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The Air Force Fitness Test: Creating New Fitness Assessment Charts Using Waist to Height Ratios

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THESIS

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Abstract

The Air Force currently uses AFI 36-2905 for fitness standards and evaluation, but no study to our knowledge has evaluated these standards using large databases. Using a 5.38 million record database from the Air Force Fitness Management System, we evaluate how the abdominal circumference, body mass index (BMI), waist to height ratio (WtHR), and height to weight ratio correlate to fitness as assessed by the 1.5 mile aerobic run in the Air Force Fitness Test. Whether individually or adjusting for age group and gender, WtHR performs better than the other body composition variables with an average rank score of 1.1 and a relative improvement of 105% percent to the current metric of abdominal circumference. Additionally, we assess how the current Fitness test adjusts for age and gender. We determine that the current test poorly adjusts for these variables at an alpha of 0.001. Because of this, we present a new scoring metric for the Air Force to consider with respect to incorporating WtHR in lieu of abdominal circumference as well adjusting for gender and age more appropriately.

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J.R. Griffith

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I. Introduction

In the United States Air Force, fitness has always been considered a part of the military lifestyle. In 1967, the Air Force decided to officially enforce a physical fitness test in order to set a standard for physical fitness (Department of the Air Force, 1969:2). The fitness test has changed over the years, but it always attempts to evaluate the degree in which Airmen are physically capable of fulfilling their duties and being combat ready. Currently, the Air Force Fitness Test includes a 1.5-mile run, push-ups, sit-ups, and a waist measurement. The Air Force also records the height and weight of each Airman for documentation purposes. The test is designed to prioritize aerobic fitness over the other metrics, but each section contains at least ten percent of the total overall score. The Air Force tracks these scores for documentation, research, and to better evaluate individual Airmen (Department of the Air Force, 2010:24-27).

The Air Education and Training Command Studies and Analysis Squadron (AETC-SAS) accumulated 5.37 million records from 2004-2015 in order to properly analyze the current fitness test measures. This research analyzes this database to discover the strengths and weaknesses of the Air Force Fitness Test. This study places an increased emphasis on the four different body composition metrics (waist circumference, height-to-waist ratio, height-to-weight ratio, and body mass index) that are currently available to the Air Force for body composition evaluation and the scoring sheet designed for run time, push-ups, and sit-ups. This research provides the Air Force with unbiased, accurate information that they can use to adjust and strengthen the Air Force Fitness Test.

Research Approach

This thesis uses data taken from the Air Force Fitness Management System (AFFMS) by AETC-SAS and analyzes it through statistical analysis and regression modeling. AFFMS is a system designed to keep track of all Air Force Airman's fitness records. Fitness tests have been recorded in AFFMS since 2004, and is used by unit fitness performance managers (UFPMs), upper leadership, and researchers who look at trends in fitness scores. The database contains the following information on the Airman's' test metrics: test performance, fitness group, if they are exempt or participating in each event, current unit, age, personal ID, passcode, when they took the test, and when they need to take the test again**.**

This study uses the programs R and JMP Pro version 12.0.1 to analyze the data obtained from AFFMS. Since the database does not include medical records or other metrics that evaluate an individual's health and fitness levels, this study looks at using "run time" and a created variable called "total fitness" as surrogates for true aerobic and total fitness. Total fitness is a variable that standardized push-ups, sit-ups, and run times of all Airmen and takes a weighted sum of the three standardized scores. These two variables are the primary dependent variables when evaluating the other sections of the fitness Test. The run time for a 1.5-mile run is considered a defendable metric for physical fitness and was deemed the "best" dependent variable we could use given the database taken from AFFMS (Callendar, 2004; Knapik, Ang, Reynolds, and Jones, 1993; Knapik, Sharp, Canham-Chervak, Hauret, Patton, Jones, 2001; Mello and Murphy, 1988; Cooper, 1967 and 1968). Other variables, such as height and age, are used to help explain variation in the dependent variables that an Airman cannot control. Other sections of the test (push-ups, sit-ups, and waist circumference) are treated as independent variables in order to analyze how models with different body composition metrics predict run time and total

fitness. To evaluate the scoring sheets for the 1.5-mile run, push-ups, and sit-ups, we relied on descriptive statistics and t testing.

Research Questions

The objectives of this research are summarized by the following questions regarding the Air Force Fitness Test:

1. What Body Composition Metric best explains the variation of aerobic and total fitness among Airmen?
2. If another Body Composition Metric better explains fitness levels, how could the Air Force use that metric to better evaluate fitness levels in Airmen?
3. How well does the current scoring rubric for the 1.5-mile run, Push-ups, and Sit-ups reflect the performance of Airmen in each category?
4. What alternative scoring rubrics could score Airmen based unbiasedly on their performance on the 1.5-mile run, Push-ups, and Sit-ups?
5. How would implementing a different Body Composition Metric and Scoring Rubric Affect the Air Force Fitness Test?

Summary

The Air Force uses a fitness test designed in 2004 to set the bar for physical fitness of Airmen, both male and female, in the United States Air Force (Department of the Air Force, 2004). The test was created due to the lack of fitness throughout the 20th and 21st centuries. The test's purpose is to direct Airmen to be physically fit enough to perform all the duties required of them as well as to maintain a healthy lifestyle. This test has a big impact on Airmen, as failures can lead to negative repercussions, while positive results can lead to acknowledgements and rewards.

While this test is important to the Air Force, a large data analysis of the events that make up the test have not been accomplished to our knowledge. While Swiderski's 2005 thesis, among others, studied the fitness test's ability to evaluate Airmen, there has yet to be a large-scale study done to get a better picture. Also, the Air Force does not have any data studies that support either its use of the waist circumference as the best body composition metric or its use of their fitness assessment charts to evaluate an Airman's performance. In order to fill this research gap, this thesis uses a 5.37 million record database to acquire a better idea about how the fitness test is performing and answer the presented research questions that address each individual section of the Test.

This thesis is divided into five chapters. Chapter Two encompasses the literature review for the thesis and explains why our study is relevant and useful to the Air Force. Chapter Three discusses our methodology for our study. Chapter Four shows the results and analysis for this thesis. Chapter Five concludes the study by offering our recommendations and discusses the benefits and liabilities the study contains.

II. Literature Review

Introduction

In order to get an accurate understanding about the significance of fitness in conjunction with the Air Force fitness test, this literature review covers three main topics regarding fitness. The first section covers the historical impact fitness has had on the United States of America. The next section covers current fitness tests in each branch of the U.S. military. The final section describes and researches the variables used in this study: Run time, pushups, sit-ups, and different body composition measures.

History of Fitness

After America achieved independence, most of the country toiled in hard labor jobs, which kept the majority of people in decent physical condition. Fitness was not of main concern to the common American citizen. Americans neither possessed the quality of life, as those in the twenty-first century, nor did they have time to worry about fitness. Despite this, Benjamin Franklin, Thomas Jefferson, J.C. Warren, and Catherine Beecher were all figureheads in society and proponents of exercise. They believed that physical fitness was important in keeping the mind at peak condition as well as keeping a person healthy. Thomas Jefferson was the biggest proponent of fitness (Jefferson and Johnston, 1903), believing that a person should exercise no less than two hours a day while Catherine Beecher created aerobic programs for women (Borish, 1997). However, the ideas and actions of these figures did not translate to any nationwide exercise programs or any type of organizational change (Dalleck and Kravitz, 2002; Keller, 1972).

It was not until the first Journal of Health came out in 1829 that the fitness ideology started to become more relevant. This was the year of President Andrew Jackson's inauguration, and President Jackson used himself as an example to promote fitness. Supporting him, the creators of the Journal of Health desired to give the common man a means to keep himself healthy in a time when expensive doctors had limited success. At this point in time, the ideology to abandon laziness and keep yourself healthy started to become more prevalent throughout the United States due to the increase in mortality rates and the lack of medical advancements. Proper hygiene, avoiding gluttony, and exercise were the main ideas that began to flourish during President Jackson's time as President (Whorton, 1982).

The Industrial Revolution sparked even more of an interest in physical fitness. With machines replacing hard labor, jobs became less physical demanding, particularly in urban areas. While jobs became less labor intensive, cancer and diabetes also became more prevalent throughout the United States, which further drew people's attention toward fitness. It was not until after the Civil War, however, that scientists began to measure and study fitness in America. Around this time Dioclesian Lewis introduced the concept of "The New Gymnastics" which became very popular in America (Rice, Hutchison, and Lee, 1958; Dalleck and Kravitz, 2002). As America developed a larger need for fitness, due to changing lifestyles, scientists and figureheads helped point people's attention to fitness and a healthy lifestyle.

When President Theodore Roosevelt became President, he gave America another example of the significance of fitness. President Roosevelt spent a large amount of time of his Presidency devoted to fitness and outdoor activities. He was physically fit because of the intense exercise program he followed, which helped him survive childhood asthma. He did his best to use his influence as President by encouraging Americans to become healthier. His dedication

influenced future presidents to take fitness more seriously, especially in regards to the military (Karoslides, 1993).

Even though the importance of physical fitness was communicated at an increasing rate, staying fit remained a problem for the United States during World War I. When America joined the war in 1917, they conducted a draft for the military in order to have enough people to fight. However, the military soon discovered that many citizens lacked the conditioning needed to be a soldier. In fact, after the war the public discovered from the military that 1 in every 3 drafted personnel were in too poor of shape to fight, and many more personnel were found physically unfit before they were drafted (Barrow and Brown, 1955; Wuest and Buecher, 1993). Given this alarming information the government passed legislation to have physical education improved in all public schools across the country.

