

Developing Exercise Guidelines by Age Group for the Baltimore City Fire Department Health
and Wellness Plan

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CERTIFICATION STATEMENT

I certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of others.

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Abstract

The problem is the Baltimore City Fire Department (BCFD) does not currently possess exercise guidelines by age group for uniform members. The department has been unable to establish a physical fitness program after the death of a recruit during training. The department chose to adopt the Candidate Physical Ability Test (CPAT) as a result of the accident. Since the adoption of CPAT, the department has been unable to move forward with complete adoption and implementation of NFPA 1583. An important part of this standard is chapter 7- Exercise and Training programs. Establishing exercise guidelines by age group would allow the department to comply with chapter 7 of NFPA 1583 in an effort to improve the health of readiness of members.

The purpose of this research is to develop exercise guidelines for established age groups. Guidelines for exercising will benefit all members no matter what state of fitness they are in. Research into general fitness standards provided a baseline for standard formulation. A review of other department's fitness programs provide a comprehensive view of outcomes that are possible. Action research answered the following research questions: a) What professional groups have established recognized age groups for exercise programs? b) What are the best exercises to maintain strength and flexibility by recognized age groups? c) What is the standard for cardiovascular health by recognized age group? d) What equipment is needed to safely perform needed exercises for all recognized age groups?

The results of the research found that the department can implement a fitness program that impacts all members of the department. The recommendation to move forward with the fitness program to fully comply with NFPA 1583.

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Developing Exercise Guidelines by Age Group

Introduction

Physical fitness has become a part of the fire service culture. Fire departments across the country encourage and provide the resources for on-duty physical fitness activities. These activities provide a healthier and less injury-prone member. Even with fire departments embracing physical fitness, emergency services personnel continue to pass away from health related causes. In August of 2013, the United States Fire Administration (USFA) published its report Firefighter Fatalities in the United States in 2012. (USFA 2012) Looking at the causes of death in the report, there were 39 members who died of a heart attack, the most for a single reason in the report. (USFA 2012) The National Fire Protection Agency (NFPA) has published standard 1583, Health-Related Fitness Programs (HRFP) for Fire Department Members in an effort to guide Departments when implementing and conducting a fitness program as part their individual effort to reduce non fire ground related deaths.

Instituting a HRFP has many issues to overcome. One issue to solve is having department members start physical fitness in a safe and meaningful way. Providing guidelines that encompass strength, flexibility, and cardiovascular fitness for each member, no matter what age or fitness level, to follow provides a starting point. Exercise guidelines also allow peer fitness trainers to develop individual instruction. Instruction and expectations about the benefits of exercise must meet realistic goals. “Unrealistic expectations(“If I exercise regularly, I should be able to shed all that excess weight within a month or two,” or “ Exercise will completely change

my life”), fueled by the media and at times a somewhat overzealous health community, currently run rampant.” (Becker p.378 2003) Guidelines provide both the trainer and member with clear and concise path to fitness. The problem is the Baltimore City Fire Department (BCFD) does not currently possess exercise guidelines by age group for uniformed members. The purpose of this research is to develop exercise guidelines by age group for all uniform members of the department. Using literature review, current standards, and other departments’ policies, the following questions will be answered. a) What professional groups have established recognized age groups for exercise programs? b) What are the best exercises to maintain strength and flexibility by recognized age groups? c) What is the standard for cardiovascular health by recognized age group? d) What equipment is needed to safely perform needed exercises for all recognized age groups? It is contended that the answers to these questions should allow for the development of an exercise action plan to implement for the BCFD’s Health and Wellness program.

Background and Significance

BCFD is an, urban all hazards fire department currently. The Department has 1500 uniformed members and 100 civilian employees operating out of its Headquarters, Pimlico Public Safety Training Center, Fire Academy, Office of the Fire Marshall, Communications center and 35 Fire Stations. (Baltimore City Fire Department, 2013) The Department provides Fire Suppression, Emergency Medical Services, technical rescue, Maritime firefighting, port protection, and provides the anchor facilities and management for Maryland Task Force 2 Urban Search and Rescue. The City of Baltimore has a static population of 621,000 residents and a transient work force that increase the population about 1million during work days. The City of Baltimore

encompasses over 81 square miles. (US Census 2010) Within the city limits reside three major sports teams with their game day complexes, two nationally renowned teaching hospitals, an active commercial passenger marine terminal, heavy industry as well as numerous visitor and tourist activities. The wide range of activities and businesses within the city limits test the Department's response capabilities. Having the ability to respond to any type of emergency takes individuals who are ready to meet the challenge both mentally and physically. The Department's level of readiness and training has enabled the Department to meet numerous challenges however; there is no way to guarantee each member is ready physically to meet these challenges.

BCFD has never embraced physical fitness as a standard for members. The reasons for not having a physical fitness training standard that is practiced regularly are numerous and diverse. Even with surrounding jurisdictions having physical fitness programs for their members, BCFD has failed to implement a department wide Health and Wellness program.

The lack of a formal Health and Wellness program in the recruit setting came to light for the Department in 2009. A firefighter paramedic recruit died during a live fire exercise in 2007. (NIOSH 2008) The exercise was being conducted as part of recruit training. The live fire exercise is part of the Firefighter I certification course. (Maryland Fire Rescue Institute, 2003) In the National Institute for Occupational Safety and Health (NIOSH) investigation, it was noted that there was no physical ability test administered by the Department to determine if candidates could perform the necessary tasks. (NIOSH 2008) The recommendation from NIOSH led BCFD to adopt the International Association of Firefighters (IAFF) and the International Association of Fire Chiefs (IAFC) joint labor-management Wellness/Fitness Initiative (WFI), Candidate Physical Ability Test (CPAT). The adoption of CPAT, naming a Health and Wellness Coordinator to run CPAT, training and certifying peer fitness trainers, and using NFPA 1582, a

Comprehensive Occupational Medical Program for Fire Departments, had put the Department on the path to a healthier and more physically capable recruit. Continued and focused physical fitness during recruit training also gave the Department some relief by providing new firefighters a baseline fitness level that would help them perform their duties and maintain the fitness level achieved to pass CPAT.

