSENT**

**PROJECT TITLE:**

The First 20 Exercise Training Program and Fire Academy Recruits' Fitness and Health

**APPROVAL DATE OF PROJECT: 01/04/2016**

**EXPIRATION DATE OF PROJECT: 01/04/2017**

**PRINCIPAL INVESTIGATORS:**

- Brittany S. Hollerbach, BS – Kansas State University (KSU)
- Katie M. Heinrich, PhD – KSU

**CO-INVESTIGATOR(S):**

- Sara A. Jahnke, PhD – National Development and Research Institutes (NDRI)
- Craig Harms, PhD – KSU
- Tom Barstow, PhD – KSU

**CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS:**

- Dr. Heinrich (785) 532-7771

**IRB CHAIR CONTACT/PHONE INFORMATION:**

- Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

**SPONSOR OF PROJECT:** Arts, Humanities & Social Sciences Small Grant Program,  
Hollerbach (PI) 1/16-5/16

*The First 20 Exercise Training Program and Fire Academy Recruits' Fitness and Health*

Amount: \$1,000

**PURPOSE OF THE RESEARCH:**

The purpose of this research project is to test the effectiveness of The First Twenty Tactical High Performance Program (TF20) compared to usual care firefighter cadet physical training in fire

academy recruits for improving body composition, fitness, cardiovascular health, and psychosocial outcomes. The information gathered during this study will provide critical data for firefighter health leadership and physical fitness programming.

#### **PROCEDURES OR METHODS TO BE USED:**

This study includes baseline assessment, 14-weeks of group exercise training, and a post-test assessment. Your group (company) will be randomly assigned to one of two exercise programs: TF20 or the Comparison Group (CG). Both groups will exercise five days per week for 14 weeks. Travel workout options will be available for both groups. You will be asked to wear a heart rate monitor during up to 15 exercise sessions to track your heart rate in order to measure exercise intensity and energy expenditure. The heart rate monitor will collect data in 5-second intervals that we will download to a computer. Each group will receive dietary information promoted by their respective program.

TF20 group will complete a structured exercise program. There are different levels of workouts to fit your current ability and fitness level. Once a week you will meet with a trained firefighter with current CPR and First Aid certifications. The rest of the time, you will be able to choose when to complete your workouts. Workouts will contain a combination of aerobic (e.g., running, rowing, jumping), body weight (e.g., air squats, pushups, situps), and weight lifting (e.g., presses, back squats, lunges) exercises with workouts designed to use equipment available in an exercise facility (e.g., weight racks, benches). Sixty-minute TF20 sessions will include a warm-up, workout and cool down.

The Comparison Group will follow their regular workout routine for the 14 weeks. Once a week, a trained firefighter with current CPR and First Aid certifications will meet with you to discuss questions. You will be able to choose when to complete your workouts; you will be asked to log all workouts/exercise.

You will be asked to complete the following measures at baseline and 16-weeks: 1) a questionnaire including demographics, health behaviors, diet, exercise history, and psychosocial measures such as exercise enjoyment and self-efficacy; and 2) field assessments: body



composition (height, weight, percent body fat, and waist circumference), fitness (Candidate Physical Ability Test (CPAT), hand grip dynamometer, one-rep max deadlift, vertical jump, one-rep max bench press, max pull-ups, max sit-ups and sit-and-reach), and cardiovascular health (resting and post-CPAT heart rate and blood pressure). These measures will be used to track changes over the course of the study. You will also be asked to keep a log of your workouts and any potential injuries using an online program/app.

#### **ALTERNATIVE PROCEDURES OR TREATMENTS:**

If you decide not to participate in the research study, you may still participate in the exercise training with your company, as well as receive all field assessments; however, your results will not be included in the study.

#### **LENGTH OF STUDY:**

Approximately 4 months (baseline assessment, 14-week exercise program, and post-test assessment)

#### **RISKS OR DISCOMFORTS ANTICIPATED:**

There are risks associated with this study. The Tanita Body Composition scale uses a low energy, high frequency electrical signal sent through the body to measure fat and lean body mass. If you have a pacemaker or other implanted/internal electrical medical device you will not complete this measure, as the weak electrical signal may cause these internal devices to malfunction. You may experience muscle soreness, fatigue, or injury from the exercise sessions or the assessments. You will document any injuries through the online program/app and you will be responsible for seeking and paying for your own medical treatment.

#### **BENEFITS ANTICIPATED:**

Through your participation in this study, you may improve your body composition, fitness, and cardiovascular health. You will receive training and supervision in exercise techniques at no charge to you. You will receive a full report of your results at each measurement point and will have the opportunity to ask questions. Potential benefits to society include better understanding

of how to effectively improve fitness in firefighter personnel and similar tactical occupational groups.

**EXTENT OF CONFIDENTIALITY:**

There is a low risk of breach of confidentiality. Study information that might identify you will be kept confidential to the extent allowed by law. No individually identifiable data will be reported back to the fire academy. Every effort will be made to maintain the confidentiality of your participation in this project. Study information will only be used for statistical purposes and will not be disclosed in identifiable form for any other purpose without additional informed consent. All information that is sent outside of KSU/NDRI will have your name and other identifying characteristics removed, so that your identity will not be known. Only members of the research team will have access to information about your identity.

**TERMS OF PARTICIPATION:**

**I understand this project is research and that my participation is completely voluntary. I understand that I will not receive compensation for participating. I understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits to which I may otherwise be entitled. I also understand that my data up to the point I dropped out would still be included in the research study. (If female) I understand that if I become pregnant, I need to notify study investigators and stop participating in the study.**

**I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.**

<b>Participant Name:</b>				
<b>Participant Signature:</b>			<b>Date:</b>	

<b>Witness to Signature:</b> <b>(project staff)</b>			<b>Date:</b>	
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## Appendix C - Image Acknowledgement

*All photographs and recordings that occur during this study will be stored electronically on a secure computer. The use of photographs will be for potential articles, posters, and conference presentations. Recordings will be used to review workouts and testing procedures as well as potentially for conference presentations.*

I \_\_\_\_\_ authorize Kansas State University to photograph my image for use in research.

☐ **Yes, I authorize the use of my image**

☐ **No, I do not authorize the use of my image**

In addition, I authorize Kansas State University to record me participating in physical training activities for use in research.

☐ **Yes, I authorize the use of my recordings.**

☐ **No, I do not authorize the use of my recordings**

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix D - Baseline Questionnaire

ID: \_\_\_\_\_ Date: \_\_\_\_\_

### Baseline Questionnaire

#### I. PHYSICAL ACTIVITY AND EXERCISE

1. During the PAST 30 DAYS, how often did you do the following kinds of physical activity? Please complete each column and row.

Type of Activity →	Number of Days →	Average Minutes per Day
<b>Moderate Physical Activity</b> – exertion that raises heart rate and breathing, but you should be able to carry on a conversation comfortably during the activity	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days
<b>Vigorous Physical Activity</b> – exertion that is high enough that you would find it difficult to carry on a conversation during the activity	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days
<b>Strength Training</b> – including bodyweight exercises or using weights or resistance training to increase muscle strength	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days

2. I enjoy doing exercise.  
☐ Strongly disagree    ☐ Disagree    ☐ No opinion    ☐ Agree    ☐ Strongly agree
3. I am motivated to exercise.  
☐ Strongly disagree    ☐ Disagree    ☐ No opinion    ☐ Agree    ☐ Strongly agree
4. Most weeks, I exercise while on-duty:  
☐ Never    ☐ Some days    ☐ Most days    ☐ Every day
5. Most weeks, I exercise when off-duty: (includes home/gym & elsewhere).  
☐ Never    ☐ Some days    ☐ Most days    ☐ Every day
6. In the PAST 30 DAYS, which of the following have prevented you from exercising as much as you would like? Please select ONE OR MORE responses that apply to you.
- ☐ Not enough time  
☐ Absence/Inconvenience of exercise facilities  
☐ School work took precedence  
☐ I had an injury  
☐ I don't like to exercise  
☐ I haven't had anyone to work out with at times I could

- ☐ The demands of my personal/family life  
☐ Another reason  
☐ I exercise as much as I like

7. **Inventory of Exercise Habits** – please read each of the following statements and then use the response scale on the right to indicate your level of agreement. There are no right or wrong answers. Work quickly and select the answer that best describes what you believe and how you feel. Make sure that you respond to all of the questions.

		I totally disagree	I disagree	Neutral	I agree	I totally agree
a	Feeling tired during exercise is my signal to slow down or stop.	①	②	③	④	⑤
b	I would rather work out at low intensity levels for a long duration rather than at high-intensity levels for a short duration.	①	②	③	④	⑤
c	During exercise, if my muscles begin to burn excessively or if I find myself breathing very hard, it is time for me to ease off.	①	②	③	④	⑤
d	I'd rather go slow during my workout, even if that means taking more time.	①	②	③	④	⑤
e	While exercising, I try to keep going even after I feel exhausted.	①	②	③	④	⑤
f	I would rather have a short, intense workout than a long, low-intensity workout.	①	②	③	④	⑤
g	I block out the feeling of fatigue when exercising.	①	②	③	④	⑤
h	When I exercise, I usually prefer a slow, steady pace.	①	②	③	④	⑤
i	I'd rather slow down or stop when a workout starts to get too tough.	①	②	③	④	⑤
J	Exercising at a low intensity does not appeal to me at all.	①	②	③	④	⑤
k	Fatigue is the last thing that affects when I stop a workout; I have a goal and stop only when I reach it.	①	②	③	④	⑤
L	While exercising, I prefer activities that are slow-paced and don't require much exertion.	①	②	③	④	⑤
m	When my muscles start burning during exercise, I usually ease off some.	①	②	③	④	⑤
n	The faster and harder the workout, the more pleasant I feel.	①	②	③	④	⑤
o	I always push through muscle soreness and fatigue when working out.	①	②	③	④	⑤
p	Low-intensity exercise is boring.	①	②	③	④	⑤

8. Using the scale below, please rate how **confident** you are that you can perform each of the following activities.

1	2	3	4	5	6	7	8	9	10
Cannot do this at all				Moderately certain I can do this					Certain I can do this

Activity	Confidence Level
a. Establish and maintain relationships with people I don't know well.	
b. Practice a sport that requires effort.	
c. Compete in a sport that requires accuracy.	
d. Do physical exercises that require resistance.	
e. Do physical exercises or compete in a sport that requires agility.	
f. Avoid obstacles in a race.	
g. Do physical exercises or compete in a sport that requires coordination.	
h. Do physical exercises or compete in a sport that requires balance.	
i. Do physical exercises or compete in a sport that requires strength.	
j. Describe my fitness goals and objectives.	
k. Recognize my strengths and weaknesses in different situations.	

9. What exercise goals have you accomplished in the 30 days? \_\_\_\_\_

## II. HEALTH

10. Would you say that **in general** your health is:

☐ Excellent    ☐ Very good    ☐ Good    ☐ Fair    ☐ Poor

11. Explain how your **overall health** has changed in the past 4 months. \_\_\_\_\_

12. How do you describe your current weight?

☐ Very underweight  
☐ Slightly underweight  
☐ About the right weight  
☐ Slightly overweight  
☐ Very overweight

13. Which of the following are you currently trying to do about your weight?

☐ Lose weight  
☐ Gain weight  
☐ Stay the same weight  
☐ I am not trying to do anything about my weight

14. Are you currently enrolled in a weight control/management program?

☐ Yes    ☐ No

15. Do you currently follow any of these diets/meal plans? (Check One)

☐ I do not currently follow a specific diet/meal plan

<input type="checkbox"/> Atkins Diet	<input type="checkbox"/> Dash Diet	<input type="checkbox"/> ECO-Atkins Diet	<input type="checkbox"/> Glycemic Index Diet
<input type="checkbox"/> Mayo Clinic Diet	<input type="checkbox"/> Medifast Diet	<input type="checkbox"/> Mediterranean Diet	<input type="checkbox"/> Nutrisystem Diet
<input type="checkbox"/> Ornish Diet	<input type="checkbox"/> Paleo Diet	<input type="checkbox"/> Raw Food Diet	<input type="checkbox"/> Slim Fast Diet
<input type="checkbox"/> South Beach Diet	<input type="checkbox"/> TLC Diet	<input type="checkbox"/> Vegan Diet	<input type="checkbox"/> Vegetarian Diet
<input type="checkbox"/> Volumetrics Diet	<input type="checkbox"/> Weight Watchers	<input type="checkbox"/> Zone Diet	

☐ I do not follow a specific diet by try to stay low-fat  
☐ I do not follow a specific diet by try to stay low-carbohydrate  
☐ Other (please specify): \_\_\_\_\_

16. How has your physical appearance changed in the past 2 months? \_\_\_\_\_

17. We would like to ask you a few questions about any injuries you might have sustained while you were working. We are only interested in injuries while on-duty regardless of the activity you were performing.

a. How many injuries did you have in the past 6 months?