Despite the public learning of the status of the average soldier, emphasis on fitness was short lived due to the Great Depression. With limited economic resources, the government turned its focus to more important problems arising in the country (Welch, 1996; Rice, 1958). Despite the government's focus moving away from fitness, Francois Henri "Jack" LaLanne headed his own movement. Jack LaLanne was addicted to sugar until he was fifteen years old, but then decided to turn his life around. He became one of the first major advocates for fitness and opened one of the first major gyms in Oakland, California. Multiple gyms were created under his name, and he promoted weightlifting even though the majority of doctors believed it to be unhealthy. Jack LaLanne also invented many workout machines, including the leg extension and pulley devices, which were groundbreaking for fitness (St. James Press, 2000).

Despite Lalanne's movement, the physical fitness of the common American citizen during World War II was very similar to World War I. America once again conducted a draft,

and afterwards the public was similarly informed that over half of the draftees selected for World War II were either rejected or given non-combat positions due to fitness concerns (Rice, Hutchinson, and Lee, 1958). The release of this information helped reignite the fitness movement. Also during this time, Dr. Thomas K. Cureton Jr. further promoted health through his academic publications involving fitness and the heart. In 1944 he established the Physical Fitness Research Laboratory in the Department of Physical Education for Men in the University of Illinois and developed ways to test physical fitness and flexibility. Unlike other proponents of fitness at the time, Dr. Cureton produced academic studies and data to support his findings. Similarly to Jack LaLanne, Dr. Cureton's studies were met with numerous naysayers in the medical community. However, towards the later years of his life it was revealed that he ran through the cemetery where many of those naysayers died at an earlier age (Berryman, 2013).

As America moved into the Cold War, another study showed that the common child in America needed to be more physically fit. A study conducted by Dr. Kraus and Mrs. Hirschland, which tested children's trunk and leg fitness showed that American children had a 57.9% failure rate while European children only had a 9.7% failure rate (Kraus and Hirschland, 1954). In a time where nationalism and competition ran rampant in America, this statistic proved alarming to American policy-makers, and the desire for change increased. In 1954, the American College of Sports Medicine was formed, which established a researched based stance on many issues regarding physical fitness.

President Eisenhower responded to this study in 1956 by holding a White House conference, which led to the creation of the President's Council on Youth Fitness and a Citizen's Advisory Committee on the Fitness of American Youth. These groups helped educate American on fitness as well as help them find organizational solutions to help make American children

healthier (Nieman, 1990). Other organizations also came forward to help educate American's about physical fitness. Among these organizations were the American Health Organization, the American Medical Association, the American Alliance for Health, and the Physical Education Recreation and Dance (Barrow and Brown, 1988). These organizations sparked more organizational influence on fitness in America.

The 1960's kept the fitness momentum rolling after the Cold War Era. When President John F. Kennedy came into office in 1961, he made a point to give special attention to fitness and health for all Americans instead of on American children alone. He renamed the President's Council on Youth Fitness to the President's Council on Physical Fitness. He also increased the government's involvement in fitness education and promotion. The council's findings were titled "The soft American" and "The vigor we need," and were released to Sports Illustrated for public education. President Kennedy used these articles to speak directly to Americans about the significance of fitness to the common man (Kennedy J.F., 1960 and Kennedy J.F., 1962).

Following President Kennedy, Dr. Ken H. Cooper became a prominent figure in physical fitness with his book titled *Aerobics*. This book, released in 1968, focused on telling the American people that regular exercise and good overall fitness can help prevent diseases and can lead to a healthy lifestyle. Instead of simply treating diseases, he educated Americans on how healthy living can prevent diseases. He also studied how oxygen utilization can be used to help test physical fitness levels and how aerobic exercise can help increase the fitness level of individuals. Dr. Cooper's studies also caused the Air Force to use aerobic fitness for measuring the physical fitness level of Airmen, which is discussed in the second section of this literature review (Cooper, 1967 and 1968). Dr. Cooper's impact on American physical fitness is still seen to this day.

President Kennedy's emphasis on physical fitness went on to impact the 1970's and 1980's, marking the time when America's cultural stance on fitness changed. Being physically fit became more of a necessity for social acceptance. Despite medicine being able to treat most fatal diseases, the American culture began to realize that medicine would not be able to fix all their physical issues. The average American citizen believed in Dr. Cooper's concept of using fitness as a preventative measure. Also, there was a cultural belief that being physically fit would lead to increased productivity for the entire country as well as increased health (Rader, 1991). While there were still problems with fitness, the common American citizen was much more likely to be more active through aerobic fitness and gym use than in the past (Andreasson and Johansson, 2014).

From 1990 and onward, the fitness movement has skyrocketed. Gyms became globalized and people began to focus on transforming their bodies for physical appeal. Steroid issues in the 1990's and 2000's started to cause Americans to have a poorer view on bodybuilders and some athletes, but the general American citizen worked out regularly in order to improve their physique. Fitness franchises also exploded across the country as well as around the world (Andreasson and Johansson, 2014).

Despite the popularity of physical fitness, obesity rates continued to increase in both children and adults from the 90's to modern times. America still had a health problem. To help remedy this issue, the most recent political activist for physical fitness, Michelle Obama, launched the Let's Move! Initiative in 2012. This initiative focused on helping to provide healthier foods to public schools, increasing the availability for fitness programs in schools, and providing education and information to families in order for them to eat healthier and be more active. Additionally, with the help of researchers and analysts, Mrs. Obama helped start the

initiation of the article *Childhood Obesity*, which uses research to educate Americans on how obesity happens and ways to prevent obesity in children (Obama, 2012).

Over the course of the past 250 years, the emphasis and need for physical fitness has greatly increased. Political figures, celebrities, and researchers have dictated the cultural shift towards physical fitness. However, the level of fitness in Americans has always left something to be desired. As the emphasis on fitness has increased, technology and unhealthy foods have caused Americans to stay unfit. For this reason, the increased emphasis on fitness levels of Americans as well as soldiers will stay relevant in modern times. Fitness is still a major problem for Americans and will continue to be a topic for research and awareness for years to come.

Army, Navy, and Marines

The Army's current fitness test resembles the fitness test they used back in 1980. The Army published its latest document for fitness, Field Manual (FM) 7-22, in October 2012. FM 7-22 discusses all aspects of the fitness test including how to administer the test, what members can bring to the test, the order in which the fitness test must be administered, and alternate testing procedures for special situations (U.S. Army, 2012). The general fitness test includes pushups, sit-ups, and a 2-mile run, and uses the DA 705 to score each section (U.S. Army, 2010).

The Navy's OPNAV INSTRUCTION 6110.1J contains all current instruction for general fitness and fitness testing. This document instructs members to exercise a total of 2 hours and 30 minutes per week, and complete the Physical Fitness Assessment (PFA) twice a year. The PFA consists of a medical screening, a body composition assessment, and a physical readiness test (PRT). The Navy conducts the body composition assessment (BCA) by using a height to weight comparison. For each designated height, the participant must be under the maximum allowable

weight. If the participant fails the height-weight test, that participant will undergo an abdominal circumference exam. The Navy uses PRIMS to calculate body fat percentage based on height, weight, and abdominal circumference. If the participant is under the maximum allowable body fat percentage, the participant passes the BCA. Further, the PRT consists of sit-ups, push-ups, and a 1.5-mile run (Chief of Naval Operations, 2011).

The Marines use Marine Corps Order 6100.13 to govern current fitness standards. This document dictates that all marines must accomplish two fitness tests: The Combat Fitness Test and the Physical Fitness Test. The Combat Fitness Test includes three events: movement to contact, ammunition lift, and maneuver under fire. The movement to contact event tests the participant's ability to move towards a target at high speed and reaction time. The ammunition lift event consists of having the participant lift a 30-pound ammunition can from shoulder height to overhead as many times as they can in a certain period of time. The maneuver under fire event is a shuttle run that includes crawls, buddy drags/carries, ammunition resupply, grenade throw, and agility running. The Physical Fitness Test includes pull-ups (flexed arm hang for females), crunches, and a 3-mile run (Commandant of the Marine Corps, 2008).

The Combat Fitness Test that the Marines incorporated into their fitness testing target some of the issues that studies address with military fitness tests. Often, fitness tests tend to have a bias towards leaner participants, who could struggle to do combative jobs because of their body composition. Some studies have also used this test to help show how other military fitness tests could be improved (Harman and Frykman, 1992; Worden and White, 2012; Vickers, 2007). The Army considered having a combat fitness portion added to their fitness test, similar to the Marine Corps, in 2011. However, no real change has resulted from the Army's research into combat

fitness testing (Mcilvaine, 2011) and the Navy hasn't considered changing its current fitness test to include combat fitness components.

In summary, the Army, Navy, and Marines agree on many, but not all, aspects of fitness testing. Every branch uses a run time component in its fitness testing as well as sit-ups. Different branches incorporate aspects such as push-ups, pull-ups, body composition assessments, and combat fitness assessments into their fitness tests, but not all branches have decided to use these metrics to measure overall fitness.

Air Force

Air Force Regulation (AFR) 50-5 was the first Air Force Regulation regarding fitness. AFR 50-5 was published in 1947 and focused an Airman's spirit and health. Multiple changes and additional regulations followed (Department of the Air Force 1947, 1959:1-10, 1961, 1969, 1971, 1972; Royal Canadian Air Force, 1965; Air Force Military Personnel Center, 1963; Cooper, 1967, 1968; Susi, 1974). However, nothing showed much impact and remained relatively unchanged until 1992 (Department of the Air Force, 1977; Bennington 1978, Department of the Air Force 1994, 1998).