Once a recruit graduated from the Fire Academy and left for their permanent assignment, there is no further physical fitness mandate or annual fitness test required by the Department. Individuals and some stations choose to exercise and have obtained exercise equipment to continue their fitness training. The Department and Labor groups have not been able to forge an agreement on how to implement and conduct a complete and working Health and Wellness program. In 2012 an initiative started by Assistant Chief Paul W. Moore III, Community Risk Reduction, to gather sponsors of fitness equipment for fire stations has achieved some positive results. (personal communications June 7, 2014) Two Fire stations and the Fire Academy are slated to receive new fitness gyms in which members can come to exercise during work hours or during off time to enhance their individual fitness.

Even with some positive gains, no matter how fragmented, no HRFP is in place and no health and wellness plan exists. The Department cannot evaluate the overall health of its members or measure fitness gains from the new gyms without an exercise program in place. Developing an HRFP is an important part of modernizing the Department. Understanding the past and future hurdles to implementation will help in the development of an HRFP.

The Department has another equally important mandate that should drive the development and implementation of a HRFP. The Mayor of Baltimore, Stephanie Rawlings Blake (2013) has issued a mandate to increase the health and wellness of all city employees. The Mayor's 10 Year

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Financial Plan states the following “Expand disease management and wellness initiatives, with a significant commitment of City funding and support”. (A ten-year financial, p7, 2013) Mayor Rawlings-Blake (2013) has also directed the establishment of a City-wide and health and Wellness program with clear and obtainable goals.

There will certainly be push back that will come from some incumbent members when it comes to fitness training and an annual fitness evaluation. Acknowledging that there is a wide range of ages and fitness levels within the Department requires the development of exercise guidelines that meets the needs of all Department members.

The purpose of this Applied Research Paper is to develop exercise guidelines by age group for all uniform members of the Department. Establishing this section of the HRFP will aid the Department in meeting Chapter 7- Exercise and Training Programs of NFPA 1583. The Department currently is able to meet the first 5 parts of the standard. The completion of Chapter 7 will allow the Department to move forward with (a) Chapters 6- Fitness Assessment, (b) Chapter 8- Health promotion Education, and (c) Chapter 9- Data Collection thus being completely compliant with the NFPA 1583 standard.

This APR should provide the Department with a positive change towards a healthier workforce, a change in organizational culture , and the ability to fully implement a comprehensive Health and Wellness program. These concepts can be related back to the United States Fire Administration(2010) strategic plan goal #1 Reduce risk at the local level through prevention and mitigation and goal #3 Improve the fire and emergency services capability for response to and recovery from all hazards. (USFA 2010) These objectives can be linked to the Executive Development course through its major concepts of Executive Leadership and Organizational Culture and Change. (Executive Fire Officer 2013)

Literature Review

The fire service has embraced the need to have its members physically fit. Being able to perform the tasks of firefighting over the course of one's career takes continued dedication to the one piece of equipment, the body, which will fail if not maintained. Time was spent searching through different documents and web sites to gain a better understanding about the amount of knowledge already available on fitness, health, and job related exercises. Searching through the National Fire Academy Learning Resource Center, the IAFF website, health and wellness section and University of Baltimore's Lansdale Library provided a great deal of information.

There are some age groupings used to determine exercise regime, fitness levels, and quality of health. The Center for Disease Control (CDC) has outlined three groups in their *2008 Physical Guidelines for Americans*. The three groups are (a) Children ages 6-17, (b) Adult 18-65, and (c) Older Adults age 65-up. (Centers for Disease Control 2011) These three broad age groups may not help set a specific fire service standard but they suggest that any exercise or fitness activity should have an age related component.

The Cooper Institute in Dallas, Texas offers physical training programs for police, fire, and military personnel. (Cooper Institute 2014) The company found by Dr. Kenneth H. Cooper, MD., MPH, (2014) states on their web site that its fire service programs are NFPA 1582 and 1583 complainant. As part of their physical fitness assessment, the use of age groups starts at (a) -20, (b) 20-29 years old, (c) 30-39 years old, through 60 years of age. (Cooper Institute 2014)

The military uses age groupings for their annual fitness evaluations. Members of the armed forces are required to meet certain physical standards each year and in some branches twice a year. The age groupings are in groups of four (4) years such as 21-25 or 22-26, and so forth.

(Knapik 2014) The Indianapolis Fire Department uses age groupings to set its minimum fitness standards. (IAFF, 2014) (Appendix A) The department age groupings used are in four (4) year increments.

The literature did not support a clearly defined set of age groupings for exercise programs that was supported by professional organizations. The use of defined age groups for developing or conducting physical fitness regimes and exercises appears to not be a readily adhered to principle. Most of the references to age groupings and exercises were broad. The groupings focused on what to expect from the body upon reaching a specific age grouping and what exercises are needed to maintain a healthy life style only. Exercise programs rely on the evaluation of the individuals' health and fitness level.

The research does support the use of age groupings in expected outcomes or testing expectations of physical fitness programs. The Military and the Cooper Institute were the examples where age groupings were used to set a level of fitness..

A study called *Age-predicted maximal heart rate in healthy subjects: The HUNT Fitness Study*, examined the relationship between age and maximal heart rate. One of the key components in the study was the use of age groupings to determine what is the maximal heart for a specific age group. In the study the authors use age groups by ten years. Groupings such as 30-39 and 40-49 where used. (Nes 2013) Nes (2013) states that the maximal heart rate by age group is used with some exercises and on exercise machines as a guide to determine the intensity of a workout.

The American Council on Exercise produces the *Ace Personal Trainer Manual*. The manual was used by members of BCFD as part of their certification as peer fitness trainers. Part IV of the manual provides guidance on developing an individual exercise program.

The manual states the following in the chapter introduction:

“People vary widely in their health and fitness status, motivation, goals, age, needs and desires, education, occupation, health habits, and medical background.