Injuries

18. In the PAST 6 MONTHS, did you seek medical care for the treatment of the following?

a. Car or motorcycle accident

☐ Yes

☐ No

b. Other type of accidental injury

☐ Yes

☐ No

c. Overuse injury (such as carpal tunnel, sports- or exercise related, etc.)

☐ Yes

☐ No

### Sleep

19. In the PAST WEEK (past 7 days), about how many hours on average did you sleep each 24 hour period?

Hours AND

Minutes

### III. Psychosocial Measures

20. In the PAST MONTH, how often did you feel a lot of stress?

☐ Always

☐ Often

☐ Sometimes

☐ Seldom

☐ Never

**Thank you for completing this survey!**



## Appendix E - Post-Intervention Questionnaire

ID: \_\_\_\_\_ Date: \_\_\_\_\_

### POST INTERVENTION QUESTIONNAIRE

#### IV. PHYSICAL ACTIVITY AND EXERCISE

1. During the PAST 30 DAYS, how often did you do the following kinds of physical activity? Please complete each column and row.

Type of Activity →	Number of Days →	Average Minutes per Day
<b>Moderate Physical Activity</b> – exertion that raises heart rate and breathing, but you should be able to carry on a conversation comfortably during the activity	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days
<b>Vigorous Physical Activity</b> – exertion that is high enough that you would find it difficult to carry on a conversation during the activity	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days
<b>Strength Training</b> – including bodyweight exercises or using weights or resistance training to increase muscle strength	<input type="checkbox"/> About every day <input type="checkbox"/> 5-6 days a week <input type="checkbox"/> 3-4 days a week <input type="checkbox"/> 1-2 days a week <input type="checkbox"/> Less than 1 day a week <input type="checkbox"/> Not at all in the past 30 days	<input type="checkbox"/> 60 or more minutes <input type="checkbox"/> 30 to 59 minutes <input type="checkbox"/> 20 to 29 minutes <input type="checkbox"/> Less than 20 minutes <input type="checkbox"/> Never in the past 30 days

2. I enjoy doing exercise.  
☐ Strongly disagree    ☐ Disagree    ☐ No opinion    ☐ Agree    ☐ Strongly agree
3. I am motivated to exercise.  
☐ Strongly disagree    ☐ Disagree    ☐ No opinion    ☐ Agree    ☐ Strongly agree
4. Most weeks, I exercise while on-duty:\*    \*This only applies if you work on a fire department.  
☐ Never    ☐ Some days    ☐ Most days    ☐ Every day
5. Most weeks, I exercise when off-duty: (includes home/gym & elsewhere, not including working out for the study).  
☐ Never    ☐ Some days    ☐ Most days    ☐ Every day
6. In the PAST 30 DAYS, which of the following have prevented you from exercising as much as you would like? Please select ONE OR MORE responses that apply to you.
- ☐ Not enough time
  - ☐ Absence/Inconvenience of exercise facilities
  - ☐ School work took precedence
  - ☐ I had an injury
  - ☐ I don't like to exercise
  - ☐ I haven't had anyone to work out with at times I could
  - ☐ The demands of my personal/family life
  - ☐ Another reason
  - ☐ I exercise as much as I like

7. **Inventory of Exercise Habits** – please read each of the following statements and then use the response scale on the right to indicate your level of agreement. There are no right or wrong answers. Work quickly and select the answer that best describes what you believe and how you feel. Make sure that you respond to all of the questions.

		I totally disagree	I disagree	Neutral	I agree	I totally agree
a	Feeling tired during exercise is my signal to slow down or stop.	①	②	③	④	⑤
b	I would rather work out at low intensity levels for a long duration rather than at high-intensity levels for a short duration.	①	②	③	④	⑤
c	During exercise, if my muscles begin to burn excessively or if I find myself breathing very hard, it is time for me to ease off.	①	②	③	④	⑤
d	I'd rather go slow during my workout, even if that means taking more time.	①	②	③	④	⑤
e	While exercising, I try to keep going even after I feel exhausted.	①	②	③	④	⑤
f	I would rather have a short, intense workout than a long, low-intensity workout.	①	②	③	④	⑤
g	I block out the feeling of fatigue when exercising.	①	②	③	④	⑤
h	When I exercise, I usually prefer a slow, steady pace.	①	②	③	④	⑤
I	I'd rather slow down or stop when a workout starts to get too tough.	①	②	③	④	⑤
J	Exercising at a low intensity does not appeal to me at all.	①	②	③	④	⑤
k	Fatigue is the last thing that affects when I stop a workout; I have a goal and stop only when I reach it.	①	②	③	④	⑤
L	While exercising, I prefer activities that are slow-paced and don't require much exertion.	①	②	③	④	⑤
m	When my muscles start burning during exercise, I usually ease off some.	①	②	③	④	⑤
n	The faster and harder the workout, the more pleasant I feel.	①	②	③	④	⑤
o	I always push through muscle soreness and fatigue when working out.	①	②	③	④	⑤
p	Low-intensity exercise is boring.	①	②	③	④	⑤

8. Using the scale below, please rate how **confident** you are that you can perform each of the following activities.

1	2	3	4	5	6	7	8	9	10
Cannot do this at all				Moderately certain I can do this					Certain I can do this

Activity	Confidence Level
l. Establish and maintain relationships with people I don't know well.	
m. Practice a sport that requires effort.	
n. Compete in a sport that requires accuracy.	
o. Do physical exercises that require resistance.	
p. Do physical exercises or compete in a sport that requires agility.	
q. Avoid obstacles in a race.	
r. Do physical exercises or compete in a sport that requires coordination.	
s. Do physical exercises or compete in a sport that requires balance.	
t. Do physical exercises or compete in a sport that requires strength.	
u. Describe my fitness goals and objectives.	
v. Recognize my strengths and weaknesses in different situations.	

9. What exercise goals have you accomplished in the past 12 weeks? \_\_\_\_\_

## V. HEALTH

10. Would you say that **in general** your health is:

☐ Excellent    ☐ Very good    ☐ Good    ☐ Fair    ☐ Poor

11. Explain how your **overall health** has changed in the past 12 weeks. \_\_\_\_\_

12. How do you describe your current weight?

☐ Very underweight  
☐ Slightly underweight  
☐ About the right weight  
☐ Slightly overweight  
☐ Very overweight

13. Which of the following are you currently trying to do about your weight?

☐ Lose weight  
☐ Gain weight  
☐ Stay the same weight  
☐ I am not trying to do anything about my weight

14. Are you currently enrolled in a weight control/management program?

☐ Yes    ☐ No

15. Do you currently follow any of these diets/meal plans? (Check One)

<input type="checkbox"/> I do not currently follow a specific diet/meal plan			
<input type="checkbox"/> Atkins Diet	<input type="checkbox"/> Dash Diet	<input type="checkbox"/> ECO-Atkins Diet	<input type="checkbox"/> Glycemic Index Diet
<input type="checkbox"/> Mayo Clinic Diet	<input type="checkbox"/> Medifast Diet	<input type="checkbox"/> Mediterranean Diet	<input type="checkbox"/> Nutrisystem Diet
<input type="checkbox"/> Ornish Diet	<input type="checkbox"/> Paleo Diet	<input type="checkbox"/> Raw Food Diet	<input type="checkbox"/> Slim Fast Diet
<input type="checkbox"/> South Beach Diet	<input type="checkbox"/> TLC Diet	<input type="checkbox"/> Vegan Diet	<input type="checkbox"/> Vegetarian Diet
<input type="checkbox"/> Volumetrics Diet	<input type="checkbox"/> Weight Watchers	<input type="checkbox"/> Zone Diet	
<input type="checkbox"/> I do not follow a specific diet by try to stay low-fat			
<input type="checkbox"/> I do not follow a specific diet by try to stay low-carbohydrate			
<input type="checkbox"/> Other (please specify): _____			

16. Did you change your diet during the study? If so, what changes did you make? \_\_\_\_\_

17. How has your physical appearance changed in the past 12 weeks? \_\_\_\_\_

18. We would like to ask you a few questions about any injuries you might have sustained while in the fire academy. We are only interested in injuries while on the fire ground regardless of the activity you were performing.

b. How many injuries did you have in the past 12 weeks?   Injuries

c. How many injuries did you have in the past 12 weeks for which you completed an injury report?  
  Injuries

19. In the PAST 12 WEEKS, did you seek medical care for the treatment of the following?

a. Car or motorcycle accident	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Other type of accidental injury	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Overuse injury (such as carpal tunnel, sports- or exercise related, etc.)	<input type="checkbox"/> Yes	<input type="checkbox"/> No

#### Sleep

20. In the PAST WEEK (past 7 days), about how many hours on average did you sleep each 24 hour period?

Hours AND   Minutes

## VI. Psychosocial Measures

21. In the PAST 12 WEEKS, how often did you feel a lot of stress?

☐ Always    ☐ Often    ☐ Sometimes    ☐ Seldom    ☐ Never

*The following questions are designed to assess your perceptions of your exercise program and your company/exercise group. There are no right or wrong answers so please give your immediate reaction. Your candid responses are very important. Your individual responses will be kept in strict confidence.*

22. The following statements are designed to assess your feelings about **YOUR PERSONAL INVOLVEMENT** with your company. Please rate your level of agreement with each of the following statements.

1 - Strongly Disagree	2	3	4	5	6	7	8	9 - Strongly Agree
-----------------------	---	---	---	---	---	---	---	--------------------

Statement	Level of Agreement
a. I enjoy the social interactions I have with my company/exercise group.	
b. I'm happy with the amount of progress I made towards my health and fitness goals with my company/exercise group.	
c. I would miss the members of my company/exercise group if I left the group.	
d. I'm happy with my company/exercise group's level of desire to achieve our health and fitness goals.	
e. Some of my best friends are in this company/exercise group.	
f. This company/exercise group gives me enough opportunities to make progress toward my health and fitness goals.	
g. I enjoy my time with the people in my company/exercise group.	
h. I like the type of exercise we do with this company/exercise group.	
i. For me, this company/exercise group is an important social community to which I belong.	

23. The following statements are designed to assess your perceptions of your **COMPANY/EXERCISE GROUP AS A WHOLE**. Please rate your level of agreement with each of the following statements.

1 - Strongly Disagree	2	3	4	5	6	7	8	9 - Strongly Agree
-----------------------	---	---	---	---	---	---	---	--------------------

Statement	Level of Agreement
j. Our group is united in trying to reach its health and fitness goals.	
k. Members of our group would rather go out as a group than go out on their own.	
l. We all take responsibility for the improved health and fitness of our group.	
m. Our group spends time socializing before or after workouts.	
n. Our group members have similar aspirations for the group's overall health and fitness.	
o. Our group would like to spend time together if the program was to end.	
p. If members of our group have problems with exercising, everyone wants to help them.	
q. Members of our group stick together outside of the gym/fire academy.	
r. Our group members communicate freely about each other's progress toward their goals.	