In 1992, the Air Force began testing a new procedure for measuring fitness. They turned to a cycle ergometry test, instead of testing a person's run/walk time. This change occurred due to some fatalities during the run caused overexertion. The new program consisted of two Air Force Instructions: AFI 40-501 or the Air Force Physical Fitness Program, and AFI 40-502 or The Weight and Body Fat Management Program (Department of the Air Force 1994, 1998). Both instructions prioritize the annual evaluations that were required: a cycle ergometry test and an annual weigh in. The instructions did not mandate exercise periods or types of exercises, but

left the preparation up to the individuals. The Air Force used the program primarily to create a standard and to motivate members to get in shape in order to pass the tests.

The submaximal cycle ergometry test (SCET) used in AFI 40-501 is a test that tries to measure how efficiently the heart and lungs work as a machine to transfer oxygen to the muscles. These kinds of tests are cheaper then maximal tests which generally use treadmills for three to four hours and require medical personnel (Smith and Flatten, 1997). Both tests try to measure an individual's VO_2 max. An individual's VO_2 max is when the aerobic workload increases and the individual's oxygen uptake remains the same (Hunn, 2002; Mitchell and Blomquist, 1971). In other words, VO_2 max is the point in which a person needs more oxygen, but physically can't intake any more. Studies on submaximal tests show that they are less accurate than maximal tests at predicting VO_2 max (Hermansmen and Saltin, 1969; Jackson and Ross, 1996). When trying to measure VO_2 max using a submaximal test, typically the measured VO_2 max is about 10-20% away from the actual VO_2 max of an individual (Pollock, 1994). In summary, the ergometry test used by the Air Force at the time was cheaper than treadmill tests that focus on VO_2 max and was less dangerous than the 1.5-mile run, but the ergometry test sacrificed accuracy for these benefits.

In 2004, the fitness test was altered again with AFI 10-248. This AFI abandoned the cycle ergometry test and instead opted for basic measures to include push-ups, sit-ups, a 1.5-mile run, and a waist measurement. All scores for each category were specific to the Airman's gender and age, which was provided in a chart. This chart was also provided by AFI 10-248 (Department of the Air Force, 2004). The Air Force Chief of Staff, General John P. Jumper, defended the change by stating:

We deploy to all regions of the world…Some of our Airmen today are operating inside Iraq, subject to attack, and could be called upon to help defend the base, a trend that will surely

increase in the growing expeditionary nature of our business. The amount of energy we devote to our fitness program is not consistent with the growing demand of our warrior culture…It's time to change that. (Callendar, 2004)

The test used a weighted scoring system: 50 points for the 1.5-mile run, 30 points for the abdominal circumference, 10 points for push-ups, and 10 points for crunches. The max score was 100, and a passing score was 70 points. The Air Force was cautious when turning to this kind of test, due to the problems with fatalities in the past. They created provisions that excluded people from the 1.5-mile run based on health, primarily cardiac concerns. The frequency of the test also changed for Airmen in 2004. If the participant scored above 75 points, then that Airmen would not need to retake the test for 12 months. If he scored less than 75 points, then he had to retake the test in 6 months (Department of the Air Force, 2004).

Following this new method of measuring fitness, the Air Force established AFI 36-2905 for Airmen in 2010. The new instruction had every Airman take the fitness test twice a year unless they scored over a 90 on the Test. If an Airmen scored less than a 75 on the test, he would receive a "poor" score and retake the test within 90 days. He would go through the Healthy Living Program within 10 days and enroll in the unit Fitness Improvement Program. Scores also began to be documented in an Airmen's EPR or OPR and was worded as "Meets Standards", "Does Not Meet Standards," or "Exempt" (Department of the Air Force, 2011).

The scoring composition of the test was changed in 2010 as well. The aerobic portion of the test increased to sixty percent of an Airman's total score, while the body composition section of the section decreased to twenty percent. Failing the test was increased from below 70 points to below 75 points, which increased the physical standard for all Airmen (Department of the Air Force, 2011). The scores were recorded electronically in AFFMS (Air Force Fitness Management System). The records were kept for documentation and research (Department of

the Air Force, 2010). One problem this led to was the system telling Airmen who scored above a 90 to test 6 months later. However, this was addressed in a memorandum in 2011 where AFI 36-2905_AFGM2.1 emphasized that excellent scores would retest in 12 months. This memorandum also made individual Airmen responsible for taking the test in concurrence with their schedule, and the memo gave more direction to physical training leaders (PTLs). The memorandum provided training expectations for PTLs as well as the authority for commanders to appoint PTLs to manage fitness assessment cells (fitness assessment cells focused on recording and conducting fitness tests) during periods where there were high employee turnover rates. (Department of the Air Force, 2011).

Based on this literature, we conclude that the Air Force originally took a passive approach to fitness. The branch did not have a fitness test until 1969. However, over time, the Air Force started to prefer fitness tests to assess the fitness level of Airmen. The fitness test created in 2004 is the most stringent test the Air Force has had historically. We also conclude that the Air Force values accuracy of the fitness test over safer testing methods. This claim was proven when they went back to a 1.5 mile run from the cycle test. Therefore, in our analysis we will focus on accuracy of the fitness test over other characteristics. The next section of the literature review discusses current Air Force fitness standards.

Air Force Fitness in 2016

Currently, the Air Force uses AFI 36-2905 and places responsibility on the Airman to maintain the physical standards set forth by this AFI at all times during the year. The instruction was originally created in 2010, but was republished in 2013 due to changes regarding the

frequency of fitness tests and fitness test scoring. The physical standards set by AFI 36-2605 can be found in Appendix A. (Department of the Air Force, 2013).

The current fitness test has a total possible score of 100 and requires Airmen to have a score of 75 or greater to meet the component minimums and pass the Test. The Air Force has suggested minimum values, but if an Airman fails one part of the test, they can make up the points in a different section still pass the Test. The test is divided up between three components: body composition, aerobic, and muscular fitness component. All the components are given specific weights, and an Airman must complete all components of the test within a three-hour window on the same day. However, if an Airman is on a medical profile they are exempted from the specified components of the test, but the components that the Airman can complete will be tested and the Airman will still receive a score. (Department of the Air Force, 2013).

For the Body Composition Component, the Air Force records an Airman's height and weight. The height is rounded to the closest full inch, and the weight is rounded to the closest full pound. Following the height and weight, the assessment team measures an Airman's abdominal circumference using a standardized tape measure made of non-stretch (fiberglass) material. The measurement is taken immediately above the right uppermost hip bone at the side of the body vertically in line with the right armpit. The measurement is taken on bare skin to not skew the results. If the tester scores less than satisfactory on the abdominal circumference component of the test but has a total score of above 75 points, the evaluator gives the Airman a body fat assessment. The Air Force uses both the BMI and the body fat assessment for this evaluation. If the Airman passes either portion of the exam, he or she is exempt in AFFMS for the abdominal circumference measurement. The BMI requirement for this portion of the test is 25 kg/m^2. For the body fat assessment, the evaluator measures the neck and waist for males and

neck, waist, and hip for females. If the Airman achieves a body fat percentage equal to or lower than 26% for females or less than 18% body fat for males, they pass this portion of the exam. The body composition component has a total possible score of 20 points (Department of the Air Force, 2013).

The muscular component of the exam contains both push-ups and sit-ups. Airman receive one minute to complete each portion and scores are based on sex and age. AFI 36-2905 contains complete instructions on the proper form for both push-ups and sit-ups as well as instruction for the evaluators when counting to keep scores standardized. The total possible score for this section is 20 points. Appendix A shows the fitness assessment charts for this component based on gender and age (Department of the Air Force, 2013).

The aerobic component of the exam consists of a 1.5-mile run. Scores are based on gender, age, and elevation (if the elevation is 5,250 feet or higher). The only alternative aerobic test is a timed two kilometer walk. At no point in the alternate exam can an Airman have both feet off the ground. The aerobic component has a total possible score of 60 points. A scoresheet for this component is found in Appendix A (Department of the Air Force, 2013).

Whenever there is a medical exemption from a specific part of the test, the score for that person follows the equation:

$$Total\ Score = \frac{Points\ Scored\ on\ All\ Sections * 100}{Total\ Possible\ Points}$$

For example, if an Airman is exempt from the sit-up portion of the exam and he scored 81 points total for the rest of the exam, the Airman would receive a score of (81/90) * 100 or a 90 on the Test. This particular Airman would score an "Excellent" on the test (Department of the Air Force, 2013).

The protocol for the amount scored on the fitness assessment according to AFI 36-2905 are as follows: Airmen that score an Excellent score (90 or above) will retest in 12 months. Airmen that score Satisfactory (75-89) will retake the fitness test in 6 months. Airmen that receive an Unsatisfactory (less than 75) must retest within 90 days. If unsatisfactory, the Air Force recommends, but does not mandate, waiting at least 42 days in order to improve one's physical condition (Department of the Air Force, 2013).

More recent changes to the new AFI made include: extending post-pregnancy Fitness Assessment requirements from 6 months to 12 months; removing exercise physiologist positions; authorizing Airmen on permanent medical exemptions to test annually; making referral performance reports optional for fitness assessment failures upon close-out of EPR/OPR/TR; making enlisted Airmen who have most recently failed the assessment or who were considered not current ineligible to promote; adding and modified optional command actions for failures; exempting Airmen with approved retirement/separation dates within 12 months of last fitness assessment; recognizing a fitness assessment administered at a commissioning source (for example, the United States Air Force Academy); and authorizing local fitness information managers to update corrections resulting from administrative errors approved through the appeal process in the Air Force Fitness Management System II (Department of the Air Force, 2013).