Developing an exercise program that best meets the client’s needs in a safe

And effective manner requires a clear understanding of that person.”

(Becker, 2003 p328)

Strength training is exercising with progressively heavier resistance for the purpose of strengthening the musculoskeletal system. (Becker, 2003) Strength training involves performing repetitions that move specific muscles in the same pattern repeatedly against a resisting object or force. There are numerous exercises that will assist in maintaining or increasing strength available to firefighters. Specific exercise development is influenced by the available resources. Some departments provide fully equipped gyms and others may not, leaving the firefighter to use items that will provide the needed resistance. Exercises for strength can often be ill designed and lead to injury while not increase strength. Exercises are not limited to age group either. A bench press is just as acceptable for a 25 year old as a 50 year old as long as it is done correctly and within the individual’s abilities.

There are numerous exercises available for use to gain and maintain muscle strength. An example of weight training exercises that are common are the bench press, shoulder press, curls, calf raise, and squat. (Appendix B) These and other exercises can be defined by body region:

- Chest: bench press, chest press machine, pushups, pec deck machine
- Back: one-armed row, seated row machine, back extensions, lat pull downs
- Shoulders: overhead press, lateral raise, front raise

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- Biceps: bicep curls, hammer curls, concentration curls
- Triceps: tricep extensions, dips, kickbacks
- Quadriceps: Squats, lunges, leg extension and leg press machines
- Hamstrings: dead lifts, lunges, leg curl machine
- Abs: crunches, reverse crunches, oblique twists, pelvic tilts

(Wahner, para.2 2014)

There are similar exercises that can be conducted using the weight of one's body as the resistance force in the absence of weight lifting equipment. The exercises that best fit this group are listed:

- Inchworm: Stand up tall with the legs straight, and
 - let those fingertips hit the floor. Keeping the legs straight, slowly lower the
 - torso toward the floor, and then walk the hands forward.
 - Once in a push-up position, start taking tiny steps so the feet meet the hands.
- Tuck Jump: Standing with the knees slightly bent, jump up as high as possible and bring the knees in toward the chest while extending the arms straight out. Land with the knees slightly bent and quickly jump again.
- Bear Crawl: Starting on the hands and knees, rise up onto the toes, tighten the core, and slowly reach forward with the right arm and right knee, followed by the left side.

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- **Plyometric Push-Up:** Start on a well-padded surface and complete a traditional push-up. Then, in an explosive motion, push up hard enough to come off the floor..
- **Stair Climb with Bicep Curl:** Grab some dumbbells (or station objects) and briskly walk up and down the stairway while simultaneously doing bicep curls to work the whole body.
- **Mountain Climber:** Starting on your hands and knees, bring the left foot forward directly under the chest while straightening the right leg. Keeping the hands on the ground and core tight, jump and switch legs. The left leg should now be extended behind the body with the right knee forward.
- **Prone Walkout:** Beginning on all fours with the core engaged; slowly walk the hands forward, staying on the toes but not moving them forward. Next, gradually walk the hands backwards to the starting position, maintain stability and balance.
- **Burpees:** One of the most effective full-body exercises around, this one starts out in a low squat position with hands on the floor. Next, kick the feet back to a push-up position, complete one push-up, then immediately return the feet to the squat position. Leap up as high as possible before squatting and moving back into the push-up portion of the show.
- **Plank:** Lie face down with forearms on the floor and hands clasped. Extend the legs behind the body and rise up on the toes. Keeping the back straight, tighten the core and hold the position for 30-60 seconds (or as long as you can hang).

- **Plank-to-Push-Up:** Starting in a plank position, place down one hand at a time to lift up into a push-up position, with the back straight and the core engaged. Then move one arm at a time back into the plank position (forearms on the ground). (Schwecherl, 2012)

When engaging in strength training a participant must use caution when deciding how much weight to use. Starting off small and moving up as gains are made is the safest way to proceed. Using weights also requires a safety aspect. Working out in pairs not only provides motivation and technique comments, but a much higher level of safety. The partner acts as a spotter who should provide a level of protection when conducting exercises with free weights. Free weight exercises such as bench press, incline press, and squats require a spotter. “These lifts should not be performed without proper spotting, since failure to complete the final repetition could trap the client under a heavy barbell.”(Becker p.257, 2003) When starting an exercise routine, warm up is a key. Light cardio vascular and stretching will prepare the body for working out and help in reducing injury.

“Flexibility is the range of motion within a joint along the various planes of motion.” (Becker p306, 2003) Flexibility exercises help your muscles stretch farther in a given direction. Flexibility training helps prevent cramps, stiffness, and injuries, and can give you a wider range of motion. These exercises also emphasize proper breathing, balance, and alignment. (Becker 2003) Flexibility is derived from taking the time to properly stretch the body. Stretching is required prior to and after a fitness routine or other exercises. “After twenty-five, normal aging tends to accelerate, causing significant changes in connective tissue and eventually decreased extensibility.” (Becker p313, 2003)

Since there are no consensus age groupings, exercises that promote flexibility are appropriate at any age. Flexibility exercises should target areas of known tightness such as joints and large

muscle groups. This will also promote the ability to increasing or maintain range of motion in these areas. Developing and maintaining a wide range of motion in major joints promotes the following: (a) increased physical efficiency and performance (b) better chance at injury reduction (c) increased blood and nutrient flow to joint structures (d) healthy synovial fluid allows for greater freedom of movement (e) increased neuromuscular coordination (f) improved balance and posture. (Becker 2003) The American Council on Exercise Personal trainer manual promotes four basic techniques to increase flexibility. They are static stretching; (a)ballistic stretching,(b) proprioceptive neuromuscular facilitation (PNF), and (c)active isolated stretching (AIS). Static Stretching is the process of elongating structures through slow and controlled nature. Ballistic stretching uses rapid uncontrolled bouncing motions. PNF stretching is used in the rehabilitation setting. This method requires maximum resistance at the far end of a limbs range of motion followed by periods of relaxation. AIS is a technique similar to a strength training workout by stretching a muscle with resistance and then returning to it to its resting state.