## VII. Program Feedback

- What are your overall thoughts about the exercise program you completed for this study (either Control or TF20)?
- What did you like most about the exercise program?
- What did you dislike most about the exercise program?
- What would you do to improve the exercise program?
- What physical, mental, emotional, or other changes did you experience from the exercise program?
- What type of exercise program would you like to see the Fire Academy continue?

7. Would you continue this program for the next 6-12 months?
8. What impact did taking the CPAT at the beginning of the semester have on your ability to train for the exam?
9. Did taking the CPAT at the beginning of the semester influence your desire to complete the Fire Academy?
10. What impact did taking the CPAT at the beginning of the semester have on how you trained during the rest of the semester?
11. Did you find the pre and post intervention measures a helpful way to gauge your progress throughout the semester? What did you like/dislike about the pre and post measures?
12. Would you liked to have seen different measures used to gauge your progress? (Ie: bench press, dead lift, waist circumference, etc.) Give examples.
13. What did you feel was the most time consuming part about the study? What suggestions do you have for change?

## Participant Satisfaction Survey – Training Session

Please indicate how much you liked the following aspects of The First Twenty Program (TF20):

	Like Very Much	Like Some- What	Neither Like or Dislike	Dislike Some What	Dislike Very Much	Don't Know
Pre-event information						
Registration Process						
Start & End time of training						
Length of Training						
Online Programming						
Organization of Training						
Dietary Information						
Mental Fitness Information						
Other (describe below)						

Other:

For each topic, please indicate if you have used the information provided and how useful the information on this topic has been:

	Like Very Much	Like Some- What	Neither Like or Dislike	Dislike Some What	Dislike Very Much	Don't Know
Provided a safe, healthy, and purposeful environment						
Advanced firefighters' physical and intellectual development						
Established productive relationships with my company						
Exercises Provided						
Dietary Information						
Mental Fitness						
Stress Reduction						
Other (describe below)						

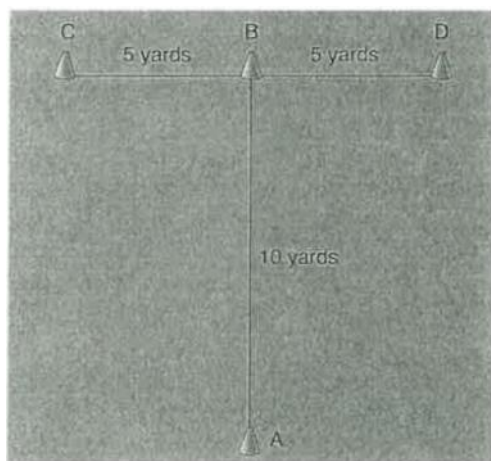
Other: \_\_\_\_\_

**Thank you for completing this survey!**

## **Appendix F - Agility (T-test)**

Equipment: four cones, tape measure (yards or meters), stopwatch, flat floor with good traction.

- Arrange four cones as seen in figure below (points A, B, C, and D)
- Have the participant warm up and stretch prior to the test. Practice submaximally.
- The test begins with the participant standing at point A.
- On an auditory signal, the participant sprints forward to point B and touches the base of the cone with the right hand.
- Then, while facing forward and not crossing the feet, the participant shuffles to the left 5 yards (4.6 m) and touches the base of the cone at point C with the left hand.
- The participant then shuffles to the right 10 yards (9.1 m) and touches the base of the cone at point D with the right hand.
- The participant then shuffles to the left 5 yards and touches the base of the cone at point B with the left hand, and next runs backwards past point A, at which time the test is concluded.
- For safety, a spotter and gym mat should be positioned several feet behind point A to catch a participant who falls while running backward.
- The best time of two trials is recorded to the nearest 0.1 second.
- Reasons for disqualification of a trial: the participant fails to touch the base of any cone, crosses one foot in front of the other instead of shuffling feet, or fails to face the forward the entire test





## **Appendix G - Candidate Physical Ability Test Description**

The CPAT consists of eight separate events. The test is a sequence of events that requires the candidate to progress along a predetermined path from event to event in a continuous manner. It is a pass/fail test based on a maximum total test time of 10 minutes and 20 seconds. In these events, the candidate wears a 50-pound (22.68-kg) vest to simulate the weight of self-contained breathing apparatus (SCBA) and fire fighter protective clothing. An additional 25 pounds (11.34 kg), using two 12.5-pound (5.67-kg) shoulder weights that simulate a high-rise pack (hose bundle), is added for the stair climb (first) event. Throughout all events, the candidate must wear long pants, a hard hat with chin strap, work gloves and footwear with no open heel or toe. Watches and loose or restrictive jewelry are not permitted. All props were designed to simulate critical fire ground tasks and obtain the necessary information regarding the candidate's physical ability (IAFF, 2007).

The first event, Stair Climb, is designed to simulate the critical tasks of climbing stairs in full protective clothing while carrying a high-rise pack (hose bundle) and climbing stairs in full protective clothing carrying fire fighter equipment. This event challenges the candidate's aerobic capacity, lower body muscular endurance and balance. This event affects the aerobic energy system as well as the following muscle groups: quadriceps, hamstrings, glutes, calves, and lower back stabilizers (IAFF, 2007).

The second event, Hose Drag, is designed to simulate the tasks of dragging an uncharged hoseline from the fire apparatus to the fire occupancy and pulling an uncharged hoseline around obstacles while remaining stationary. This event challenges the candidate's aerobic capacity, lower body muscular strength and endurance, upper back muscular strength and endurance, grip strength and endurance, and anaerobic endurance. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: quadriceps, hamstrings, glutes, calves, lower back stabilizers, biceps, deltoids, upper back, and muscles of the forearm and hand (grip) (IAFF, 2007).

The third event, Equipment Carry, is designed to simulate removing power tools from a fire apparatus, carrying them to the emergency scene and returning the equipment to the fire apparatus. This event challenges the candidate's aerobic capacity, upper body muscular strength and endurance, lower body muscular endurance, grip endurance, and balance. This event affects

the aerobic energy system as well as the following muscle groups: biceps, deltoids, upper back, trapezius, muscles of the forearm and hand (grip), glutes, quadriceps, and hamstrings (IAFF, 2007).

The fourth event, Ladder Raise and Extension, is designed to simulate placing a ground ladder at a fire structure and extending the ladder to the roof or window. This event challenges candidate's aerobic capacity, upper body muscular strength, lower body muscular strength, balance, grip strength, and anaerobic endurance. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: biceps, deltoids, upper back, trapezius, muscles of the forearm and hand (grip), glutes, quadriceps, and hamstrings (IAFF, 2007).

The fifth event, Forcible Entry, is designed to simulate the critical tasks of using force to open a locked door or to breach a wall. This event challenges the candidate's aerobic capacity, upper body muscular strength and endurance, lower body muscular strength and endurance, balance, grip strength and endurance, and anaerobic endurance. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: quadriceps, glutes, triceps, upper back, trapezius, and muscles of the forearm and hand (grip) (IAFF, 2007).

The sixth event, Search, designed to simulate searching for a fire victim with limited visibility in an unpredictable area. This event challenges the candidate's aerobic capacity, upper body muscular strength and endurance, agility, balance, anaerobic endurance, and kinesthetic awareness. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: muscles of the chest, shoulder, triceps, quadriceps, abdominals, and lower back (IAFF, 2007).

The seventh event, Rescue, is designed to simulate the critical task of removing a victim or injured partner from a fire scene. This event challenges the candidate's aerobic capacity, upper and lower body muscular strength and endurance, grip strength and endurance, and anaerobic endurance. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: quadriceps, hamstrings, glutes, abdominals, torso rotators, lower back stabilizers, trapezius, deltoids, latissimus dorsi, biceps, and muscles of the forearm and hand (grip) (IAFF, 2007).

The eighth and final event, Ceiling Breach and Pull, is designed to simulate breaching and pulling down a ceiling to check for fire extension. This event challenges the candidate's aerobic capacity, upper and lower body muscular strength and endurance, grip strength and

endurance, and anaerobic endurance. This event affects the aerobic and anaerobic energy systems as well as the following muscle groups: quadriceps, hamstrings, glutes, abdominals, torso rotators, lower back stabilizers, deltoids, trapezius, triceps, biceps, and muscles of the forearm and hand (grip) (IAFF, 2007).

## Appendix H - Aerobic Capacity (VO<sub>2max</sub>)

The Stepmill should be a StairMaster 7000PT. The new WFI test was validated on a unit that has 20 intensity levels. It is imperative that the administrator insure that the unit is calibrated to the same steps-per-minute rate for each level indicated in the testing protocol. Refer to the Table below.

**Table 5.0**

**Intensity (steps/min) for each level on the Stepmill**

Level	Steps/min	Level	Steps/min
1	24	11	97
2	31	12	104
3	39	13	111
4	46	14	118
5	53	15	126
6	60	16	133
7	65	17	140
8	75	18	147
9	82	19	155
10	89	20	162

Note: If your Stepmill is not calibrated to the same steps/min rate as the 20-level table, the test may be invalid for your Stepmill. Please refer to the manufacturer for options.

The purpose of this assessment is to estimate the  $\text{VO}_{2\text{max}}$  of each participant.

- Conduct Pre-Evaluation Procedures.
- Monitor the participant's heart rate continuously throughout the assessment.
- Instruct the participant to temporarily grasp the handrails to reduce the possibility of losing balance when the stairs begin to move.
- The starting position is approximately two-thirds of the way up the stairs.
- The assessment starts at level 4 for 2 minutes, then level 5 for 1 minute (warm-up period). Start the stopwatch once the Stepmill begins. Inform the participant that the evaluation is a series of 1-minute intervals with increasing workloads on each subsequent minute.
- Once the assessment commences, do not allow the participant to hold or lean on the handrails; this will result in overestimation of aerobic capacity.
- At the completion of the 3 minute-warm-up, proceed to level 7 for 1 minute. \*Note: This is marked by increasing the workload from level 5 to level 7.
- Once the heart rate exceeds the Target Heart Rate (THR), note the time and continue the assessment for an additional 15 seconds. Do not make any changes to the assessment intensity level during this time. If the participant's heart rate remains above the THR for the full 15 seconds, then the participant has completed the assessment. Stop the assessment and record the time at which the participant exceeded the THR.
- The total Test Time (TT) begins from the time the participant starts on the Stepmill, to the point at which the participant exceeds their THR. It does not include the final 15 second monitoring period that the heart rate was above the THR.

<b>Time</b>	<b>Level</b>	<b>Steps/min</b>
0:00 – 1:00	4	46
1:01 – 2:00	4	46
2:01 – 3:00	5	53
3:01 – 4:00	7	65
4:01 – 5:00	8	75
5:01 – 6:00	9	82
6:01 – 7:00	10	89
7:01 – 8:00	11	97
8:01 – 9:00	12	104
9:01 – 10:00	13	111
10:01 – 11:00	14	118
11:01 – 12:00	15	126
12:01 – 13:00	16	133
13:01 – 14:00	17	140
14:01 – 15:00	18	147
15:01 – 16:00	19	155
<b>Recovery Phase</b>		
0:00 – 1:00	3	39
1:01 – 2:00	3	39

- The assessment is complete once the participant's heart rate exceeds the target for 15 seconds. If the participant's heart rate exceeds the target, but then drops down to the THR or below within 15 seconds, then the assessment should continue.
- The THR must be calculated. First determine the participant's estimated MAX heart rate (220-age) then find 85% of that value, that is the THR.
- Once the assessment is completed, the participant will cool down for a minimum of 2 minutes at level 3. Continue to monitor the heart rate during the cool-down.
- Record the recovery heart rate at one minute of cooldown.
- The participant may grasp the handrails during the cool-down phase.
- Upon completion of the cool-down, instruct the participant to grasp the handrails. Stop the stepmill and assist the participant off the apparatus.