Summary of Air Force Fitness

For the Air Force, emphasis has focused on physical fitness over combat fitness. Many studies have shown throughout history that members are unfit and unhealthy. Air Force

Instructions emphasize having an environment that promotes physical fitness to ensure that Airmen remain fit enough to sufficiently perform in deployed atmospheres.

The Air Force has used different tests to try and measure physical fitness. The Air Force has learned that testing aerobic fitness is vital in determining an individual's total fitness level. This discovery led to a more accurate way of assessing physical fitness since they learned that a direct measure of aerobic fitness (run-time) is more ideal than an indirect measure of aerobic fitness that is less risky to human life (ergometry testing or the bike test). The Air Force is also interested in different types of body composition testing, incorporating the waist circumference measurement to the test in 2004. The Air Force has also extended the fitness test to include other physical measures such as push-ups and sit-ups. The current fitness test has given the Air Force the best to date measure of Airmen's fitness, and has created a standard in which Airman can be evaluated and judged.

Research on Variables

This section of the literature review focuses on the different variables of this study. The different variables specifically researched in this study were waist circumference (WC), waist to height ratio (WtHR), height to weight ratio, Body Mass Index, 1.5-mile run, push-ups, and sit-ups. Please note that WtHR is different from the height to weight ratio, as it is a ratio of a person's height to their abdominal circumference instead of a ratio of a person's height to their weight. This section also looks at recent studies involving the aforementioned variables to help give a better idea on how other research studies related these variables to a person's health and fitness.

Run Time

A 1.5-mile run time remains a proven metric for the Air Force Fitness test since 2004 (Department of the Air Force 2004; 2013). The concept that a person's ability to consume oxygen measures their level of fitness has been studied since Dr. Cooper's findings in 1967 (Cooper, 1997). Dr. Knapick, Ang, Reynolds, and Jones studied infantry soldiers to assess injury risk levels. This study found that a high risk for musculoskeletal injuries more often occurred, on average, in a younger individual with slower run times and fewer sit-ups (Knapik, Ang, Reynolds, and Jones, 1993; Knapik, Sharp, Canham-Chervak, Hauret, Patton, Jones, 2001). Swiderski (2005) found that the run time was so significant a predictor of physical fitness that the study used it as a dependent variable for measuring overall fitness (Swiderski, 2005). Throughout the years that the Air Force has conducted fitness tests, the Air Force recognizes that an Airman's run time is the best available measure that they have for overall fitness (Callendar, 2004). However, research into this metric does not provide cutoff points for aerobic run times for different ages and sexes. While there is a relationship between aerobic fitness and overall fitness/health (according to research), no specific run times are widely known to predict low/high health risks. Despite this discrepancy, aerobic fitness in general was the best variable the Air Force has in predicting total overall fitness and health risk.

Push-Ups

Push-ups have also been a metric of physical fitness since 2004 (Department of the Air Force, 2004; 2013). While the results on aerobic fitness are similar, the multiple studies' conclusions on push-ups are mixed regarding how well push-ups help predict fitness levels. Some studies agree that push-ups can help indicate the possibility of future injuries from physical

training (Knapik, 2001) and predict an Airman's level of combat fitness (Worden and White, 2012). However, another study that looked at a large sample of Canadian men and women found that there was no association between an increased risk of mortality and push-ups (Katzmarzyk and Craig, 2002). When examining push-ups for Air Force Airmen, a study concluded that push-ups were helpful in determining physical fitness, but was less significant than other variables. He offered a solution to get rid of a maximum score for the push-ups to help make the variable more predictive (Swiderski, 2005). While push-ups might have some association to physical fitness, the significance of this association seems small.

Sit-Ups

Along with the 1.5-mile run and push-ups, the Air Force has used sit-ups as a testing metric since 2004 (Department of the Air Force, 2004; 2013). This metric is the only other metric besides run time that is used for all fitness tests in the DoD (Commandant of the Marine Corps, 2008; U.S. Army, 2010; Chief of Operations, 2011). Generally, studies found that sit-ups prove significant in determining an individual's physical fitness (Knapik, 2001; Swiderski, 2005; Knapik, 1993). Further, sit-ups tend to be a major metric in determining the physical fitness of subjects in many studies (Fortier, Katzmarzyk, Malina, and Bouchard, 2001; Sallis, McKenzie, Alcaraz, 1997; Dwyer, Sallis, Blizzard, Lazarus, 2001; Castelli, Hillman, Buck, Erwin, 2007; Prista, Marques, Maia, 1997). For instance, a study conducted by Fortier, Katzmarzyk, Malina, and Bouchard in 2001 used sit-ups as a variable for fitness when trying to ascertain how the stability of physical activity levels relate to musculoskeletal fitness (Fortier, Katzmarzyk, Malina, and Bouchard, 2001). These studies either validate sit-ups as a variable for

fitness or use them to measure fitness; so sit-ups appear to be a credible variable when measuring physical fitness.

Body Composition Assessment

The Air Force has incorporated a form of testing body composition since 1992 (Department of the Air Force, 1994). Currently, the Air Force uses a waist circumference measurement for this section of the fitness Test. Many studies have looked at body composition and determined that there is some significant correlation between body composition and endurance as well as other physical activities. However, the correlation between body composition and performance in physical activities only explain five to thirty percent of the variation in performance (Cureton et al., 1979; Jette et al., 1990; Vogel and Friedl, Chapter 6; Jones, Bovee, and Knapick, 1992). Jones, Bovee, and Knapick found in a study that the correlation between body composition and physical injuries were dependent on the gender of the individual. While a high percentage of body fat in men highly correlated with physical injury, they found that women with the lowest body fat percentage were more prone to injury than women with the highest body fat percentage. Further, they found that physical fitness was a better predictor of injury than body composition (Jones, Bovee, and Knapick, 1992).

Lee, Blair, and Jackson (1998) found that physical fitness is more significant than body composition in predicting overall health. The study found that lean, unfit men were much more likely to suffer from "all-cause mortality" than fatter, fit men. However, they found that fit men do gain health benefits from being lean (Lee, Blair, and Jackson, 1999). From these studies, one can conclude that body composition does have a limited role in predicting fitness and health, but

needs to be looked at with other variables like gender and performance measures of physical fitness.

Waist Circumference

The Air Force currently use the waist measurement instead of different methods to perform the body composition assessment (Department of the Air Force, 2004). The Air Force based the change on studies that support waist circumference as a simple but effective tool to measure body fat, which will be discussed in this section of the literature review. The Air Force considers men to be a moderate health risk with a waist circumference over 35 inches and a high risk with a waist circumference over 39 inches; while considering women to be a moderate health risk with a waist circumference over 31.5 inches and a high health risk with a waist circumference over 35.5 inches (Department of the Air Force, 2013).

Dr. Pi-Sunyer (1998) indicated that physicians should measure a patient's waist circumference to determine if the patient is at a higher health risk. Similarly, the physicians were to specifically take note if the waist circumference of the patient eclipsed 35 inches for women and 40 inches for men. The researchers also looked at the BMI of patients and found that BMI correlating to the waist circumferences were also health risks (Pi-Sunyer, 1998). Janssen, Katzmarzyk, and Ross (2004) found that waist circumference predicted more health problems in 14,924 adult participants than BMI, concluding that waist circumference explains obesity-related health risk better than BMI (Janssen, Katzmarzyk, and Ross, 2004). Han, van Leer, Seidell, and Lean (1995) concluded an increased cardiovascular disease risk is positively associated with waist circumference (Han, van Leer, Seidell, Lean, 1995). When looking at high blood pressure, Genovesi, Antolini, Giussani, Pieruzzi, Galbiati, Valsecchi, Maria, Brambilla, and Stella (2008)

found that waist circumference was a useful tool in predicting high blood pressure, even when BMI is a variable in the model (Genovesi, Antolini, Giussani, Pieruzzi, Galbiati, Valsecchi, Maria, Brambilla, and Stella, 2008). All these studies tend to validate waist circumference as a valid tool in assessing health risk and predicting high blood pressure, and they conclude that waist circumference is a better tool than BMI in general for predicting health risk.

Other studies show that measuring waist circumference is an acceptable method in predicting the amount of body fat in a person. Taylor, Jones, Williams, and Goulding (2000) found that the waist measurement predicted the amount of trunk fat mass at a significantly higher rate than both waist-to-hip ratio and the conicity index in children. The study used a dual-energy X-ray absorptiometry to find the correct amount of trunk fat mass to determine which of the three methods had the best results. The Waist Circumference method had an Area Under the Curve (AUC) of .97 for both girls and boys, while the other two methods had AUC's of .73/.71 for waist-to-hip ratio and .80/.81 for conicity index (Taylor, Jones, Williams, and Goulding, 2000). Pouliot, Despres, Lemieux, Moorjani, Bouchard, Tremblay, Nadeau, and Lupien (1993) found that both waist circumference and abdominal sagittal diameter (the distance from the small of the back to the upper abdomen) were better predictors of abdominal visceral adipose tissue accumulation (fat tissue accumulation) than the waist-to-hip ratio for both men and women. The study found that a "waist circumference above approximately 100 cm (39.47 in) are more associated with potentially "atherogenic" metabolic disturbances, or unhealthy fat tissue (Pouliot, Despres, Lemieux, Moorjani, Bouchard, Tremblay, Nadeau, Lupien, 1993). These studies validated waist circumference as one of the best measures in determining body fat in a person.