Stretching and flexibility target major muscle groups. These areas include but are not limited to the shoulder, hip, lower back, hamstrings, and calves. Exercises that specifically target these areas are the anterior shoulder stretcher, outer hip rotator, low back stretch, hamstring stretch, and calf stretch. There are other exercises that can be used effectively to target these areas. The shoulder rotator and supraspinatus stretches benefit the shoulder. The back is a particular area that is prone to injury. Having a wide variety of stretching exercises to use including the lumbar rotation and lumbar flexion help increase the ability of the back to withstand the stresses of firefighting. There are many more exercises that are useful and helpful in obtaining and

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maintaining flexibility. The stretches listed are but a few many more are available depending on which body area is being used. (Appendix C)

Exercising to obtain and maintain strength and flexibility are important components to an exercise program. A third factor that plays just as large of a role is cardiovascular health. As with any exercise, a structured program to improve the current level of cardiovascular fitness is the place start. Cardiovascular fitness can also be defined as aerobic fitness which is the body's ability to provide the needed oxygen to muscle groups during exercise. There are ways to measure the body's response to exercise and be able to moderate the intensity of a workout to prevent injury. Heart rate during exercise is one method. The much used standard for max heart rate has been the formula $220 - \text{age} = \text{maximum heart rate}$. The formula allows the exerciser to set the intensity of a work out based on their age. The chart below provides a look at the formula with different ages and provides figures for 50% - 85% of the maximum heart rate.

Table 1

Target Heart Rate Zone

Age	Target HR Zone 50–85%	Average Maximum Heart Rate 100%
20 years old	100–170 beats per minute	200 beats per minute
25 years old	98–166 beats per minute	195 beats per minute
30 years old	95–162 beats per minute	190 beats per minute
35 years old	93–157 beats per minute	185 beats per minute
40 years old	90–153 beats per minute	180 beats per minute
45 years old	88–149 beats per minute	175 beats per minute
50 years old	85–145 beats per minute	170 beats per minute
55 years old	83–140 beats per minute	165 beats per minute
60 years old	80–136 beats per minute	160 beats per minute
65 years old	78–132 beats per minute	155 beats per minute
70 years old	75–128 beats per minute	150 beats per minute

This commonly used heart rate calculator has endured for many years. There is an opposing theory that the formula underestimates the exercising heart rate. In his fitness blog Christian Finn (2014) states “Although scientists have been attempting to predict maximal heart rates since the late 1930’s, the 220 minus age formula originated in the late sixties. In subsequent years, the formula has become immortalized in charts on every gym wall, on cardiovascular exercise machines, and even in medical textbooks.” (Finn para. 5,6 2014) “In 2001, Dr. Douglas Seals (2001), an exercise physiologist at the University of Colorado, tried to come up with a more accurate formula, gathering data from 351 published studies involving 18,712 people.” (Finn para 11, 2014). “ A much more accurate formula, he says, is 208 minus age times 0.7 ($HR_{max} = 208 - 0.7 \times \text{age}$). In a more recent study, Oakland University researchers also came up with a very similar formula ($HR_{max} = 207 - 0.7 \times \text{age}$). Table 2 shows you the difference between predicted maximal heart rates obtained using both the new and old equations.” (Finn para 13-14, 2014)

Table 2

Heart Rate Formula Comparison

Age	Old formula	New formula
20	200	194
30	190	187
40	180	180
50	170	173
60	160	166
70	150	159

Source:Finn2014

If you want to train at a given percentage of your maximum heart rate, you're better off ignoring what the exercise machines tell you and using a more accurate formula (e.g. $HR_{max} = 207 - 0.7 \times \text{age}$). (Finn 2014)

The American Council on Exercise refers back to the American College of Sports Medicine (ACSM) as its source for standardization of cardiovascular exercise criteria. ACSM says we need moderate-intensity exercise (40-60% of HRR) for at least 30 minutes on 5 or more days a week, for a total of 150 minutes per week, or vigorous-intensity exercise (60-85% of HRR) for at least 20-25 minutes on 3 or more days a week for a total of 75 minutes per week. (Becker 2003)

Another indicator that is used to test cardio respiratory fitness is the VO₂ max formula. VO₂ max is the maximal oxygen uptake or the maximum volume of oxygen that can be utilized in one minute during maximal or exhaustive exercise. (Quinn 2014) VO₂ max or maximal oxygen uptake is one factor that can determine an athlete's capacity to perform

sustained exercise and is linked to aerobic endurance. It is generally considered the best indicator of cardiorespiratory endurance and aerobic fitness. (Quinn, 2014) This formula seems to be the most accurate for the fire service. Firefighting is highly aerobic activity. Reviewing normative data of VO₂ max from different sports and age groups can provide insight into this measurement. (Appendix D) The Los Angeles County Fire Department (LACoFD) uses this standard to measure member aerobic fitness. The use of the standard proves its applicability to the fire service. (IAFF 2014)

Creating an exercise program requires the assistance of a trainer to develop a program but also the proper equipment to provide a platform in which the exercise goals can be met. The three types of exercises outlined in this paper do have an equipment component to it. Each one of the exercises has a different types of equipment that provides the needed benefit.

Stretching is the easiest exercise to obtain equipment for. The first and foremost equipment needed is space. When starting an exercise routine one must assure that a firm floor and room is available to conduct stretching activities. Exercises demonstrated in appendix B give visual reference to the size of the area needed to perform the stretches. The use of mats is preferred but not an absolute piece of equipment. Mats come in many forms. Thickness, length and width can all very depending on what you are able to afford and fit in your exercise area. (Appendix E) Mats are also available for exercise equipment to sit on protecting the station floor. These mats are usually much firmer and defined sizes. The equipment mats can double as exercise mats for stretching. Bands are another piece of equipment that can be used to assist in stretching. A person may enlist the help of a partner or coworker to assist in some stretches that involve the

legs and hamstrings. In the absence of a partner the bands provide an excellent alternative.