**TERMINATE THE ASSESSMENT IF ANY OF THE FOLLOWING OCCURS:**

- The participant's heart rate exceeds THR for 15 seconds.
- The THR has not been met after 16 minutes.
- The participant asks to terminate the exercise.
- The equipment malfunctions.
- Medical conditions arise that prohibit completing the assessment.
- Record the reason for terminating the assessment and the initial time the heart rate had been exceeded (if applicable). Record time in minutes and convert second(s) into decimal.
  - **See Table 5.6**
- Insert the test time (TT) at which the participant completed the assessment, along with the stepmill conversion formula to estimate VO<sub>2</sub> max.

- Record the VO2 max.

\*Note: TT is the time in minutes that the participant's THR was exceeded and the test terminated

**Stepmill Sub-maximal VO2 Prediction Formula**

$$\text{VO}_{2\text{max}} = 57.774 + (1.757 \times \text{TT}) - (0.904 \times \text{BMI})$$



## Appendix I - BMI Classification

Table Classification of Disease Risk Based on Body Mass Index (BMI) and Waist Circumference (ACSM, 2014).

		Disease Risk* Relative to Normal Weight and Waist Circumference	
Weight Classification	BMI ( $\text{kg}\cdot\text{m}^{-2}$ )	Men, $\leq 102$ cm Women, $\leq 88$ cm	Men, $> 102$ cm Women, $> 88$ cm
Underweight	$< 18.5$	--	--
Normal	$18.5 - 24.9$	--	--
Overweight	$25.0 - 29.9$	Increased	High
Obesity, class			
I	$30.0 - 34.9$	High	Very High
II	$35.0 - 39.9$	Very High	Very High
III	$\geq 40.0$	Extremely High	Extremely High

\*Disease risk for Type 2 diabetes, hypertension, and cardiovascular disease. Dashes (--) indicate that no additional risk at these levels of BMI was assigned. Increased waist circumference can also be a marker for increased risk even in individuals of normal weight.

## Appendix J - VO2max Fitness Categories

Table Fitness Categories for Maximal Aerobic Power for Men by Age

MEN, Age 20-29		
%		Max VO2 (ml/kg/min)
99	Superior	60.5
95		55.5
90	Excellent	54.0
85		51.8
80		51.1
75	Good	48.5
70		47.5
65		46.8
60		45.6
55	Fair	44.8
50		43.9
45		42.6
40		41.7
35	Poor	41.0
30		39.9
25		39.0
20		38.0
15	Very Poor	36.7
10		34.7
5		31.8
1		26.5

## **Appendix K - Feasibility Analysis**

1. Did you complete all of the assigned First Twenty workouts?
2. If no, why?
3. What issues did you face working with The First Twenty program? (ie: app issues, did not like the programming of the workouts, did not like the progression, time consuming, etc.)
4. What workout plan (if any) do you currently follow? (explain your normal workout routine.)
5. Did you use any of the additional information/programming available in The First Twenty Program? (nutrition & mental toughness education, height/weight tracking, completing challenges, etc.)
6. What did you like/dislike about The First Twenty? (can be anything from the workouts to nutrition and mental health information, etc.)
7. What suggestions do you have for future cadet class physical training?

## **Appendix L - Feasibility Analysis Responses**

### **TF20-1**

1. I completed all of the assigned First Twenty workouts assigned throughout the semester.
3. The workout itself wasn't anything harder than what I am used to but I would say the only issue was having access to specific tools "required" for some of the workouts, but they were easily replaceable with free weights.
4. I don't currently have a gym membership anymore but am getting one again soon. As of right now I am doing cardio, situps and pullups mostly.
5. I did not use any of the additional information/programming that was available in The First Twenty Program.
6. I really don't have any complaints about the workout because they focused on the muscle area that we use most in the fire service. Although I've never been a fan of leg workouts, they were necessary.

### **TF20-2**

1. No I did not.
2. Because I could not get on the app and the workouts required lots of on facility workouts, also I thought we would have someone there guiding us with the workouts.
3. Did not make the effort because I did not know most of the workouts and could not travel to the facility.
4. No
5. Once Brittany started to send us the workouts it's started to work for me I could not do them all but I could simulate some.
6. App and did not know about the nutrition I signed on to the website but I could only do it once and then could not.
7. If some of the participants don't have a gym or don't know I believe you should have someone to be there and help.

### **TF20-3**

1. Did you complete all of the assigned First Twenty workouts?

Yes

2. If no, why?

3. What issues did you face working with The First Twenty program? (ie: app issues, did not like the programming of the workouts, did not like the progression, time consuming, etc.)

The workouts seemed a little slow paced for me. When i workout i like to be breathing hard and very tired at the end of my workout

4. What workout plan (if any) do you currently follow? (explain your normal workout routine.)

I do not follow a plan of any sort when i workout. i just do whatever i feel like doing that day.

5. Did you use any of the additional information/programming available in The First Twenty Program? (nutrition & mental toughness education, height/weight tracking, completing challenges, etc.)

No I did not.

6. What did you like/dislike about The First Twenty? (can be anything from the workouts to nutrition and mental health information, etc.)

Any easier/simpler way to log the workouts. the program we used had a lot of glitches

7. What suggestions do you have for future cadet class physical training?

Do lots of cardio

### **TF20-4**

1. I did not complete all of them but did try to get the majority of them done. I would say 75%

2. N/a

3. The biggest issues I faced using the program was definitely the app. I would log my information and sometimes it would work and save and then next time I would have it the info would be gone. Other times it would not let me log the info at all.

4. Now I am back with my strength and conditioning coach from high school. Monday through Friday a group of athletes my age go in and perform a variety of exercises ranging from sled pushes to box jumps, interval sprints, foot work. All of those are always followed up by intense weight training in the weight room.

5. I thought the mental toughness tools were super helpful because it was a completely different environment on the fire ground as opposed to the football field. My strength coach already takes my height and weight measurements and gives nutrition plans but if he did not do that I would have for sure used those tools as well.

6. I liked that it was trying to get us ready for the cpat. If I wouldn't have done the program I would have had no idea what to do in order to prepare myself to pass that test so for that I am very grateful.

7. I highly suggest future cadets take advantage of this program. Especially ones that don't have much of a physically athletic background and have to start from scratch. The program will lead them from the ground up.

**TF20-5 – Did not complete follow-up questionnaire**

**TF20-6**

1. & 2. I completed most of them. On the mobile app it wouldn't let me go past week 15. Same as on the web site at least on my computer.

3. The first twenty program App would not log my completed workouts. I tried going onto the website from my home computer and logging them and I don't think that did either.

4. My regular workout plan is Monday- legs, Tuesday- shoulders, bis, tris, Wednesday- chest and back, Thursday- Legs again, Friday, Saturday, Sunday- Farm

5. No

6. for me the workouts were too easy. For people who don't workout or have a regular routine it would be awesome.

7. Be consistent, and workout hard and intense every time you're in the gym.

## **TF20-7**

1. Did you complete all of the assigned First Twenty workouts?

Not every workout, but a majority

2. If no, why?

Time constraints, and no place for certain workouts

3. What issues did you face working with The First Twenty program? (ie: app issues, did not like the programming of the workouts, did not like the progression, time consuming, etc.)

Some app issues, not recording workouts done. Some workouts can't be done alone or without equipment.

4. What workout plan (if any) do you currently follow? (explain your normal workout routine.)

2 times a week. Upper body/cardiovascular and core/lower body as well as biking/rock climbing.

5. Did you use any of the additional information/programming available in The First Twenty Program? (nutrition & mental toughness education, height/weight tracking, completing challenges, etc.)

Mental toughness education.

6. What did you like/dislike about The First Twenty? (can be anything from the workouts to nutrition and mental health information, etc.)

I dislike the app in the way the workouts were given.

7. What suggestions do you have for future cadet class physical training?

Focus on cardiovascular and core strength, try working out together.

## Appendix M - TF20 Workout

	A	B	C	D	E
1	Periodization Scheme	Program goals: Weight loss; improved occupational performance; injury reduction through movement pattern proficiency and enhanced stabilizer capacity; anaerobic and aerobic endurance, muscular endurance, strength			
2	Total caloric expenditure from fitness program (kcal):	20697			
3	Total weight loss from fitness program (lb) (conservative estimate):	5.9			
4	RT: Resistance Training				
5	ET: Endurance Training				
6					
7					
8	Mesocycle	Week	Microcycle goal	Objective	Cycle Details (Resistance Training + Endurance Training)
9	1	Week 1	GPP	Technique	Conduct Full USAFOA (record time); Practice basic movement patterns
10		Week 2	GPP / Transmutation	Foundation	Develop aerobic base / exercise technique; Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-20 min-walking 3 mph)
11		Week 3	GPP / Transmutation	Foundation	Develop aerobic base / exercise technique; Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-25 min-walking 3 mph)
12		Week 4	GPP / Realization	Functional / Performance	Develop aerobic base / exercise technique; Functional circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-30 min-walking 3 mph)
13		Week 5	GPP / Realization	Functional / Performance	Develop aerobic base / exercise technique; Functional circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-30 min-walking 3 mph)
14		Week 6	Active recovery	Recovery	Mod intensity cardio (3 d/wk-45 min-walking 3 mph)
15	2	Week 7	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-30 min-walk 3 mph; 1 d/wk: walk w/ SCBA 20 min)
16		Week 8	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-30 min-walk 3 mph; 1 d/wk: walk w/ SCBA 25 min)
17		Week 9	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-30 min-walk 3 mph; 1 d/wk: stair climb 8 min (2 min intervals/1 min rest))
18		Week 10	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 1 d/wk-30 min-walk 3 mph; 1 d/wk: stair climb 10 min (2 min intervals; 1 min rest))
19		Week 11	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 1 d/wk-30 min; 1 d/wk: stair climb 12 min (2 min intervals; 1 min rest))
20		Week 12	Active recovery	Recovery	Mod intensity cardio (3 d/wk-60 min-walk 3 mph)
21	3	Week 13	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-45 min-walk 3 mph; Vig intensity intervals: 1 d/wk-walk w/ SCBA 25 min)
22		Week 14	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-45 min-walk 3 mph; Vig intensity intervals cardio: 1 d/wk-walk w/ SCBA 25 min)
23		Week 15	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-45 min-walk 3 mph; Vig intensity cardio: 1 d/wk-Stairclimb w/ SCBA 12 min-2 min w
24		Week 16	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-45 min-walk 3 mph; Vig intensity cardio: 1 d/wk-Stairclimb w/ SCBA 14 min (2 min w
25		Week 17	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-45 min-walk 3 mph; Vig intensity cardio: 1 d/wk-Stairclimb w/ SCBA 16 min (2 min w
26		Week 18	Active recovery	Recovery	Mod intensity cardio (3 d/wk-60 min-walk 3 mph)
27	4	Week 19	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 3 d/wk; Mod intensity cardio: 1 d/wk-60 min-walk 3 mph; Vig intensity intervals cardio: 1 d/wk-walk w/ SCBA 30 min)
28		Week 20	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 3 d/wk; Mod intensity cardio: 1 d/wk-60 min-walk 3 mph; Vig intensity intervals: 1 d/wk-walk w/ SCBA 30 min)
29		Week 21	Transmutation	Metabolic conditioning / Apparatus	Apparatus circuit (RT: 3 d/wk; Mod intensity cardio: 1 d/wk-60 min-walk 3 mph; 1d/wk stairclimb w/ SCBA 18 min (2 min work/1 min rest)
30		Week 22	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 1 d/wk-60 min-walk 3 mph; 1 d/wk stairclimb w/ SCBA 20 min (2 min work/1 min rest)
31		Week 23	Realization / Tactical	Functional / Performance	Functional circuit (RT: 2 d/wk; Mod intensity cardio: 2 d/wk-60 min-walk 3 mph) TAPER
32		Week 24	Active recovery / Assessment	Performance	Mod intensity cardio (2 d/wk-2 days: 30 min) + USAFOA
33					*Perform 20 min of cardio at moderate intensity after each RT bout.
34	Periodization Scheme	Exercise Description	Alternative #1	Alternative #2	Alternative #3
			Alternative #4	Week 0-USAFOA	Wk 1-Schedule
				Wk 1-#1	Wk 1-#2
				Wk 1-#3	