While the majority of studies concluded that waist circumference predicted health risk and the amount of body fat in a person, not every study agreed that Waist Circumference is a

predictive factor of health risks for cardiovascular disease (CVD). Garnett, Baur, Srinivasan, Lee, and Cowell (2007) looked to see if waist circumference would be a better measure of CVD than BMI and found that both measures were not significantly predictive and suggested to not consider either measure when looking at CVD (Garnett, Baur, Srinivasan, Lee, and Cowell, 2007). Swiderski (2005) studied the physical fitness of Airmen at Wright-Patterson AFB and recommended not using waist circumference as a testing metric for the Air Force Fitness test at all and found that other variables predicted fitness better than the waist circumference. He defended his position by saying that measuring waist circumference was often inaccurate (Swiderski, 2005). Waist circumference appears, per the literature, to be a good predictor of health risk and body fat accumulation, but proves ineffective at predicting CVD and possible overall fitness for Air Force Airman.

Han, Seidell, Currall, Morrison, Deurenberg, and Lean (1997) looked to see if there existed a relationship between height or age with waist circumference. The study used linear regression analysis and found that neither height nor age were significant in predicting the differences of waist circumference in Caucasian subjects. However, the study found that weight was significant in predicting waist circumference (Han, Seidell, Currall, Morrison, Deurenberg, Lean, 1997). Lean, Han, and Morrison (1995) also found that height in men correlated weakly with waist circumference, while it did not with women and concluded with recommendations that were more directed towards different age groups and sexes (Lean, Han, Morrison, 1995). In summary, waist circumference appears to be an acceptable predictor for health risk, body composition, but could possibly lack in predictive power for overall fitness. Also, the height in men might be a factor in predicting waist circumference, so using waist circumference without

accounting for height in men could reduce the magnitude of predictive power for waist circumference as a variable in a statistical model.

Waist to Height Ratio

As an alternative test for the body composition assessment, the Air Force could use the waist to height ratio, which has been supported in multiple studies. Lean, Han, and Morrison (1995) found a correlation was found between height for men and the waist circumference (Lean, Han, Morrison, 1995). Currently, an Airman's height and waist circumference are measured by the Air Force during the Air Force Fitness Test, so using this measure instead of the waist circumference would not necessarily require any further time or training for the Air Force (Department of the Air Force, 2013).

Ashwell, Gunn, and Gibson (2012) showed that waist-to-height ratio (WtHR) screened better for adult cardiometabolic risk factors than both waist circumference and BMI. The study used 300,000 adults in multiple ethnic groups and the difference between the WtHR, waist circumference, and BMI was significant for both men and women. The study found that WtHR had 4-5% improved discrimination over BMI while the waist circumference only had 3% improved discrimination (Ashwell, Gunn, Gibson, 2012). Hsieh and Muto (2005) found that WtHR was a better predictor than both BMI and waist circumference when used to evaluate the clustering of coronary risk factors among non-obese men and women (Hsieh and Muto, 2005). Also, Savva, Tornaritis, Savva, Kourides, Panagi, Silikioutou, Georgiou, and Kafatos (2000) found that both Waist Circumference and WtHR were better predictors of CVD than BMI for children (Savva, Tornaritis, Savva, Kourides, Panagi, Silikiotou, Georgiou, Kafatos, 2000).

These studies show that WtHR might be a better predictor of body composition than both BMI and waist circumference.

Swiderski (2005) found that the WtHR was the better predictor of fitness over waist circumference, and recommended removing the waist circumference measurement from the fitness test altogether. He did note that measuring the exact height and weight would greatly improve the accuracy of the WtHR on the test, but couldn't quantify the amount of improvement (Swiderski, 2005).

Browning, Hsieh, and Ashwell (2016) concluded that WtHR may be the most significant screening tool at predicting diabetes and CVD. Dr. Ashwell created WtHR cutoffs for both men and women when assessing obesity and health risk for an individual. Table 1 shows the cutoffs suggested for WtHR:

Table 1: Cutoffs for WtHR

Underweight	Healthy	Overweight	Obese
less than .4	.4-.499	.5-.599	.6 and higher

The cutoffs are for both underweight and overweight individuals. These cutoffs, created by Dr. Ashwell, are simple to understand and remember and do not vary due to gender (Browning, Hsieh, Ashwell, 2016).

In summary, WtHR could be the best measure of body composition and is an item of interest in this thesis. With better predictive power over waist circumference and BMI, WtHR could help the Air Force Fitness test more accurately measure body composition and Airmen's physical fitness.

Height to Weight Ratio

Height-to weight ratio remains less researched than the other variables in this thesis, because most researchers look to BMI. BMI is the ratio of weight to height squared. Keys, Fidanze, Karvonen, Kimura, and Taylor (1972) confirmed that BMI explains more variation of fat thickness in a person over the strict height-to-weight ratio. The study confirmed that BMI is a better metric due to its applicability to all populations and ages (Keys, Fidanze, Karvonen, Kimura, and Taylor, 1972). While not often used, this metric remains readily available to use if the Air Force found that it predicts fitness better than the other variables (Department of the Air Force, 2013). Since the metric is readily available for testing, this thesis considers its predictive power but doesn't have any research that would back strong predictive power in determining an Airman's fitness level.

Body Mass Index

Body Mass Index (BMI) is the ratio of the weight of a person to the height of person squared. The Air Force measures both the height and weight of a person already, so this index could be used as a method to determine body composition (Department of the Air Force, 2013). This index has been used broadly in the past, but many recent studies have determined that other methods do a better job of both determining percent body fat and explaining the variation of health risk and cardiovascular disease (Savva, 2008; Janssen, 2004; Garnett, 2007; Ashwell, 2011). Still, some studies do conclude that BMI is a predictive metric of health and can be used to help flag potential health problems in patients. For instance, Keys (1972), Genovesi (2008), and Pi-Sunyer (1998) all found that BMI was a better tool in predicting "body fatness" than a strict height to weight ratio (Keys, 1972; Genovesi, 2008; Pi-Sunyer, 1998). Meeuwsen, Horgan,

and Elia (2010) also looked at BMI's relationship with percent body fat. The study found that "the association between BMI and % body fat is not strong, particularly in the desirable BMI range, is curvilinear rather than linear, and is affected by age" (Meeuwsen, Horgan, and Elia, 2010). These studies have rather negative reviews of BMI, and find that there are better measures out there to measure body composition in a person. Since the data is readily available for this analysis, this thesis does look at BMI but has little research to support a claim that BMI is the best predictor of physical fitness in Airmen.

Summary of the Body Composition Metrics

When looking at all the body composition metrics, it is important to note that these metrics are used primarily to screen for health problems in an individual. They are only marginally correlated to performance in physical fitness activities and weakly correlated to physical injuries. While body composition does provide a health benefit to people who are already physically fit, it is only weakly associated (with significance) to fitness and health in general.

Based off the research of all these metrics, it was worth noting that the waist circumference measurement, the height-to-waist-ratio, and body mass index all can predict the percent body fat in a person. Most studies, however, agree that waist circumference and the height-to-waist ratio predict body composition better than BMI and using BMI as a metric could cause inaccurate predictions due to possible covariance with gender and height. Between the last two metrics for body composition, it appears that more recent studies support height-to-waist ratio, especially for the Air Force. Possible age and gender factors could help explain body fat percentage as well, and was specifically analyzed in this study. This thesis looks at all for body

composition metrics in determining what is the best predictor of aerobic fitness. However, due to the findings of this literature review, we focus on waist circumference and WtHR when doing the analysis.

Chapter Summary

The purpose of this thesis is to analyze fitness test data obtained from AFFMS in order to get a better idea of how the Air Force measures fitness. While past studies have looked at the Air Force fitness test, no study has had the data needed to do a complete analysis. This thesis looks at how predictive the different events in the fitness test predict an Airman's fitness level. This thesis looks at the body composition assessment to determine which of the four available measures best predicts the fitness level of an individual, as well as to evaluate the current scoring rubric for the fitness test.

In order to get a complete and accurate understanding about physical fitness in the Air Force, this literature review covered how physical fitness has developed over the course of history in the United States. The review looked at the evolving emphasis placed on fitness by leadership, which exposed how fitness is still a glaring issue in the country today. This section presented how the country started, grew, and currently stands in regards to fitness.

The review also looked at how physical fitness has grown throughout the different military branches of the United States. The review steps through how the fitness standards changed and how branches enforced fitness standards differently. Presently, the branches focus on giving Airmen individual responsibility for passing the test while placing leadership with the responsibility of maintaining an environment that promotes physical fitness. This section addresses how this study can be used to help improve the Air Force fitness test.

The final section of this literature review discussed various studies conducted on the variables the Air Force uses to assess an Airman's current physical fitness. This section helped provide an idea of each variable's accuracy in predicting physical fitness based on academic studies and findings across the world.

In summary, physical fitness has not always been a priority for many Americans throughout history. Thus, military leaders have taken responsibility to help fix this issue, as it has led to many health problems and injuries and affects a military member's ability to deploy. In the military, leadership recognizes the importance of physical fitness but has yet to perfect the organizational structure necessary to ensure that all members are physically fit. The Air Force specifically focused on the physical fitness test to keep Airmen in shape, but they have not published any studies that can justify why they use the current measures they use for the fitness Test. While a study has been accomplished for Airmen stationed at Wright-Patterson in 2005, a larger study covering the entire Air Force needs to be performed to validate the metrics in which the Air Force uses to measure fitness. This thesis attempts to fill this research gap.

III. Methodology

Introduction

In this section of the thesis, we explain the methodology we use for the study. The topics include: data origination, computer programs used to assess the data, processes adopted to identify and correct data issues, the tests conducted to verify data assumptions, and data analysis methods. Lastly, we discuss the reasoning behind our data cleaning techniques and our analysis.