(Appendix E)

Strength training has many different types of equipment that can be used during these specific exercises. Weightlifting is the most recognized form of strength training. Free weights and barbell are the most recognized weights. If you are going to use free weights a weight bench of some type would be advisable to facilitate exercises and safety. It is also possible to obtain specific machines with weights that are specifically made to work on a particular body group. These machines provide maximal exercise to a muscle group and insure a level of safety when working out alone. The machines may take up a large area requiring a great deal of space. Machines can also come designed to take up a fixed area and accomplish many different exercises. These machines are commonly referred to as “Universal Gyms”. There are also machines that work on the machine principle but are designed to concentrate on specific muscles. The machines can come with weights already fixed for use or require the addition of free weights to provide proper resistance. Dumbbells are another piece of weightlifting equipment. (Appendix F) These pieces can be used to perform most weightlifting exercises. The dumbbell is available in sizes as low as 5 lbs through 100lbs or even heavier.

Cardiovascular training requires equipment that can elevate the heart rate to certain levels. Exercises such as running/walking, riding a bike, walking up steps, and rowing can be simulated through stationary equipment. These activities can also be done away from the station, common sense would dictate that during work hours, simulation of these activities is better suited to the job of a firefighter. Equipment such as stationary bikes, treadmills, ellipticals, stair climbers, and rowers provide the needed activity to increase heart rate. These pieces of equipment may require

electrical service and space for use. These pieces of equipment can also cost a sizeable amount of money per piece, planning and deciding which piece of equipment will allow for the maximum benefit will be a tough decision.

There is other equipment that is available for conducting exercises that are beneficial. Exercise Balls or Swiss Balls (Appendix G) are rubber balls of different sizes that can be used to stretch, strengthen small and large muscle groups. Jump rope is long standing piece of equipment that is better known for its childhood fun but it also very useful as part of a cardiovascular and leg strengthening workout. A weight vest if available is another low tech piece of equipment. The weight being carried in the vest will help increase cardiovascular fitness as well as strengthen legs and core muscles. The amount of equipment available is too large to mention in this paper. Whether the piece is small and designed to focus on a particular body area or large requiring electricity, a comprehensive exercise program can be achieved with a combination of equipment.

Fire Service equipment such as hose, appliances, fans, rescue tools, bunker gear and hand tools are also suitable to use as exercise equipment. When developing an exercise routine these available pieces of equipment can provide extra or job related aides to become more physically fit. These items are already available as part of the Departments equipment list.

Having a standard procedure to identify space and appropriate equipment in a station is the sign of a commitment to the HRFP. The Calgary, Canada Fire Department has made the commitment. The Department has a standard equipment list and work area to be designated in each station. The ability to standardize equipment in each station provides the opportunity for each member to maintain their fitness program. (Appendix H)

Putting all of these pieces together can be a time consuming task and commitment. The positive results that can occur are well worth the effort. Developing exercise guidelines for all members of the Department no matter what age group they represent will pay long term benefits.

Procedures

The research for this paper began with gaining familiarization with NFPA standards 1582 and 1583. Obtaining and reading these standards was essential to understand what the possible boundaries and requirements that should be included in an exercise program. Both of these standards were obtained from the National Fire Academy Learning Resource Center and through the set of standards owned by the Baltimore City Fire Department Fire Academy Library. In NFPA standard 1583 there is a mention of a Peer Fitness Trainer designation through the American Council on Exercise. (National Fire Protection Association, 2014)

The Baltimore City Fire Department sent several members from the Fire Academy to be certified as a peer fitness trainers in preparation for the implementation of CPAT. A copy of the manual used for the *Peer Fitness Mentor* class was obtained. This valuable resource provided a great deal of insight into exercise program development.

Visiting the National Fire Academy Learning Resource center gave a wide range of general information on fitness within the fire service. Access to previous Applied Research Projects that touched certain areas of this work provided additional information and knowledge.

The use of Google and Yahoo search engines was also done. Keyword searches were completed using terms such as cardiovascular fitness standards, exercise equipment, fitness age groups, and other terms directly related to my research questions. The results of the searches

provided a great deal information that was useful to help in writing this paper and for general concept formulation.

Results

The first question was a) What professional groups have established recognized age groups for exercise programs? It was very difficult to find any consensus on age groupings. Through several internet searches and text book searches, many results talked about age groups for fitness outcomes. The most prolific was the military. Their use of age group related fitness results was very clear and concise. The Cooper Institute, who conducts physical ability testing for fire departments, was also clear and concise on their use of age groups for expected or required outcomes. The one fact that was quiet clear in the results is that exercise programs are truly an individual process.

The second research question asked b) what are the best exercises to maintain strength and flexibility by recognized age groups? Since question #1 failed to result in consensus age groups, research was driven more towards exercises that could be modified to meet the needs of any person, level of fitness, and any age. The review provided numerous exercises increasing strength. Most exercises were defined by major muscle group or body part. Using weights in various formats and configurations to execute these exercises was the most common. Exercises were found that used one's own body weight to provide the resistance needed to build muscle. Common themes were present in these results, what was the level of fitness, what is the individual trying to accomplish and what exercises can be performed safely. Flexibility results were not focused on age either. The only consideration found dealing with age was the lack of

flexibility that can occur as the body ages. Appendix C provides an example of all the different types of stretching that benefits an individual. Overall stretching is beneficial not only for flexibility but also in the warm-up and cool down phases of an exercise program. Stretching major body areas such as the legs, back, shoulders, and neck are of the most importance to all.

An important component of any exercise program is cardiovascular health. The third question asked c) What is the standard for cardiovascular health by recognized age group? Again no specific age groups were found when it comes to specific exercises. There were also no standard defined parameters of cardiovascular health. Exercising to produce a target range sustained heart rate was found. There was some debate over which heart rate calculations were the best. The general formula of $220 - \text{age} = \text{maximum heart rate}$ was found to be a common practice across the spectrum. Exercising several times a week anywhere from 50%-80% of the max heart rate using any exercise was considered a standard.