Optimal schedule of workout sequence						
Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Workout 1	Workout 2	Workout 3				
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						



<b>Week 1: TASKS</b>				
Watch the Postural Alignment/Bracing video (1) and Hip hinge video (2) and practice these techniques.				
These workouts are meant to focus on technique, not create excessive fatigue.				
<b>Week 1: Workout #1</b>				
Goals: Perform dyanmic warm-up, postural alignment/bracing, hip hinge progression, cardio and cool down exercises.				
<b>Dynamic Warm-up (3)</b>				
<b>*Perform 10 reps of each of the following exercises.</b>				
-Hip hinge				
-High Knee March to Toe touches				
-Lunge to lunge while raising opposite arm				
-Jumping jack				
-Cat & Camel				
-Birddog position: hip raise, arms circles, push-up				
<b>**Myofascial release as needed</b>				
<b>Workout Proper</b>				
<b>Practice Postural Alignment / bracing sequence with plank (1)</b>				
-Hold plank 5-10 seconds, rest, and repeat 5 times or until technique fails				
<b>Practice Hip hinge / deadlift sequence (2)</b>				
Perform 3 sets of 10 repetitions of each of the following exercises				
-Kneeling shortstop				
-Standing shortstop				
-Deadlift (no load)				
<b>Cardio workout:</b>				
<b>*15 min walking at a brisk pace following workout</b>				
<b>Cool-down</b>				
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch		-Quads/IT band/hip flexors		
-Arm across chest stretch		-Hamstrings		
-Chest stretch		-Calf		
-Lunge while raising opposite arm		-Glutes		
-Calf stretch		-Thoracic		
-Hurdler stretch		-Traps		
-Hip strech				
-Forward butterfly stretch				

<b>Week 1: TASKS</b>				
Watch the Postural Alignment/Bracing video (1) and Hip hinge video (2) and practice these techniques. These workouts are meant to focus on technique, not create excessive fatigue.				
<b>Week 1: Workout #2</b>				
Goals: Perform dynamic warm-up, postural alignment/bracing, hip hinge progression, cardio and cool down				
<b>Dynamic Warm-up (3)</b>				
<b>*Perform 10 reps of each of the following exercises.</b>				
-Hip hinge				
-High Knee March to Toe touches				
-Lunge to lunge while raising opposite arm				
-Jumping jack				
-Cat & Camel				
-Bird dog position: hip raise, arms circles, push-up				
<b>**Myofascial release as needed</b>				
<b>Workout Proper</b>				
<b>Practice Postural Alignment / bracing sequence with plank (1)</b>				
-Hold plank 5-10 seconds, rest, and repeat 5 times or until technique fails				
<b>Practice Hip hinge / deadlift sequence (2)</b>				
Perform 3 sets of 10 repetitions of each of the following exercises				
-Kneeling shortstop				
-Standing shortstop				
-Deadlift (no load)				
<b>Cardio workout:</b>				
<b>*15 min walking at a brisk pace following workout</b>				
<b>Cool-down</b>				
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors			
-Arm across chest stretch	-Hamstrings			
-Chest stretch	-Calf			
-Lunge while raising opposite arm	-Glutes			
-Calf stretch	-Thoracic			
-Hurdler stretch	-Traps			
-Hip stretch				
-Forward butterfly stretch				

<b>Week 1: TASKS</b>		
<i>Watch the Postural Alignment/Bracing video (1) and Hip hinge video (2) and practice these techniques. These workouts are meant to focus on technique, not create excessive fatigue.</i>		
<b>Week 1: Workout #3</b>		
<i>Goals: Perform dynamic warm-up, postural alignment/bracing, hip hinge progression, cardio and cool down</i>		
<b>Dynamic Warm-up (3)</b>		
<b>*Perform 10 reps of each of the following exercises.</b>		
-Hip hinge		
-High Knee March to Toe touches		
-Lunge to lunge while raising opposite arm		
-Jumping jack		
-Cat & Camel		
-Bird dog position: hip raise, arms circles, push-up		
<b>**Myofascial release as needed</b>		
<b>Workout Proper</b>		
<b>Practice Postural Alignment / bracing sequence with plank (1)</b>		
-Hold plank 5-10 seconds, rest, and repeat 5 times or until technique fails		
<b>Practice Hip hinge / deadlift sequence (2)</b>		
Perform 3 sets of 10 repetitions of each of the following exercises		
-Kneeling shortstop		
-Standing shortstop		
-Deadlift (no load)		
<b>Cardio workout:</b>		
<b>*15 min walking at a brisk pace following workout</b>		
<b>Cool-down</b>		
<b>Static stretching (4)      Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds      *Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors	
-Arm across chest stretch	-Hamstrings	
-Chest stretch	-Calf	
-Lunge while raising opposite arm	-Glutes	
-Calf stretch	-Thoracic	
-Hurdler stretch	-Traps	
-Hip stretch		
-Forward butterfly stretch		

<b>Week 2</b>			
Week Overview: RT = 2 days; ET = 2 days			
<b>Resistance Training Workout #1</b>			
<i>Apparatus Workout</i>			
Workout goals: Focus on muscular, anaerobic, and aerobic endurance with emphasis on midline stability.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birddog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 30 sec on:60 off; 5 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Bentover row (13)</b>	L1: Bentover row with high rise pack	High rise pack/Foam bucket
		L2: 2-arm bentover row with foam buckets	Foam bucket
		L3: 1-arm bentover row with foam bucket	Foam bucket
Station 2: Apparatus anchor pt #1	<b>Decline push-up (8)</b>	L1: SUS chest press with less forward lean	SUS
		L2: SUS chest press with more forward lean	SUS
		L3: SUS chest press with while wearing SCBA	SUS, SCBA
Station 3: Apparatus-Side	<b>Side plank (34)</b>	L1: Side plank on knee	
		L2: Side plank on feet & elbow	
		L3: Side plank on feet & hand	
Station 4: Apparatus-Rear	<b>Jumps in place (43)</b>	L1: 2-foot hop in place	
		L2: 2-foot hop side-to-side	Line
		L3: 2-foot forward & backward	Line
Station 5: Apparatus-Anchor Pt #2	<b>Combo squat (22)</b>	L1: SUS squat to row	SUS
		L2: SUS squat with 1 arm row	SUS
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Week 2</b>	
Week Overview: RT = 2 days; ET = 2 days	
<b>Endurance Training Workout #1</b>	
<i>Goal: Develop aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 20 min	
*Notes: Pace should noticeably increase heart rate; walk at 3.0 mph or 100 steps/min	
Walking can occur in 1 continuous 20 min bout or 2 10 min bouts, or revise as needed	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 2</b>			
Week Overview: RT = 2 days; ET = 2 days			
<b>Resistance Training Workout #2</b>			
<i>Apparatus Workout</i>			
Workout goals: Focus on muscular, anaerobic, and aerobic endurance with emphasis on midline stability.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
Workout Parameters: 30 sec on:60 sec off; 5 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Squats (42)</b>	L1: Body weight squat L2: Squat wearing SCBA	SCBA
Station 2: Apparatus anchor pt #1	<b>Decline row (12)</b>	L1: SUS decline row (Lesser angle: feet further from anchor point; hand positions: underhand, overhand, or handshake) L2: SUS decline row (Greater angle: feet closer to anchor point) L3: SUS decline row wearing SCBA	SUS SUS SUS, SCBA
Station 3: Apparatus-Side	<b>Briddog Progression</b>	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch) L2: Lift opposite arm and leg at the same time (then switch arms/legs) L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding Padding Padding
Station 4: Apparatus-Rear	<b>Sumo Deadlift (23)</b>	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA	Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 5: Apparatus-Anchor Pt #2	<b>Push-up (7)</b>	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		

<b>Week 2</b>	
Week Overview: RT = 2 days; ET = 2 days	
<b>Endurance Training Workout #2</b>	
Goal: Develop aerobic fitness and weight management.	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 20 min	
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min	
Walking can occur in 1 continuous 20 min bout or (2) 10 min bouts, or revise as needed	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	
<b>Myofascial release with Foam Roller (5) or Ball (6)</b>	
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	



<b>Week 3</b>	
Week Overview: RT = 2 days; ET = 2 days	
<b>Endurance Training Workout #1</b>	
<i>Goal: Develop aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
Walk at a brisk pace for 25 min	
Notes: Pace should noticeably increase heart rate; 3.0 mph; 100 steps/min	
Walking can occur in 1 continuous 25 min bout or (2) 12.5 min bouts, or revise as needed	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	
<b>*Hold each stretch for 20 seconds</b>	
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	
<b>Myofascial release with Foam Roller (5) or Ball (6)</b>	
<b>*Roll out each muscle for about 30 seconds or as needed</b>	



<b>Week 3</b>			
Week Overview: RT = 2 days; ET = 2 days			
<b>Resistance Training Workout #2</b>			
<b>Apparatus Workout</b>			
Workout goals: Focus on muscular, anaerobic, and aerobic endurance with emphasis on midline stability.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 30 sec on:60 off; 5 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Goblet squats (with shoulder press) (24)</b>	L1: Body weight squat L2: Goblet squat with 1.75" hose roll L3: Goblet squat w/ shoulder press & wearing SCBA	1.75" hose High rise pack (50 ft 2.5" hose); SCBA
Station 2: Apparatus anchor pt #1	<b>Decline row (12)</b>	L1: SUS decline row (Lesser angle: feet further from anchor point) L2: SUS decline row (Greater angle: feet closer to anchor point) L3: SUS decline row wearing SCBA	SUS SUS SUS, SCBA
Station 3: Apparatus-Side	<b>Briddog Progression (35)</b>	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch) L2: Lift opposite arm and leg at the same time (then switch arms/legs) L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding Padding Padding
Station 4: Apparatus-Rear	<b>Step-up (27)</b>	L1: Step-up (body weight) L2: Step-up wearing SCBA L3: Step-up wearing SCBA & 1 hand holding foam bucket	Apparatus step Apparatus step, SCBA Apparatus step, SCBA, foam bucket
Station 5: Apparatus-Anchor Pt #2	<b>Push-up (7)</b>	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Week 3</b>																			
Week Overview: RT = 2 days; ET = 2 days																			
<b>Endurance Training Workout #2</b>																			
<i>Goal: Develop aerobic fitness and weight management.</i>																			
<b>Workout Proper (Moderate Intensity)</b>																			
Walk at a brisk pace for 25 min																			
Notes: Pace should noticeably increase heart rate; 3.0 mph; 100 steps/min																			
Walking can occur in 1 continuous 25 min bout or (2) 12.5 min bouts, or revise as needed																			
<b>Cool-down</b>																			
-Walk at slow pace for 5 minutes																			
<table> <tr> <th>Static stretching (4) *Hold each stretch for 20 seconds</th><th>Myofascial release with Foam Roller (5) or Ball (6) *Roll out each muscle for about 30 seconds or as needed</th></tr> <tr><td>-Overhead shoulder stretch</td><td>-Quads/IT band/hip flexors</td></tr> <tr><td>-Arm across chest stretch</td><td>-Hamstrings</td></tr> <tr><td>-Chest stretch</td><td>-Calf</td></tr> <tr><td>-Lunge while raising opposite arm</td><td>-Glutes</td></tr> <tr><td>-Calf stretch</td><td>-Thoracic</td></tr> <tr><td>-Hurdler stretch</td><td>-Traps</td></tr> <tr><td>-Hip stretch</td><td></td></tr> <tr><td>-Forward butterfly stretch</td><td></td></tr> </table>		Static stretching (4) *Hold each stretch for 20 seconds	Myofascial release with Foam Roller (5) or Ball (6) *Roll out each muscle for about 30 seconds or as needed	-Overhead shoulder stretch	-Quads/IT band/hip flexors	-Arm across chest stretch	-Hamstrings	-Chest stretch	-Calf	-Lunge while raising opposite arm	-Glutes	-Calf stretch	-Thoracic	-Hurdler stretch	-Traps	-Hip stretch		-Forward butterfly stretch	
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-Calf stretch	-Thoracic																		
-Hurdler stretch	-Traps																		
-Hip stretch																			
-Forward butterfly stretch																			