Data

The dataset used in this thesis was provided by the Air Education and Training Command Studies and Analysis Squadron. The Squadron compiled the data, but had not yet completed a thorough analysis of the information collected. The data itself was taken from the Air Force Fitness Management System (AFFMS). AFFMS has been used since 2004 and actively records all Air Force Airman's physical fitness test scores. A list of all the columns in the dataset and their descriptions are shown in Appendix B. The original data set possessed a total of 6,835,507 records (or rows) but was later cleaned to have 5.38 million records.

Statistical Programs

We use two software programs, R version 3.3.1 and JMP version 12.0.1, to perform all the analysis in this thesis. Both R and JMP provide the capability of handling large databases and possess the tools required to conduct the various statistical techniques discussed later in the

methodology. We use these programs specifically for cleaning and analyzing our data in this thesis.

Cleaning the Data

While the data given for this thesis was very robust, the data was taken directly from AFFMS. The records in AFFMS had some errors, and those errors translated over to the database provided for this thesis. To get an accurate picture of the association between the different events of the test and our best measure of physical fitness and aerobic run time, the data needed to be organized in a way such that erroneous data did not affect the conclusions of the study. Since this is a large database and the cleaning process was very in-depth, Table 2 describes each step of the cleaning process and its effect on the database. The following paragraphs explain the reasoning behind the actions we took described in Table 2.

Step 1: Validated the "Age" Variable

When we first received the data, the database contained test dates, age, and date of birth (DOB). We used DOB to verify that the test date and age were correct by creating a new "age" column based off the test date and DOB, and then compared it to the original age variable. For example, an Airman has a birthday of 1 January 1990 in the database, a recent test date of 1 January 2016 and an age of 26. Our method created a column for a new "age" by subtracting the time of the test date by birth date and compared the new "age" to the old. We did this for all records and found no inconsistencies in the database. After this step, we removed DOB from the database to de-identify subjects.

Table 2: List of Actions Taken to Clean the AFFMS Database.

Step	Action	Records Affected	Total Records Left
1	Validated the "Age" Variable	-	6,835,507
2	Deleted Records that did not have "1.5 Mile Run" as the Aerobic Test	1,361,272	5,474,235
3	Deleted Records with an "AERO_SCORE" of 0	219	5,474,016
4	Created Median Height	-	5,474,016
5	Removed Duplicates	10,913	5,463,103
6	For Airmen whose heights were outside the range of 63" to 77" for Men and 58.25" to 71.75" for Women, we replaced their measurement with "NA."	33,786	5,463,103
7	For Airmen whose weights were outside the range of 122lb to 265lb for Men and 98lb to 215lb for Women, we replaced their measurement with "NA."	50,308	5,463,103
8	For Airmen whose abdominal circumferences were outside the range of 26.5" to 43" for Men and 23.5" to 39" for Women, we replaced their measurement with "NA."	44,591	5,463,103
9	For Airmen whose run times were outside the range of 533s to 1148s for Men and 611s to 1311s for Women, we removed their record from the database	81,193	5,381,910
10	For Airmen whose push up counts were outside the range of 18 to 80 for Men and 2 to 59 for Women, we replaced their measurement with "NA."	37,963	5,381,910
11	For Airmen whose sit up counts were outside the range of 18 to 73 for Men and 11 to 67 for Women, we replaced their measurement with "NA."	38,503	5,381,910
12	For Airmen whose BMI's were outside the range of 18.44 to 35.85 for Men and 17.54 to 34.72 for Women, we replaced their measurement with "NA."	42,501	5,381,305
13	Removed Records Before 2004	605	5,381,305

Step 2-3: Deleted Records that Aerobic test was not "1.5-mile run" or was "NA" for Aerobic Time

Next, we planned to use the number of seconds it took for Airmen to run a mile and a half as the dependent variable for our body composition model comparison. However, the database recorded AERO_SCORE's for the 1.5-mile run, the 1-Mile Walk, the 3-Mile Walk, and the Cycle Test. Having the other tests in the database caused the variable to be inconsistent when running a regression. For example, if an Airman took 30 minutes (1800 seconds) to complete a 3-Mile Walk, that specific AERO_SCORE would be significantly slower than all the 1.5-mile run times. The difference in the score would not be related to the Airman's fitness, only that he or she took a different Test. To only look at the run, we removed all records that either measured a different test than a 1.5-mile run or if the AERO_SCORE was 0 or "NA." An AERO_SCORE of 0 or "NA" does not provide any value as a dependent variable because it is impossible to use a dependent variable of "NA" since it provides no information regarding aerobic fitness.

Step 4: Create a Median Height

We found that many records had the same person recorded with different heights for each of their tests. While it is possible that people still grow in their late teens and early twenties, as well as slowly shrink over time, this rationale was not reasonable when looking at the frequency and magnitude of the differences for many Airmen. We attributed this discrepancy to the fact that multiple testers were used to measure each person's height and weight across the years and that a tester could have measured either differently than other testers. Also, the data could have been erroneously recorded into AFFMS. For these reasons, we decided to create a median height for each individual. The median height would remove recording errors (accidentally making

someone 5’6 instead of 6’6) from the dataset because the recording error (or outlier) would not affect the median height, as it would a mean height, unless the Airman only took two fitness tests. Creating a median height also standardizes the individual’s heights to one height. For these reasons, we concluded that creating a median height was a necessary action when cleaning the data.

Step 5: Remove Duplicates

Next, we focused on finding duplicate records. A duplicate record in the database was when an entire record was the same as a different record in the database. Our goal was to find as many records that were duplicate records or if there were two records that described the same fitness test. While we may not be able to find every duplicate in this dataset (a duplicate record existed in the dataset if any record had an error, the error was found by the Airman or the fitness tester, and a duplicate record was created to change the error), we could use a broad scope to find as many duplicates as possible. The frame of reference we used is as follows: if the person’s ID (after standardizing to protect personal information), height (this is the height recorded originally and not the median height), weight, abdominal circumference, AERO SCORE, number of push-ups and sit-ups, gender, age, test year, and test semester (1 for the first half of the year and 2 for the second) were all the same; then the record was considered a duplicate record and taken out.

After finding the duplicates, we found that most of these records were changed anywhere from a day to a couple of weeks after the original record was entered into the system, which caused the record to have different test dates but the same exact scores and ages. While it is possible for someone to have a birthday in between the first and second submission of the test, we could not prove that an Airman with an identical score and a year older was always a

duplicate record; so we left these records in the database. Having the test semester and year in the filtering process helped eliminate Airmen that failed the fitness test and were required to retake it.

Step 6-12: Transform Extreme Data to "NA"

After removing duplicates, we found that many of the recorded individual statistics were impossible or highly improbable. For example, many people broke the Guinness Book of World Records for a 1.5-mile run, had BMI's smaller than humanly possible, etc. For this reason, we had reason to believe that some of the data was not correctly recorded. Due to these measurement errors, we decided to cut off the tails of the distributions for all the variables used in the study. These variables included run time, push-ups, sit-ups, abdominal circumference, BMI, height, and weight. We decided to use 99.5% and 0.5% as the cutoffs for taking the outlier data out of the analysis. The empirical rule uses 99.7% and 0.3% as the cutoffs when looking at outliers, which is relatively equivalent to our cutoffs. These cutoffs were created by gender, so cutoff points were different for males when compared to females. While there could have been legitimate records that we nullified by performing this action for these variables, we decided that losing those extreme records was necessary in order to remove erroneous records from the data set.

Step 13: Remove Records Before 2004

The final step in the cleaning process was to remove all data before 2004. 2004 was when the fitness test was created and any record before that was administered using a different Test. These records could have accumulated for several reasons, but we didn't have the

information to distinguish why the Airmen ran a 1.5-mile run before it was a standard. Without any further information, we decided to remove any records that we found before 2004 from the dataset.

Methodology: Assumptions for Independent and Dependent Variables

Due to the sheer size of the database, we use a cross sectional analysis to answer our research questions about body composition metrics. A cross-sectional analysis uses descriptive statistics to obtain an understanding of the data and performs inferential analysis to understand the relative significance of the variables on fitness. We use two surrogates for fitness, run time and a total fitness metric (which includes run time, sit-ups, and push-ups). The variables we primarily study are body composition metrics including: BMI, height-to-weight ratio, abdominal circumference, and waist-to-height ratio.

Before any analysis could be accomplished, the distributions for the dependent and independent variables are analyzed. The dependent variables consist of run-time and a created variable called total fitness. The independent variables are push-ups, sit-ups, abdominal circumference, BMI, height-to-weight ratio, waist-to-height ratio, gender, and age. We note the summary statistics and look at the distributions to fully assess the variables. These findings are found in the analysis portion of this thesis.

Due to the sheer size of the database, statistical tests will tend to conclude that the data fails basic assumptions of a linear regression model. Due to this issue, we focus on using an ordinary least squares regression when looking at the significance of the different independent variables and compare their relative standing (after checking for multicollinearity using variable inflation factor scores). Ordinary least squares regression proves to be a robust form of

regression, which is necessary given how we are testing the assumptions for our models. Since the amount data is so large, statistical tests will most likely lead to rejecting the hypothesis test because the software is treating the data like an entire population. We then look at variation inflation factor (VIF) scores to detect multicollinearity. We conclude that any parameters that had a VIF score greater than 10 would be significantly affected by multicollinearity.