An exercise program uses aides to produce results. The final question asks d) what equipment is needed to safely perform needed exercises for all recognized age groups? The results continued the trend in failing to provide consensus age groups for specific equipment. The results did find numerous pieces and styles of equipment that can be obtained to produce positive results. Some equipment could be considered dangerous without assistance such as free weights. Some equipment was very inexpensive and easy to use on an individual basis. Several results spoke to the use ordinary fire service equipment at one's station could be used to produce positive exercise results.

The results to the research questions provided a great deal of information and knowledge to begin formulation of an exercise program.

Discussion

The fire service is a job in which its members continually serve over a twenty year period or longer. Spanning these years of service require different levels and types of exercises to maintain one's ability to perform the tasks of a firefighter. Implementation of a HRFP in a department requires different exercises for all age groups and fitness levels in an effort to provide reasonable expectations.

The implementation of an exercise program where none existed can be difficult. There are those that will accept the program and those that will fight it. These members will cite numerous reasons not to be involved. It is important for the overall welfare of a fire department to move forward in an organized effort with all stakeholders on board.

It is clear through the research that there are no consensus age groups to consider when planning an exercise program. This is actually beneficial to the establishment of an exercise program in the BCFD. Throughout the department, ages vary within each unit. The age variation could be a reason for an older member of the company to be less involved in a fitness program due to their fitness needs being different than other younger members. This could also affect the female members of a unit for the same reason. The variation in age and gender does promote individual attention to each member of a unit. The individualized attention could provide some motivational aspirations, because an individual should not have to compete with other members of a unit.

It is contended that fitness outcomes should be grouped by age. Measuring a soldier's fitness is scored by assigning a numerical point value to the number of repetitions of a specified

exercise. (Knapik 2014) This type of outcome measurement is useful in the development of a method to measure an individual's fitness as part of an overall exercise program.

There are no recognized age groups for maintaining strength and flexibility. This leads back to the concept of having individualized exercise programs. It is clear in the literature that an exercise program should have a warm-up and cool down period. This is the best time for an individual to work on flexibility. Promoting stretching during warm-up prepares the muscles and joints for exercise. It helps by increasing the range of motion and reducing exercise injury. It is clear that stretching should occur at the end of a workout also. Stretching after exercise may also enhance muscle relaxation, facilitating normal resting length, circulation to structures, and removal of unwanted waste products. (Becker 2003) Advising all members to maintain and increase flexibility away from work by stretching once a day on their off time will also prove beneficial.

Maintaining strength is another key component to an exercise program. The use of weights or resistance techniques will provide the needed activity to promote strength. The individual must remember that their program is tailored to them individually and improvement will come as long as the developed program is followed. There could be a tendency for a member to work with higher weights in an effort to stay up with others in the unit. This can prove to be unsafe and cause serious injury. The peer fitness mentor must clearly craft a weightlifting plan that meets the individual's needs. There are numerous exercises to choose from that will benefit any individual plan. Appendix B offers a sample of the most recognized weightlifting exercises. The exercises should be chosen based on body area. The plan should consider exercises that are able to be performed safely and that will not cause injury.

Cardiovascular health does not have specific age groups to define a healthy heart. Clearly an 80 year old could be in great cardiovascular health and a 30 year old be in poor health no matter if it is caused by lifestyle choices, genetics, or disease process. Using a consistent method to determine cardiovascular health and consulting with the department's governing physician will benefit the HRFP and its application. The most popular is using the maximum heart rate calculation of $220 - \text{age} = \text{Max Heart Rate}$. This calculation is much easier to use across an entire department. Assigning an individual percentage of maximum heart rate to obtain during cardiovascular activity should be based on an individual fitness evaluation.

The amount and types of exercise equipment that is available for use is mind bending. Clearly departments do not have the budget to continually change equipment based on new trends. Replacement should occur in a similar way as apparatus by using a useful lifespan. Purchasing equipment in bulk may help save costs and provides uniformity for members as the work at different stations. Common equipment helps an individual stay on their routine no matter what their assignment. Equipment purchased should be able to provide flexibility training, strength and cardiovascular training.

One type of equipment has not been mentioned. Each member should be provided a "work out uniform" Most departments provide shorts and tee shirts that have the department logo on it in an effort to maintain some type of uniformity. Guidelines for acceptable wear are an important equipment component of a successful fitness program.

A fitness program can cause issues with labor management relations. Labor may perceive the fitness program as being used to rid the department of older members. The program must be

developed and seen as beneficial, rewarding, and effective to gain acceptance. All parties must clearly understand that there are diverse age groups and fitness levels. Once an exercise program has been established, there needs to be a way to evaluate the effectiveness of the program. Using data such as the number of injuries and the use of sick time are reasonable data points to try and correlate the effectiveness of the exercise program. The best way to evaluate the program is some form of evaluation such as a Work Performance evaluation or a fitness exam. The Frederick County Division of Fire/Rescue Services has an annual Work performance Evaluation for firefighters and Paramedics. The goal of the program is to ensure physical readiness and uses a test similar in nature to CPAT. (Jacobs 2012)The exam can be a pass/fail based on standards set. If a member fails, there must be meaningful remediation that occurs. Punitive actions could cause the failure of a fitness program.

Recommendations

The following recommendations are for BCFD to consider:

- Adopt NFPA 1583 in its entirety.
- Develop an affirmative statement from the Chief of Department and Labor groups stating the importance of the entire 1583 standard and its alliance with the Mayors directives.
- Develop a partnership with both labor locals to write and implement a complete health and wellness program.
- Continue the current commitment to CPAT and recruit physical fitness for all recruits.
- Provide individual fitness evaluations for all members.
- Provide medical physicals as a baseline for fitness to exercise only.
- Extend 1583 to members of the EMS Division.

- Partner with the City of Baltimore's health and wellness coordinator in an effort to promote health and wellness city wide while projecting a model of fitness to coworkers across the city.
- Commit the needed resources to equipment, non punitive physical exams and clothing to facilitate the tone of commitment by the department to members.
- Codify exercise time on shift with proper attire.
- Hold civilian employees accountable for physical fitness.
- Have peer fitness mentors develop individual exercise programs for each member.
- Develop an annual fitness evaluation for all members.