Optimal schedule of workout sequence						
Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
ET-High Intensity	ET-Moderate Intensity	OFF	RT	ET-Moderate Intensity	RT	OFF
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						

<b>Week 8</b>							
Week Overview: RT = 2 days; ET = 3 days							
<b>Endurance Training Workout #1</b>							
<i>Goal: Improve aerobic fitness carrying a load and weight management.</i>							
<b>Dynamic Warm-up (3)</b>							
<b>*Perform 10 reps of each of the following exercises.</b>							
-Hip hinge							
-High Knee March to Toe touches							
-Lunge to lunge while raising opposite arm							
-Jumping jack							
-Cat & Camel							
-Bird dog position: hip raise, arms circles, push-up							
<b>**Myofascial release as needed</b>							
<b>Workout Proper (High Intensity)</b>							
-Walk at a brisk pace with an SCBA on back (not on air) in PT clothes for 25 min							
<b>*Notes:</b> Pace should noticeably increase heart rate and breathing rate							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>						
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>						
-Overhead shoulder stretch	-Quads/IT band/hip flexors						
-Arm across chest stretch	-Hamstrings						
-Chest stretch	-Calf						
-Lunge while raising opposite arm	-Glutes						
-Calf stretch	-Thoracic						
-Hurdler stretch	-Traps						
-Hip stretch							
-Forward butterfly stretch							

<b>Week 8</b>							
Week Overview: RT = 2 days; ET = 3 days							
<b>Endurance Training Workout #2</b>							
<i>Goal: Improve aerobic fitness and weight management.</i>							
<b>Workout Proper (Moderate Intensity)</b>							
-Walk at a brisk pace for 30 min							
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>						
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>						
-Overhead shoulder stretch	-Quads/IT band/hip flexors						
-Arm across chest stretch	-Hamstrings						
-Chest stretch	-Calf						
-Lunge while raising opposite arm	-Glutes						
-Calf stretch	-Thoracic						
-Hurdler stretch	-Traps						
-Hip stretch							
-Forward butterfly stretch							

Week 8			
Week Overview: RT = 2 days; ET = 3 days			
Resistance Training Workout #1			
Apparatus Workout			
Workout goals: Focus on muscular, anaerobic, and aerobic endurance with emphasis on midline stability.			
Dynamic Warm-up (3)			
*Perform 10 reps of each of the following exercises.			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
**Myofascial release as needed			
Workout Proper			
Workout Parameters: 30 sec on:60 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits			
Exercise Location	Exercise	Exercise Progression	Required Equipment
Station 1: Apparatus-Front	Curl-up (33)	L1: Curl-up	
Station 2: Apparatus anchor pt #1	Decline push-up (8)	L1: SUS chest press with lesser forward lean	SUS
(Passenger side)		L2: SUS chest press with greater forward lean	SUS
		L3: SUS chest press while wearing SCBA	SUS, SCBA
Station 3: Apparatus-Side	Briddog Progression (35)	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch)	Padding
		L2: Lift opposite arm and leg at the same time (then switch arms/legs)	Padding
		L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding
Station 4: Apparatus-Rear	Step-up (27)	L1: Step-up (body weight)	Apparatus step
		L2: Step-up wearing SCBA	Apparatus step, SCBA
		L3: Step-up wearing SCBA & 1 hand holding foam bucket	Apparatus step, SCBA, foam bucket
Station 5: Apparatus-Side	Bentover row (13)	L1: Bentover row with high rise pack	High rise pack/Foam bucket
		L2: 2-arm bentover row with foam buckets	Foam bucket
		L3: 1-arm bentover row with foam bucket	Foam bucket
Station 6: Apparatus-Anchor Pt #2	ple Extension sequence (4	L1: SUS 2-foot triple extension	SUS
(Driver's side)		L2: SUS 2-foot forward lean - jump	SUS
Cardio workout			
*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.			
Cool-down			
Static stretching (4)	Myofascial release with Foam Roller (5) or Ball (6)		
*Hold each stretch for 20 seconds	*Roll out each muscle for about 30 seconds or as needed		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip strech			
-Forward butterfly stretch			

<b>Week 8</b>							
Week Overview: RT = 2 days; ET = 3 days							
<b>Endurance Training Workout #3</b>							
<i>Goal: Improve aerobic fitness and weight management.</i>							
<b>Workout Proper (Moderate Intensity)</b>							
-Walk at a brisk pace for 30 min							
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>						
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>						
-Overhead shoulder stretch	-Quads/IT band/hip flexors						
-Arm across chest stretch	-Hamstrings						
-Chest stretch	-Calf						
-Lunge while raising opposite arm	-Glutes						
-Calf stretch	-Thoracic						
-Hurdler stretch	-Traps						
-Hip stretch							
-Forward butterfly stretch							

Week 8			
Week Overview: RT = 2 days; ET = 3 days			
Resistance Training Workout #2			
Apparatus Workout			
Workout goals: Focus on muscular, anaerobic, and aerobic endurance with emphasis on midline stability.			
Dynamic Warm-up (3)			
*Perform 10 reps of each of the following exercises.			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
**Myofascial release as needed			
Workout Proper			
Workout Parameters: 30 sec on:60 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits			
Exercise Location	Exercise	Exercise Progression	Required Equipment
Station 1: Apparatus-Front	Push-up (7)	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
Station 2: Apparatus anchor Pt #1 (Passenger side)	Single leg squat (28)	L1: SUS single leg squat (pistol) L2: SUS single leg squat wearing SCBA (pistol) L3: SUS single leg squat (pistol) to Y's (may add SCBA for additional re	SUS SUS, SCBA SUS, SCBA
Station 3: Apparatus-Side	Side plank (34)	L1: Side plank on knee L2: Side plank on feet & elbow L3: Side plank on feet & hand	
Station 4: Apparatus-Rear	Mountain climbers (39)	L1: Mtn. climbers on apparatus step L2: Mtn. climbers on ground L3: Requires SUS; Perform level 2	Apparatus / Step
Station 5: Apparatus-Side (Driver's side)	Sumo Deadlift (with upright row) (23)	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA	Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 6: Apparatus-Anchor Pt #2	Decline row (12)	L1: SUS decline row w/ lesser angle L2: SUS decline row w/ greater angle L3: SUS decline row wearing SCBA	SUS SUS SUS, SCBA

Optimal schedule of workout sequence						
Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
ET-Moderate Intensity	OFF	ET-Moderate Intensity	OFF	ET-Moderate Intensity	OFF	OFF
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						

<b>Workout Proper (Moderate Intensity)</b>							
-Walk at a brisk pace for 60 min							
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min							
Walking can occur in 1 continuous 60 min bout or multiple bouts to accumulate 60 min							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>					
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>					
-Overhead shoulder stretch		-Quads/IT band/hip flexors					
-Arm across chest stretch		-Hamstrings					
-Chest stretch		-Calf					
-Lunge while raising opposite arm		-Glutes					
-Calf stretch		-Thoracic					
-Hurdler stretch		-Traps					
-Hip stretch							
-Forward butterfly stretch							

<b>Workout Proper (Moderate Intensity)</b>							
-Walk at a brisk pace for 60 min							
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min							
Walking can occur in 1 continuous 60 min bout or multiple bouts to accumulate 60 min							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>					
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>					
-Overhead shoulder stretch		-Quads/IT band/hip flexors					
-Arm across chest stretch		-Hamstrings					
-Chest stretch		-Calf					
-Lunge while raising opposite arm		-Glutes					
-Calf stretch		-Thoracic					
-Hurdler stretch		-Traps					
-Hip stretch							
-Forward butterfly stretch							



<b>Workout Proper (Moderate Intensity)</b>							
-Walk at a brisk pace for 60 min							
*Notes: Pace should noticeably increase heart rate, 3.0 mph, or 100 steps/min							
Walking can occur in 1 continuous 60 min bout or multiple bouts to accumulate 60 min							
<b>Cool-down</b>							
-Walk at slow pace for 5 minutes							
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>					
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>					
-Overhead shoulder stretch		-Quads/IT band/hip flexors					
-Arm across chest stretch		-Hamstrings					
-Chest stretch		-Calf					
-Lunge while raising opposite arm		-Glutes					
-Calf stretch		-Thoracic					
-Hurdler stretch		-Traps					
-Hip stretch							
-Forward butterfly stretch							

Optimal schedule of workout sequence								
<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>	<b>Day 5</b>	<b>Day 6</b>	<b>Day 7</b>		
ET-High Intensity	ET-Moderate Intensity	RT	ET-Moderate Intensity	RT	OFF	OFF		
RT: Resistance training								
ET: Endurance training								
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.								

<b>Dynamic Warm-up (3)</b>	
<b>*Perform 10 reps of each of the following exercises.</b>	
-Hip hinge	
-High Knee March to Toe touches	
-Lunge to lunge while raising opposite arm	
-Jumping jack	
-Cat & Camel	
-Bird dog position: hip raise, arms circles, push-up	
<i>**Myofascial release as needed</i>	
<b>Workout Proper (High Intensity)</b>	
-Walk at a brisk pace with an SCBA on back (not on air) for 25 min	
<i>*Notes: Pace should noticeably increase heart rate and breathing rate</i>	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	
<b>Myofascial release with Foam Roller (5) or Ball (6)</b>	
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 13</b>	
Week Overview: RT = 2 days; ET = 3 days	
<b>Endurance Training Workout #2</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 45 min	
*Notes: Pace should noticeably increase heart rate, >3.0 mph, or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 13</b>			
Week Overview: RT = 2 days; ET = 3 days			
<b>Resistance Training Workout #1</b>			
<b>Apparatus Workout</b>			
Workout goals: Improve metabolic conditioning with a focus on midline stabilization.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 30 sec on:45 sec off; 7 exercises per circuit; 3 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Mountain climbers (39)</b>	L1: Mtn. climbers on apparatus step L2: Mtn. climbers on ground L3: Requires SUS; Omit and perform Level 2	Apparatus / Step
Station 2: Apparatus-Front	<b>Curl-up (33)</b>	L1: Curl-up	
Station 3: Apparatus anchor pt #1	<b>Decline push-up (8)</b>	L1: SUS chest press with forward lean (Lesser angle: feet further from anchor point) L2: SUS chest press with forward lean (Greater angle: feet closer to anchor point) L3: SUS chest press with forward lean -use greater angle wearing SCBA	SUS SUS SUS, SCBA
Station 4: Apparatus-Side	<b>Briddog Progression (35)</b>	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch) L2: Lift opposite arm and leg at the same time (then switch arms/legs) L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding Padding Padding
Station 5: Apparatus-Rear	<b>o Deadlift (with upright row)</b>	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA	Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 6: Apparatus-Side	<b>Bentover row (13)</b>	L1: Bentover row with high rise pack L2: 2-arm bentover row with foam buckets L3: 1-arm bentover row with foam bucket	High rise pack/Foam bucket Foam bucket Foam bucket
Station 7: Apparatus-Anchor Pt #2 (Driver's side)	<b>Overhead Squat (21)</b>	L1: SUS overhead squat L2: Pike pole overhead squat L3: Overhead squat wearing SCBA & high rise pack or Pike pole overhead	SUS Pike Pole SCBA, High rise pack
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip strech			
-Forward butterfly stretch			

<b>Week 13</b>	
Week Overview: RT = 2 days; ET = 3 days	
<b>Endurance Training Workout #3</b>	
<i>Moderate Intensity</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 45 min	
*Notes: Pace should noticeably increase heart rate, >3.0 mph, or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