Methodology: Regression Model Comparison

We first fit a simple linear model using the four body-composition metrics (BMI, height to weight ratio, waist to height ratio, and abdominal circumference) as independent variables with run-time as the dependent variable. We perform these tests to see how the individual variable explained run time (our best measurement of aerobic fitness) and compare these models to the other body composition metrics models. We use ranks to assess the models, primarily using R^2 for comparison. The models are ranked as 1-4 with 1 being the best model and 4 being the worst.

Next, we fit models that paired up the different body composition metrics with different covariates and did the same model comparison technique. The covariates included: sex, age, push-up count, and sit-up count. We first included one variable, then the other, and then both to assess how each variable affects the different models' abilities to explain run time. Interactions are looked at for run time and are found to be non-impactful, so we did not include interactions for total fitness. Both age and gender greatly affect run time and total fitness, so including these variables helps the body metric variables explain the right kind of variation in run time and total fitness.

Finally, we create a new fitness metric as a dependent variable. The metric consists of a weighted summation of the standardized scores for run-time, push-ups, and sit-ups. Run-time is weighted 75%, push-ups are weighted 12.5%, and sit-ups are weighted 12.5% (similar to how the current fitness test weighs the events). Following this step, we fit a model of this new metric, "total fitness," by the body composition metrics (blocking for sex and age). We run the same type of model comparisons, inputting in age and gender individually and then together to see which body composition metric best predicts total fitness. A list of the models we use to conduct the model comparison analysis is created for documentation purposes. The specific models are shown in Table 3:

Table 3: Models Used in the Analysis

Dependent Variable	Independent Variables
Run Time	Body Composition Metric
Run Time	Body Composition Metric, Sex
Run Time	Body Composition Metric, Age
Run Time	Body Composition Metric, Sex, Age
Run Time	Body Compostition Metric, Sex, Age, Pushups, Situps
Total Fitness	Body Composition Metric
Total Fitness	Body Composition Metric, Sex
Total Fitness	Body Composition Metric, Age
Total Fitness	Body Composition Metric, Sex, Age
Run Time	Body Composition Metric Squared
Run Time	Body Composition Metric Squared, Sex
Run Time	Body Composition Metric Squared, Age
Run Time	Body Composition Metric Squared, Sex, Age
Run Time	Body Compostition Metric Squared, Sex, Age, Pushups, Situps
Total Fitness	Body Composition Metric Squared
Total Fitness	Body Composition Metric Squared, Sex
Total Fitness	Body Composition Metric Squared, Age
Total Fitness	Body Composition Metric Squared, Sex, Age

All four body composition metrics are used for all of the regression models shown in Table 3. After calculating the data for all four body composition metrics of a specific model, we rank the models based solely on R^2. The body composition metric that has the highest R^2 in predicting the dependent variable is awarded a rank of 1 (and the other body composition metrics get 2, 3, and 4 according to their R^2 values). These ranks are then averaged to get a total "score" for each body composition variable. Through this model comparison, we can make the conclusion that a specific body composition metric best assists the Air Force in evaluating the fitness of the Airmen that take the Air Force Fitness test.

Fitness Assessment Chart Analysis

We were given both performance data and scoring data from AFFMS. Since we had the data readily available, we decided to see if the scoring rubrics accurately and fairly reflect the performance of the Airmen in their perspective age and gender groups. When scoring data was entered into AFFMS, the scores were hard coded. Since the scoring sheet had changed from 2004 to 2015 and there could have been errors when entering the scores into AFFMS, we calculated what the true score of the Airmen would be under 2013 scoring standards using AFI 36-2905. We generally find that 50-60% of the data was scored in a different way than through AFI 36-2905. We use AFI 36-2905 scoring standards to standardize the entire database with correct scores to give a good comparison for scores when creating the new scoring rubrics. Calculating the scores required that the data be broken up into individual age groups.

The two key attributes we looked for when looking at the scoring rubrics and the performance data is whether the rubrics showed the same distribution in scores as the performance metrics as well as if the averages for the different age/sex groups are statistically

the same. If the distribution of scores are different, then Airmen are not being accurately and fairly scored within the age group. Similarly, if the average scores are statistically different when comparing age groups, then scores are not accurately reflecting performance scores given age and sex. This means that the scoring sheets are grading people unfairly based on their fit group (a fit group is a group delineated by age and gender).

To assess the distribution of scores, we look at the distribution of run times, push-ups, and sit-ups in comparison to the scores Airmen received. If the shape of the distributions are different, Airmen would not be receiving points proportionally to how well they performed on each athletic event. This issue causes inaccuracy in the reflection of fitness test scores, which have a large effect on an Airman's career.

When comparing scores across age and gender groups, or fit groups, we conduct two-sample t tests. These tests calculate if there is a statistical difference between the means of the data. When conducting these tests, we use an error rate, or α, of .001 because of the large data samples. We initially only conducted two-sample t tests between age groups that were close together. For example, men under 30 years old (labeled M20 in the analysis) are compared to men between 30 and 39 years old (labeled M30). However, we then saw that the results were so conclusive that we didn't need to compare every age group to other age groups (for example, we ended up not needing to compare M20 to M40). If one fit group has a statistically significant higher score than another, then the Air Force Fitness test is biased towards one fit group over another.

When looking at fit groups, we also analyze whether the age groups should be broken down into smaller groups. Currently, the Air Force puts Airmen in age groups of 10 years or more (M20, M30, M40, etc.). We look to see if the older half of the age group was scoring

statistically the same scores as the younger half to determine if the age groups should be broken into 5 year groups instead of 10. We explain these results in Chapter 4.

Scoring Rubric Creation

While the conclusions of the analysis for the prior sections of this thesis do help the Air Force, we want to provide the Air Force with a viable and accessible alternative to current test methods and scoring. This section of the methodology dives into how we draft the scoring rubrics for WtHR as well as the other performance metrics for all age and sex groups. The methodology for developing scoring rubrics for WtHR is much different than the other events in the fitness test because we want the body composition portion of the test to focus on health risk instead of bias within and between age and gender groups.

In developing a scoring rubric for WtHR, we model scores based off body composition cutoffs given by Dr. Ashwell (Browning, Hsieh, Ashwell, 2016). Table 4 from Chapter 2 is shown below for convenience to the reader:

Table 4: Body Composition Based off WtHR per Dr. Ashwell

Underweight	Healthy	Overweight	Obese
less than .4	.4-.499	.5-.599	.6 and higher

We use these cutoffs because the cutoffs are simple and backed by Dr. Ashwell in his research. While most studies agreed that WtHR does have a significant role on health risk, they did not provide cutoffs to cross check the ones in Table 4. In our scoring rubric, we gave all WtHR scores in the healthy range 20 points. The Obese range in Table 4 represents the high health risk proportion of people. Current fitness standards have given Airmen with a waist circumference in the high health risk range 0 points, so we do the same for people in the obese range. To remain

consistent for Airmen who are unhealthily thin, we give any WtHR .3 or under 0 points as well. To determine how the distribution of scores would transition from the healthy range to the health risk ranges, we look at how performance decreased as WtHR increased above and decreased below the healthy range. We use descriptive statistics to assess the decrease of performance.

To create a scoring rubric for the other events, we focus on maintaining the same distribution for scoring that was found in each age group's performance in run time, push-ups, and sit-ups. To create this "shape", we use an equation that uses the average and standard deviation of the Age Group's run time:

$$Score = 46 - \frac{\left(x - \mu(Age\ Group\ Run\ Time)\right)}{\sigma(Age\ Group\ Run\ Time)} * \frac{Range\ (Age\ Group\ Run\ Time)}{\sigma(Age\ Group\ Run\ Time)} + Balance$$

This equation is only used if the Score was less than or equal to 60 points. Used 46 points as the fixed average score for run time in the Air Force (out of 60). The average points we fixed for push-ups is 8.5, while 8.3 points is the average points scored for sit-ups. This equation effectively takes the standardized difference between an Airman's performance for each athletic event and the average performance for that event. Then, it translates the standardized difference to a 60-point spread for run time (and a 10-point spread for both push-ups and sit-ups).

While our equation captures the same shape found in athletic performance, the equation poses a problem. Some age groups have a higher proportion of Airmen that score at or above the maximum score than others, which cause the average of scores to be different (although these differences were very small). To fix this issue, the Balance Variable is created. The purpose of the Balance variable is to add or subtract from every score within an age group in order to make every fit group have the same average score. This variable is different depending on the fit group, and we use an equation that adds the appropriate amount of points to every score that wasn't considered a maximum score.

$$Balance = \frac{(Average\ Score\ Desired - Average\ Score\ for\ Fit\ Group)}{\frac{(Total\ Airmen\ in\ Fit\ Group - Total\ Airmen\ Who\ Received\ a\ Max\ Score)}{Total\ Airmen\ in\ Fit\ Group}}$$

After applying the Balance variable to the equation, the distribution of scores is assessed to make sure the maximum score is still 60 or 10. If it is higher than 60 or 10, then the performance required to achieve the max score is lowered until the max score was 60 or 10, and the Balance variable is recalculated to create the desired average score.

After using the two equations to reflect the shape of athletic performance and to make all average scores consistent across all fit groups, we turn to creating a scoring rubric that shows how many points an Airmen gets from a certain level of performance. To help eliminate any large gaps between scores, which would incentivize Airmen not to put forth maximum effort in every event, the rubrics are designed to show appropriate scores for each number of push-ups and sit-ups ranging from 1 repetition to the number of repetitions needed to receive the maximum score of 12. For run times, we assess quantile run time scores and calculated the run time needed to achieve a run time score of each hundredth of a quantile. For example, the 100th percentile of Airmen would always receive a score of 62, but we calculate the run time needed to achieve the run time score in the 99th percentile all the way down to the 1st percentile. We also include the run times needed to score 1 point on the test (no Airmen scored 1 point in the database). A thorough example of the entire scoring rubric creation process using M20 as well as the data table showing all Balance values for every fit group can be found in Appendix C. We create rubrics for both 5 year fit groups as well as 10 year fit groups to supply the Air Force with various options. We discuss the benefits and disadvantages to our alternate rubric in Chapter 5.