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Exercise Guidelines by Age Group

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Appendix A

**MINIMUM FITNESS STANDARDS
INDIANAPOLIS FIRE DEPARTMENT
PFF PROGRAM**

Age Group/ Gender	Predicted VO2 Max	% Body Fat	Accllex (inches)	Sit-n-Reach (cm)
21-24				
Male	42.49	19.5	11.8	29.5
Female	35.20	26.0	13.0	31.5
25-29				
Male	41.70	21.1	11.8	28.0
Female	34.48	26.5	13.0	34.0
30-34				
Male	40.98	22.6	8.4	27.0
Female	33.76	27.0	11.1	33.0
35-39				
Male	39.53	23.6	8.4	25.0
Female	32.31	28.6	11.1	32.0
40-44				
Male	38.09	24.7	10.0	35.5
Female	30.87	30.3	10.7	30.5
45-49				
Male	36.69	25.5	10.0	23.0
Female	29.45	32.1	10.7	30.5
50-54				
Male	35.20	26.3	8.5	31.5
Female	28.22	31.0	8.5	33.5
55-60				
Male	33.12	26.7	8.5	29.5
Female	26.88	34.4	8.5	28.0
60+				
Male	31.65	27.1	8.3	19.0
Female	25.62	34.8	7.7	26.5

Appendix B

GYM EXERCISES / WEIGHT TRAINING



Shoulder Press



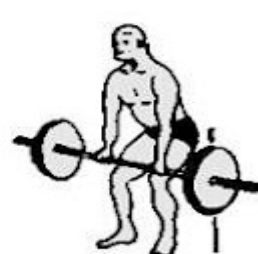
Curl



Calf Raise



Half Squat



Dead Lift



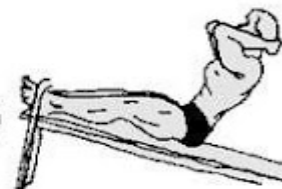
Bench Press



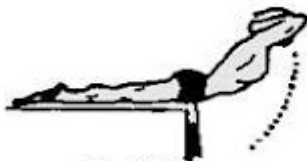
Bent Arm Pullover



Wrist Curl



Sit Up



Back Hyper Extension



Leg Extension



Leg Raises



Leg Curl



Alternate Dumb Bell Press



Alternate Dumb Bell Curl



Side Bends



Tricep Stretch

Appendix C

Stretching Exercises



1. Neck Flexion/Extension Stretch
(forward, then back)



2. Neck Lateral Flexion Stretch
(one side, then the other)



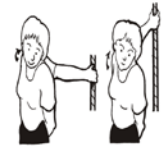
3. Latissimus Dorsi and Posterior Deltoid Stretch
(link hands, push elbows together)



4. Triceps Stretch
(pull elbow across and down)



5. Shoulder Rotator Stretch
(using towel, pull up with the top arm then down with the other)



6. Pectoral Stretch at 90° and 120°
(use a doorway or post)



7. Bicep Stretch
(hands apart)



8. Supraspinatus Stretch
(keep elbow parallel to ground)



9. Wrist Extensor Stretch
(tilt head to opposite side, keep elbow straight)



10. Thoracic Extension Stretch
(reach forward with arms, push chest towards floor, arch back down, backside behind knees)



11. Lateral Flexion Stretch
(one side, then the other, push pelvis across as you bend)



12. Lumbar Extension and Abdominal Stretch
(be gentle if sore)



13. Lumbar Flexion Stretch
(be gentle if sore)



14. Lumbar Rotation Stretch
(rotate legs one side, then the other side, draw in and brace stomach muscles at the same time, breathe)



15. Hamstring Stretch
(straighten leg)
i. with foot pointed
ii. with foot pulled back towards the knee



16. Hamstring Stretch
(commence with knee slightly bent, then push knee straight as tension allows, push chest towards foot)



17. Adductor Stretch
(push down with elbows on knees very gently, keep back straight)



18. Gluteal Stretch
(pull knee and lower leg towards opposite shoulder)



19. Gluteal and Lumbar Rotation Stretch



20. Quadriceps Stretch
(keep pelvis on floor)



21. Quadriceps Stretch



22. Adductor Stretch
(keep foot pointing forward, lunge sideways on bent knee, keep back straight)



23. Hip Flexor Stretch
(keep back straight, tuck bottom under, lunge forward on front leg)



24. Tensor Fascia Stretch
(continue to push bottom forward, whilst pushing hip to the side)



25. Gastrocnemius Stretch
(keep knee straight and heel down, feet facing forward)

Appendix D

Maximal Oxygen Uptake (ml/kg/min) in Various Population Groups			
Non Athletes	Age	Males	Females
	10-19	47-56	38-46
	20-29	43-52	33-42
	30-39	39-48	30-38
	40-49	36-44	26-35
	50-59	34-41	24-33
	60-69	31-38	22-30
	70-79	28-35	20-27
Athletes			
Baseball/softball	18-32	48-56	52-57
Basketball	18-30	40-60	43-60
Bicycling	18-26	62-74	47-57
Canoeing	22-28	55-67	48-52
Football	20-36	42-60	
Gymnastics	18-22	52-58	36-50
Ice Hockey	10-30	50-63	
Jockey	20-40	50-60	
Orienteering	20-60	47-53	46-60
Racquetball	20-35	55-62	50-60
Rowing	20-35	60-72	58-65
Skiing, alpine	18-30	57-68	50-55
Skiing, nordic	20-28	65-94	60-75
Ski jumping	18-24	58-63	
Soccer	22-28	54-64	50-60
Speed skating	18-24	56-73	44-55
Swimming	10-25	50-70	40-60
Track & field, discus	22-30	42-55	
Track & field, running	18-39	60-85	50-75
	40-75	40-60	35-60
Track & field, shot put	22-30	40-46	
Volleyball	18-22		40-56
Weightlifting	20-30	38-52	
Wrestling	20-30	52-65	

Taken from Wilmore and Costill (2005) (3)