Week 13			
Overview: RT = 2 days; ET = 3 days			
stance Training Workout #2			
Apparatus Workout			
Workout goals: Improve metabolic conditioning with a focus on midline stabilization.			
Dynamic Warm-up (3)			
*Perform 10 reps of each of the following exercises.			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Bird dog position: hip raise, arms circles, push-up			
**Myofascial release as needed			
Workout Proper			
Workout Parameters: 30 sec on:45 sec off; 7 exercises per circuit; 3 rotations of each circuit; 2 min off b/t circuits			
Exercise Location	Exercise	Exercise Progression	Required Equipment
Station 1: Apparatus-Front	Squats (42)	L1: Body weight squat L2: Squat wearing SCBA	SCBA
Station 2: Apparatus-Front	Push-up (7)	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
Station 3: Apparatus anchor pt #1	Decline row (12)	L1: SUS decline row with body at lesser angle L2: SUS decline row with body at greater angle L3: SUS decline row wearing SCBA	SUS SUS SUS, SCBA
Station 4: Apparatus-Side	Bear Crawl (36)	L1: Static bear crawl position L2: Bear crawl hose pull L3: Bear crawl	
Station 5: Apparatus-Rear	Lunge (26)	L1: Walking lunge (body weight) L2: Lunge wearing SCBA L3: Lunge wearing SCBA & shoulder pressing high rise pack	SCBA SCBA, HRP
Station 6: Apparatus-Side	Burpee (41)	L1: Burpee L2: Burpee with push-up L3: Burpee with push-up & vt jump	
Station 7: Apparatus-Anchor Pt #1 (Driver's side)	Gators (18)	L1: SUS gators (Lesser angle: feet further from anchor point) L2: SUS gators (Greater angle: feet closer to anchor point) L3: SUS gators wearing SCBA	SUS SUS SUS, SCBA
Cardio workout			
*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.			
Cool-down			
Static stretching (4)		Myofascial release with Foam Roller (5) or Ball (6)	
*Hold each stretch for 20 s *Roll out each muscle for about 30 seconds or as needed			
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

Optimal schedule of workout sequence						
<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>	<b>Day 5</b>	<b>Day 6</b>	<b>Day 7</b>
USAFFOA	ET-Moderate Intensity	ET-High Intensity	OFF	RT	ET-Moderate Intensity	OFF
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						

<b>Week 17</b>	
Overview: RT = 1 day; USAFFOA = 1 day; ET = 3 days	
<b>Endurance Training Workout #1</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 45 min	
*Notes: Pace should noticeably increase heart rate, at 3.0 mph, or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 17</b>						
erview: RT = 1 day; USAFFOA = 1 day; ET = 3 days						
<b>Endurance Training Workout #2</b>						
<i>Goal: Improve aerobic fitness and weight management.</i>						
<b>Dynamic Warm-up (3)</b>						
<b>*Perform 10 reps of each of the following exercises.</b>						
-Hip hinge						
-High Knee March to Toe touches						
-Lunge to lunge while raising opposite arm						
-Jumping jack						
-Cat & Camel						
-Birdog position: hip raise, arms circles, push-up						
<b>**Myofascial release as needed</b>						
<b>Workout Proper (High Intensity)</b>						
-Stair climb at a brisk pace with an SCBA on back (not on air) in PT clothes; Perform 8 repetitions of 2 min of stair climbing with 1 minute recovery (Total work=16 min)						
<b>*Notes: Pace should noticeably increase heart rate and breathing rate</b>						
<b>Cool-down</b>						
-Walk at slow pace for 5 minutes						
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>				
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>				
-Overhead shoulder stretch		-Quads/IT band/hip flexors				
-Arm across chest stretch		-Hamstrings				
-Chest stretch		-Calf				
-Lunge while raising opposite arm		-Glutes				
-Calf stretch		-Thoracic				
-Hurdler stretch		-Traps				
-Hip stretch						
-Forward butterfly stretch						



<b>Week 17</b>			
RT = 1 day; USAFFOA = 1 day; ET = 3 days			
<b>tance Training Workout #1</b>			
<b>Functional Workout</b>			
<i>Workout goal: Improve occupational performance.</i>			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 30 sec on:45 sec off; 7 exercises per circuit; 3 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Hose drag sequence (forward) (46)</b>	L1: Hose drag with 1.75" hose L2: Hose drag with 5" hose	Unrolled hose (charged or uncharged) OR tactical webbing with several hose rolls on sked Unrolled hose (charged or uncharged) OR tactical webbing with several hose rolls on sked
Station 2: Apparatus-Front	<b>Sumo Deadlift (with upright row) (23)</b>	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA	Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 3: Apparatus anchor pt	<b>Kneeling hose pull (14)</b>	L1: Kneeling hose pull with 50 ft. 1.75" hose L2: Kneeling hose pull with 100 ft. 1.75" hose L3: Kneeling hose pull with 50 ft. 2.5" hose	50 ft 1.75" hose 100 ft. 1.75" hose 50-100 ft. 2.5/3" hose
Station 4: Apparatus-Side (Passenger's side)	<b>Forcible entry w/ tire (49)</b>	L1: Swing hammer overhead & strike top of tire L2: Swing laterally to strike side of tire	Sledge hammer, tire Sledge hammer, tire
Station 5: Apparatus-Rear	<b>Step-up (27)</b>	L1: Step-up (body weight) L2: Step-up wearing SCBA L3: Step-up wearing SCBA & 1 hand holding foam bucket	Apparatus step Apparatus step, SCBA Apparatus step, SCBA, foam bucket
Station 6: Apparatus-Side (Driver's side)	<b>Burpee (41)</b>	L1: Burpee L2: Burpee with push-up L3: Burpee with push-up & vt jump	
Station 7: Apparatus-Anchor Pt	<b>Farmer's carry (25)</b>	L1: Farmer's carry with 2 foam buckets L2: Farmer's carry with 1 foam bucket L3: Farmer's carry wearing SCBA & 1 hand holding a hose roll or foam bucket	(2) Foam buckets Foam bucket SCBA, 1 hose roll or foam bucket
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4) Myofascial release with Foam Roller (5) or Ball (6)</b>			
<b>*Hold each stretch for 20s *Roll out each muscle for about 30 seconds or as needed</b>			
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Endurance Training Workout #3</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 45 min	
*Notes: Pace should noticeably increase heart rate, at 3.0 mph, or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

Optimal schedule of workout sequence									
<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>	<b>Day 5</b>	<b>Day 6</b>	<b>Day 7</b>			
RT	ET-High Intensity	ET-Moderate Intensity	RT	OFF	RT	OFF			
RT: Resistance training									
ET: Endurance training									
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.									

<b>Week 20</b>			
Week Overview: RT = 3 days; ET = 2 days			
<b>Resistance Training Workout #1</b>			
<b>Apparatus Workout</b>			
Workout goal: Metabolic conditioning with a focus on midline stabilization.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 45 sec on:45 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Hose roll swings (44A)</b>	L1: Hose roll swing with 1.75" hose L2: Hose roll swing with 2.5" hose	1.75" Hose roll 2.5" Hose roll
Station 2: Apparatus anchor pt #1 (Passenger side)	<b>Decline push-up (8)</b>	L1: SUS chest press with forward lean at lesser angle L2: SUS chest press with forward lean at greater angle L3: SUS chest press with forward lean -use greater angle wearing SCBA	SUS SUS SUS, SCBA
Station 3: Apparatus-Side	<b>Briddog Progression (35)</b>	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch) L2: Lift opposite arm and leg at the same time (then switch arms/legs) L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding Padding Padding
Station 4: Apparatus-Rear	<b>Step-up (27)</b>	L1: Step-up (body weight) L2: Step-up wearing SCBA L3: Step-up wearing SCBA & 1 hand holding foam bucket	Apparatus step Apparatus step, SCBA Apparatus step, SCBA, foam bucket
Station 5: Apparatus-Side (Driver's side)	<b>Bentover row (13)</b>	L1: Bentover row with high rise pack L2: 2-arm bentover row with foam buckets L3: 1-arm bentover row with foam bucket	High rise pack/Foam bucket Foam bucket Foam bucket
Station 6: Apparatus-Anchor Pt #2	<b>Triple Extension sequence (4)</b>	L1: SUS 2-foot triple extension L2: SUS 2-foot forward lean - jump	SUS SUS
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Week 20</b>	
Week Overview: RT = 3 days; ET = 2 days	
<b>Endurance Training Workout #1</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Dynamic Warm-up (3)</b>	
<b>*Perform 10 reps of each of the following exercises.</b>	
-Hip hinge	
-High Knee March to Toe touches	
-Lunge to lunge while raising opposite arm	
-Jumping jack	
-Cat & Camel	
-Bird dog position: hip raise, arms circles, push-up	
<b>**Myofascial release as needed</b>	
<b>Workout Proper (High Intensity)</b>	
-Walk at a brisk pace with an SCBA on back (not on air) for 30 min	
*Notes: Pace should noticeably increase heart rate and breathing rate	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) o</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 20</b>	
Week Overview: RT = 3 days; ET = 2 days	
<b>Endurance Training Workout #2</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
Walk at a brisk pace for 60 min continuously or accumulate 60 min in several short walks	
Notes: Pace should noticeably increase heart rate; 3.0 mph; 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 20</b>		
Work Overview: RT = 3 days; ET = 2 days		
<b>Resistance Training Workout #2</b>		
<b>Apparatus Workout</b>		
Workout goal: Metabolic conditioning with a focus on midline stabilization.		
<b>Dynamic Warm-up (3)</b>		
<b>*Perform 10 reps of each of the following exercises.</b>		
-Hip hinge		
-High Knee March to Toe touches		
-Lunge to lunge while raising opposite arm		
-Jumping jack		
-Cat & Camel		
-Bird dog position: hip raise, arms circles, push-up		
<b>**Myofascial release as needed</b>		
<b>Workout Proper</b>		
<b>Workout Parameters: 45 sec on:45 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>		
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>
Station 1: Apparatus-Front	<b>Mountain climbers (39)</b>	L1: Mtn. climbers on apparatus step L2: Mtn. climbers on ground L3: Requires SUS; Perform L2
		SUS
Station 2: Apparatus anchor Pt #1 (Passenger side)	<b>Single leg squat (28)</b>	L1: SUS single leg squat (pistol) L2: SUS single leg squat wearing SCBA (pistol) L3: SUS single leg squat (pistol) to Y's (may add SCBA for additional resistance)
		SUS, SCBA
Station 3: Apparatus-Side	<b>Side plank (34)</b>	L1: Side plank on knee L2: Side plank on feet & elbow L3: Side plank on feet & hand
Station 4: Apparatus-Rear	<b>Push-up (7)</b>	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA
		SCBA
Station 5: Apparatus-Side (Driver's side)	<b>Sumo Deadlift (with upright row)</b>	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA
		Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 6: Apparatus-Anchor Pt #2	<b>Decline row (12)</b>	L1: SUS decline row at lesser angle L2: SUS decline row (Greater angle: feet closer to anchor point) L3: SUS decline row wearing SCBA
		SUS SUS SUS, SCBA
<b>Cardio workout</b>		
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>		
<b>Cool-down</b>		
<b>Static stretching (4) Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds *Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors	
-Arm across chest stretch	-Hamstrings	
-Chest stretch	-Calf	
-Lunge while raising opposite	-Glutes	
-Calf stretch	-Thoracic	
-Hurdler stretch	-Traps	
-Hip stretch		
-Forward butterfly stretch		

<b>Week 20</b>			
Week Overview: RT = 3 days; ET = 2 days			
<b>Resistance Training Workout #3</b>			
<b>Apparatus Workout</b>			
Workout goal: Metabolic conditioning with a focus on midline stabilization.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 45 sec on:45 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Farmer's carry (25)</b>	L1: Farmer's carry with 2 foam buckets L2: Farmer's carry with 1 foam bucket L3: Farmer's carry wearing SCBA & 1 hand holding a hose roll or foam bucket	(2) Foam buckets Foam bucket SCBA, 1 hose roll or foam bucket
Station 2: Apparatus anchor Pt #1 (Passenger side)	<b>Decline row (12)</b>	L1: SUS decline row at lesser angle L2: SUS decline row at greater angle L3: SUS decline row wearing SCBA	SUS SUS SUS, SCBA
Station 3: Apparatus-Side	<b>Briddog Progression (35)</b>	L1: Lift 1 arm forward & back (then switch) OR lift 1 leg out & back (then switch) L2: Lift opposite arm and leg at the same time (then switch arms/legs) L3: Lift opposite arm and leg forward and out to the side (then switch arms/legs)	Padding Padding Padding
Station 4: Apparatus-Rear	<b>Push-up (7)</b>	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
Station 5: Apparatus-Side (Driver's side)	<b>Lunge (26)</b>	L1: Walking lunge (body weight) L2: Lunge wearing SCBA L3: Lunge wearing SCBA & shoulder pressing high rise pack	SCBA SCBA SCBA, HRP
Station 6: Apparatus-Anchor Pt #2	<b>Burpee (41)</b>	L1: Burpee L2: Burpee with push-up L3: Burpee with push-up & vt jump	
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Optimal schedule of workout sequence</b>						
<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>	<b>Day 5</b>	<b>Day 6</b>	<b>Day 7</b>
RT	OFF	ET-High Intensity	ET-Moderate Intensity	RT	OFF	OFF
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						

<b>Week 22</b>			
Week Overview: RT = 2 days; ET = 2 days			
<b>Resistance Training Workout #1</b>			
<i>Functional Workout</i>			
Workout goal: Improve occupational performance.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Bird dog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
<b>Workout Parameters: 45 sec on:30 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits</b>			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	<b>Farmer's carry (25)</b>	L1: Farmer's carry with 2 foam buckets L2: Farmer's carry with 1 foam bucket L3: Farmer's carry wearing SCBA & 1 hand holding a hose roll or foam bucket	(2) Foam buckets Foam bucket SCBA, 1 hose roll or foam bucket
Station 2: Apparatus anchor pt #1 (Passenger's side)	<b>Decline push-up (8)</b>	L1: SUS chest press with forward lean L2: SUS chest press with greater forward lean L3: SUS chest press with forward lean -use greater angle wearing SCBA	SUS SUS SUS, SCBA
Station 3: Apparatus-Side	<b>Standing hose pull (15)</b>	L1: Standing hose/equipment pull with 50 ft 1.75" hose L2: Standing hose/equipment pull with 100 ft 1.75" hose L3: Standing hose/equipment pull with 50-100 ft 2.5" hose	50 ft 1.75" hose 100 ft. 1.75" hose 50-100 ft. 2.5/3" hose
Station 4: Apparatus-Rear	<b>Step-up (27)</b>	L1: Step-up (body weight) L2: Step-up wearing SCBA L3: Step-up wearing SCBA & 1 hand holding foam bucket	Apparatus step Apparatus step, SCBA Apparatus step, SCBA, foam bucket
Station 5: Apparatus-Side (Driver's side)	<b>Forcible entry w/ tire (49)</b>	L1: Swing hammer overhead & strike top of tire L2: Swing laterally to strike side of tire	Sledge hammer, tire Sledge hammer, tire
Station 6: Apparatus-Anchor Pt #2	<b>Lunge (26)</b>	L1: Walking lunge (body weight) L2: Lunge wearing SCBA L3: Lunge wearing SCBA & shoulder pressing high rise pack	SCBA SCBA, HRP
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			



<b>Week 22</b>									
Week Overview: RT = 2 days; ET = 2 days									
<b>Endurance Training Workout #1</b>									
Goal: Improve aerobic fitness and weight management.									
<b>Dynamic Warm-up (3)</b>									
<b>*Perform 10 reps of each of the following exercises.</b>									
-Hip hinge									
-High Knee March to Toe touches									
-Lunge to lunge while raising opposite arm									
-Jumping jack									
-Cat & Camel									
-Bird dog position: hip raise, arms circles, push-up									
<b>**Myofascial release as needed</b>									
<b>Workout Proper (High Intensity)</b>									
-Stair climb at a brisk pace with an SCBA on back (not on air); Perform 10 repetitions of 2 min of stair climbing with 1 minute recovery between reps (Total work=20 min)									
<b>*Notes: Pace should noticeably increase heart rate and breathing rate</b>									
<b>Cool-down</b>									
-Walk at slow pace for 5 minutes									
<b>Static stretching (4)</b>		<b>Myofascial release with Foam Roller (5) or Ball (6)</b>							
<b>*Hold each stretch for 20 seconds</b>		<b>*Roll out each muscle for about 30 seconds or as needed</b>							
-Overhead shoulder stretch		-Quads/IT band/hip flexors							
-Arm across chest stretch		-Hamstrings							
-Chest stretch		-Calf							
-Lunge while raising opposite arm		-Glutes							
-Calf stretch		-Thoracic							
-Hurdler stretch		-Traps							
-Hip stretch									
-Forward butterfly stretch									

<b>Week 22</b>	
Week Overview: RT = 2 days; ET = 2 days	
<b>Endurance Training Workout #2</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
Walk at a brisk pace for 60 min continuously or accumulate 60 min in multiple shorter bouts	
Notes: Pace should noticeably increase heart rate; walk at 3.0 mph or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Resistance Training Workout #2</b>			
<b>Functional Workout</b>			
Workout goal: Improve occupational performance.			
<b>Dynamic Warm-up (3)</b>			
<b>*Perform 10 reps of each of the following exercises.</b>			
-Hip hinge			
-High Knee March to Toe touches			
-Lunge to lunge while raising opposite arm			
-Jumping jack			
-Cat & Camel			
-Birdog position: hip raise, arms circles, push-up			
<b>**Myofascial release as needed</b>			
<b>Workout Proper</b>			
Workout Parameters: 45 sec on:30 sec off; 6 exercises per circuit; 2 rotations of each circuit; 2 min off b/t circuits			
<b>Exercise Location</b>	<b>Exercise</b>	<b>Exercise Progression</b>	<b>Required Equipment</b>
Station 1: Apparatus-Front	Farmer's carry (25)	L1: Farmer's carry with 2 foam buckets L2: Farmer's carry with 1 foam bucket L3: Farmer's carry wearing SCBA & 1 hand holding a hose roll or foam bucket	(2) Foam buckets Foam bucket SCBA, 1 hose roll or foam bucket
Station 2: Apparatus anchor pt #1	Sumo Deadlift (with upright row) (23)	L1: Sumo Deadlift with foam bucket load L2: Sumo Deadlift lifting foam bucket & wearing SCBA L3: Sumo Deadlift with upright row (Ladder/FB) & wearing SCBA	Foam bucket SCBA, foam bucket SCBA, Ladder or foam bucket
Station 3: Apparatus-Side (Passenger's side)	Tripod hose advance (37)	L1: Tripod slide without hose L2: Tripod slide with hose	Padding Padding / Hose
Station 4: Apparatus-Rear	Battle rope (47)	L1: 2-arm battle rope (same motion) with 1.75/2.5/5" hose L2: 2-arm battle rope (opposite movement) with 1.75/2.5/5" hose L3: 1-arm battle rope with 1.75/2.5/5" hose	Hose Hose Hose
Station 5: Apparatus-Side (Driver's side)	Push-up (7)	L1: Push-up on knees L2: Body weight push-up on toes L3: Push-up wearing SCBA	SCBA
Station 6: Apparatus-Anchor Pt #2	Rescue drag (backward) (45)	L1: Drag tractor tire OR 5" hose roll(s) on sked with tactical webbing	re or tactical webbing with several hose rolls on sked
<b>Cardio workout</b>			
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>			
<b>Cool-down</b>			
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>		
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>		
-Overhead shoulder stretch	-Quads/IT band/hip flexors		
-Arm across chest stretch	-Hamstrings		
-Chest stretch	-Calf		
-Lunge while raising opposite arm	-Glutes		
-Calf stretch	-Thoracic		
-Hurdler stretch	-Traps		
-Hip stretch			
-Forward butterfly stretch			

<b>Optimal schedule of workout sequence</b>						
<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>	<b>Day 5</b>	<b>Day 6</b>	<b>Day 7</b>
ET-Moderate Intensity	OFF	USAFFOA	OFF	ET-Moderate Intensity	OFF	OFF
RT: Resistance training						
ET: Endurance training						
*If this schedule is not convenient for you, please adjust accordingly to complete the prescribed workouts.						

<b>Week 24</b>	
Week Overview: ET = 2 days; USAFFOA = 1 day	
<b>Endurance Training Workout #1</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 30 min	
*Notes: Pace should noticeably increase heart rate; walk at 3.0 mph or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	

<b>Week 24</b>		
Week Overview: ET = 2 days; USAFFOA = 1 day		
<b>USAFFOA</b>		
<i>Workout goal: Assessment and occupational workout.</i>		
<b>Dynamic Warm-up (3)</b>		
<b>*Perform 10 reps of each of the following exercises.</b>		
-Hip hinge		
-High Knee March to Toe touches		
-Lunge to lunge while raising opposite arm		
-Jumping jack		
-Cat & Camel		
-Bird dog position: hip raise, arms circles, push-up		
<b>**Myofascial release as needed</b>		
<b>Workout Proper</b>		
<b>***Perform USAFFOA in full turnout gear (including SCBA) and on air</b>		
<b>Workout Parameters: Perform 1 rotation of the circuit for time and report to The First 20.</b>		
<b>Exercise Location</b>	<b>Exercise</b>	<b>Required Equipment</b>
Station 1	<b>1-Arm hose carry</b>	1.75" hose roll
Station 2	<b>Ladder carry</b>	Extension ladder
Station 3	<b>Advance charged hoseline</b>	2 sections of 1.75" hose-charged
Station 4	<b>Ladder climb</b>	Extension ladder
Station 5	<b>Standing equipment pull</b>	Rope and 5" hose
Station 6	<b>Forcible entry</b>	Tire, table, sledge hammer
Station 7	<b>Victim drag</b>	Rescue maniquin or tractor tire
Station 8	<b>Ladder climb</b>	Extension ladder
Station 9	<b>Ladder carry</b>	Extension ladder
Station 10	<b>Spreader tool carry</b>	Spreader tool
<b>Cardio workout</b>		
<b>*20 min walking at a brisk pace following RT workout. Then, walk at slow pace for 5 additional min to cool-down.</b>		
<b>Cool-down</b>		
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>	
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>	
-Overhead shoulder stretch	-Quads/IT band/hip flexors	
-Arm across chest stretch	-Hamstrings	
-Chest stretch	-Calf	
-Lunge while raising opposite arm	-Glutes	
-Calf stretch	-Thoracic	
-Hurdler stretch	-Traps	
-Hip stretch		
-Forward butterfly stretch		

<b>Week 24</b>	
Week Overview: ET = 2 days; USAFFOA = 1 day	
<b>Endurance Training Workout #2</b>	
<i>Goal: Improve aerobic fitness and weight management.</i>	
<b>Workout Proper (Moderate Intensity)</b>	
-Walk at a brisk pace for 30 min	
*Notes: Pace should noticeably increase heart rate; walk at 3.0 mph or 100 steps/min	
<b>Cool-down</b>	
-Walk at slow pace for 5 minutes	
<b>Static stretching (4)</b>	<b>Myofascial release with Foam Roller (5) or Ball (6)</b>
<b>*Hold each stretch for 20 seconds</b>	<b>*Roll out each muscle for about 30 seconds or as needed</b>
-Overhead shoulder stretch	-Quads/IT band/hip flexors
-Arm across chest stretch	-Hamstrings
-Chest stretch	-Calf
-Lunge while raising opposite arm	-Glutes
-Calf stretch	-Thoracic
-Hurdler stretch	-Traps
-Hip stretch	
-Forward butterfly stretch	