Appendix E

Exercise Mat



Stretching Bands

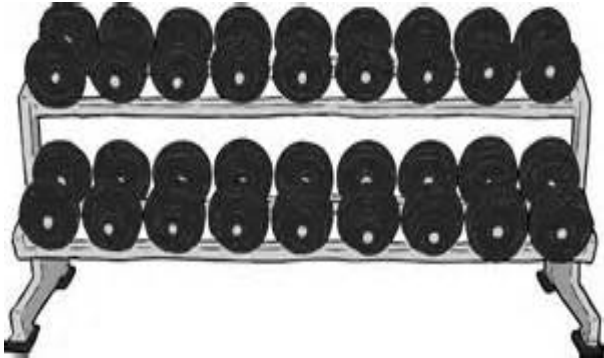


Appendix F

Universal Gym



Dumbbells



Appendix G



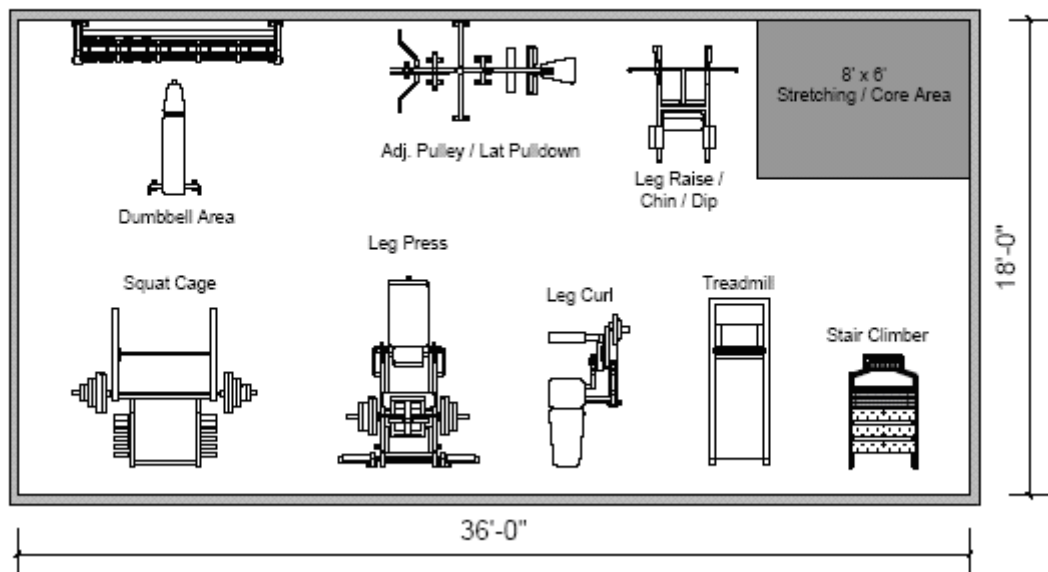
Appendix H

Here is the basic equipment list for outfitting of fitness equipment for the Calgary Fire Dept. halls.

- Precore Treadmill
- Lemond Stationary Bike
- Life Fitness Elliptical Cross Trainer

- Equalizer Pro Power/Olympic Cage (with safety catches, custom dip bar attachments, and chin up bar apparatus)
- PPP 7' Olympic Bar with Cemco Olympic Plate Set and one pair pressure collars
- 3-Tier Magnum Dumbbell rack (15 pair capacity)
- Ivanko pro-style Dumbbell set (5 to 90 lb in 5 lb increments)
- (4) x 2.5 lb platemates
- 2 Magnum Flat-to-Incline Bench(s)
- Magnum 3 stack Expandable Tower System with:
 - o Lat Pull Down
 - o Low Row
 - o Adjustable Column (with SA-8 double pulley option)
- Ivanko cable attachment / handle package
- Magnum plate load Leg Press (plus Olympic plate set)
- Magnum Plate Load Leg Curl (plus Olympic Plate)
- Abdominal Fitness Balls (1 x 55 cm, & 1 x 65 cm)
- (2) skip ropes
- (2) Stretch Mats

E.g. Layout – Minimum Space requirement 648 square feet



Appendix I

Action Plan

A plan of action for the design and implementation of exercise guidelines within a Health and Wellness Plan will ensure all members safely execute the fitness program. The Department has already invested the time and money to name a Health and Wellness Coordinator as well as train Peer Fitness mentors. The plan takes into consideration that those positions should be maintained and dedicated to the fitness program.

- I. CFD and Labor publish joint statement on importance of Fitness.
 - a. Committee formed to Develop and monitor comprehensive Health and Wellness Plan.
 - b. Commitment to equipment, non punitive physicals, SOP's on exercise time and attire.
- II. Committee begin work
 - a. Equipment standards
 - b. Uniform standards
 - c. Author SOP's
 - d. Annual fitness evaluation development.
- III. Each member of the Department receive a baseline health and fitness evaluation.
- IV. The Department dedicate resources to purchase recommended equipment.
- V. Peer Fitness mentors will be assigned an exercise group. The mentor will develop individual workout programs for each member of the group and monitor progress.
 - a. Individual workouts shall consist of Cardio, strength and flexibility training.
 - i. Cardio for 20-30 minutes

Exercise Guidelines by Age Group

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1. Running
 2. Walking
 3. Stair climbing
 4. Elliptical machine
 5. Stationary bike
 - ii. Strength for 15-20 minutes
 1. Weight lifting
 2. Resistance training
 - iii. Flexibility training 5
 1. 5 minutes at the warm-up and cool down phases of workout
 2. Focus on major joint and muscle areas.
 - b. Workouts shall be no longer than 60 minutes in length.
 - c. The Peer Fitness mentor and member will set realistic results for improvement.
 - d. The member will be encouraged to continue workouts off duty.
- VI. An annual fitness test and codified results shall be established.
- a. The test will be done in conjunction with members anniversary date.
 - b. There will be remediation actions for those who do not pass annual test
 - i. Ineligible for promotion
 - ii. Negative annual work evaluation
 - iii. Ineligible for Overtime opportunities.