Conclusion

In conclusion, this chapter discusses the methods we use to clean the data and how we use the data to answer the provided research questions. This section discusses the major assumptions about the models we use as well as a list of models we looked at to find out what body composition metric best predicts physical fitness. We also explain the process of how we evaluate the current scoring rubric and how we create the alternate rubric that will be shown in the next two chapters. After establishing our methodology, we have the necessary clean database and methodological plan needed to complete an accurate and thorough analysis, which we present in Chapter 4. The steps we describe in this section resembles the analysis we conduct on the dataset to ascertain which body composition metric best measures aerobic and total fitness.

IV. Analysis and Results

Chapter 4 looks at the analysis performed and the results obtained in this thesis. This section includes: the descriptive statistics of the cleaned database, descriptions of the specific regression models used in the analysis, model comparisons, model results used, current scoring standard distributions, and alternate scoring rubrics. After the aforementioned steps are recorded, we use the results to determine the best possible body composition metric that predicts both aerobic fitness and total fitness and how to apply that metric to the Air Force fitness Test. This chapter also includes our evaluation of the current scoring rubric's effectiveness and equality and offers an alternative rubric to use instead of the current standards.

After the cleaning process, the entire database had 5,377,008 entries. These entries do not contain every variable originally presented in the data, but at least have an ID tag, a gender, and a run time. The data is split up into continuous and categorical variables, with the continuous variables being shown first by gender in Table 5 and 6.

Table 5: Descriptive Statistics of Continuous Variables for Men

Name	Minimum	Median	Maximum	Mean	Mode	IQR	Range	Standard Deviation	Variance	Total Records
Height	63	70.00	77.00	70.17	70	4.00	14.00	2.66	7.08	3500327
Weight	122	183.00	265.00	184.12	180	36.00	143.00	26.40	697.04	4233146
Abdominal Circumference	26.5	34.00	43.00	33.91	32	4.00	16.50	3.04	9.25	4375824
Run Time	531	730.00	1148.00	737.57	750	123.00	617.00	97.73	9552.10	4409783
Push-ups	18	50.00	80.00	50.55	50	14.00	62.00	10.54	110.99	4321789
Sit-ups	18	51.00	73.00	49.93	50	10.00	55.00	8.77	76.86	4357426
Age	18	28.00	69.00	30.29	23	13.00	51.00	8.43	71.07	4409783
BMI	18.44	25.97	35.84	26.11	26.58	4.43	17.40	3.22	10.37	3492839
Height to Weight Ratio	1.61	2.59	4.08	2.61	2.5	0.46	2.47	0.34	0.11	3471054
Height to Waist Ratio	0.34	0.48	0.68	0.48	0.5	0.06	0.34	0.04	0.002	3473787
Total Fitness Score	-3.23	0.25	2.16	0.21	0.12	0.95	5.40	0.75	0.56	4282508

Most of the continuous variables in Table 5 are normally distributed. The cleaning process took out Airman who stood over 6 feet 5 inches tall and under 5 feet 3 inches tall that are men. The variable that has the most missing data in the dataset was height simply because the data was

missing from the original database (BMI, Height to Weight Ratio, and Waist to Height Ratio are all calculated with height). For both men and women, we only removed thirty-three thousand height values and replaced the values with "NA", the rest of the missing heights were just not inputted into the database originally. Table 6 shows the descriptive statistics for women.

Table 6: Descriptive Statistics of Continuous Variables for Women

Name	Minimum	Median	Maximum	Mean	Mode	IQR	Range	Standard Deviation	Variance	Total Records
Height	58.25	65.00	71.75	64.71	64.00	3.50	13.50	2.51	6.31	777607
Weight	98.00	143.00	215.00	144.93	140.00	29.50	117.00	21.58	465.65	926321
Abdominal Circumference	23.50	30.00	39.00	29.94	29.00	4.00	15.50	2.81	7.92	959229
Run Time	611.00	862.00	1311.00	870.83	840.00	150.00	700.00	115.74	13395.83	967077
Push-ups	2.00	30.00	59.00	30.69	30.00	16.00	57.00	10.36	107.24	933967
Sit-ups	11.00	44.00	67.00	43.23	40.00	12.00	56.00	9.39	88.14	952814
Age	18.00	27.00	67.00	29.09	23.00	11.00	49.00	8.11	65.80	967077
BMI	17.54	23.96	34.72	24.24	24.03	4.32	17.18	3.17	10.05	777549
Height to Weight Ratio	1.43	2.20	3.54	2.23	2.00	0.41	2.11	0.30	0.09	771296
Height to Waist Ratio	0.33	0.46	0.66	0.46	0.50	0.06	0.33	0.04	0.00	771540
Total Fitness Score	-4.54	-0.90	1.32	-0.95	-1.20	1.13	5.85	0.87	0.76	924543

Generally, the statistics for women are lower than men. For total fitness, the performance of the Airman is standardized with both men's and women's scores, which is why women's total fitness scores are lower than men's. The shapes of the distributions for the continuous variables are similar to men's.

Table 7: Count and Frequency of Sex and Test Year

Sex	Men	Women	Unknown
Count	4409783	967077	148
Frequency	0.82012	0.17985	0.00003

Test Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Count	422809	420891	425358	412547	442844	485909	683381	548364	531901	513554	489450
Frequency	0.079	0.078	0.079	0.077	0.082	0.090	0.127	0.102	0.099	0.096	0.091

The categorical variables we use in the database are test year and sex. These two variables describe the population of the dataset and needed to be studied in order to understand the Air Force population for the physical fitness Test. Table 7 describes the two nominal variables in terms of count and frequency.

The Air Force population was predominately male from 2004-2014 (82% of the population), while there seemed to be a general increase of Airmen from 2004-2010 and decrease from 2010-2014. We also note that since the population is male dominated, most of the body composition metrics that explain more variance on run times, on average, might be more effective for men than women.

Model Comparison Results

The results of the model comparisons are shown in Table 8. These ranks are the average ranks for all the models listed in Table 2. A table showing the ranks for all of the body composition variables as well as their R^2 values are shown in Appendix D. Our rank structure is based on four sections of models: linear functions of the body composition metrics predicting run time and total fitness as well as quadratic functions of the body composition metrics predicting run time and total fitness.

As shown in Table 8, waist to height ratio (WtHR) beat out every other body composition metric in every model (except BMI when push-ups and sit-ups were included in the model against run time). Both Abdominal Circumference and Waist to Height Ratio proves to do better at explaining the variation in total fitness over run time, while height to weight ratio and BMI do the opposite. Even though the Abdominal Circumference is not the worst variable in predicting

both run time and total fitness, BMI and Waist to Height Ratio proved to be better variables in predicting fitness. Table 9 shows both the rankings and percent difference (in R^2) when comparing WtHR with Waist Circumference only.

Table 8: Model Comparison Results-Lower Total Weight Score Leads to a Better Variable

	Abdominal Circumference	Height to Weight Ratio	BMI	Waist to Height Ratio
Total Rank	3	4	2	1
Run Time Rank	3.40	3.40	2.00	1.20
Total Fitness Rank	2.75	3.75	2.50	1.00
Average Rank	3.075	3.575	2.250	1.100

Table 9: Comparing WtHR to Waist Circumference

	Waist Circumference	Waist to Height Ratio	% R^2 Increase
Run Time Score	2	1	106.40%
Total Fitness Score	2	1	103.67%
Rank	2	1	105.04%

As shown in Table 9, optimizing the body composition variables in the model did not change the results for the model comparison. When WtHR was included in the model instead of WC, every model was more predictive. Per 5.38 million records of Airmen taking the test since 2004, WtHR is more predictive of our best measures of aerobic and total fitness. In fact, the models with WtHR in them explained 3.78% more run time (106.4% increase in R^2 explained from waist circumference) and 3.49% more total fitness (103.67% increase) than WC. In summary, the entirety of our analysis points to the conclusion that models with WtHR explain more variation

than models with waist circumference. We recommend that WtHR should replace waist circumference in the Air Force fitness test as the main form of body composition evaluation.

Applying WtHR to the Fitness Test

The Air Force fitness test currently uses the waist circumference metric to measure body composition. The distribution of waist circumference for the Air Force is shown in Figure 1. While the test's primary components have not changed since 2004, the body composition score decreased from 30 to 20 percent of the total score. During our analysis, we focused on the amount of people who should have received max scores based on their waist circumference measurement.

Based on the current standards, 68.1% of men and 73.6% of women get a maximum score on the body composition section of the test, and the models have similar distributions. The Air Force's intent for the section is to give maximum scores to Airmen that are considered low risk for health problems due to their body composition. These distributions will be used as a frame of reference to compare our created WtHR scores in the following paragraphs.

WtHR appears to be a better metric in predicting fitness and is a viable alternative to the current standard (to replace WC with WtHR) due to no implementation costs. WtHR is determined to be a significant variable when screening for health problems, and is found in the most significant models when modeling for aerobic and total fitness. Dr. Ashwell shows the ranges of WtHR that leads to a low risk of cardiovascular disease and mortality in Table 10 (Browning, Hsieh, Ashwell, 2016).

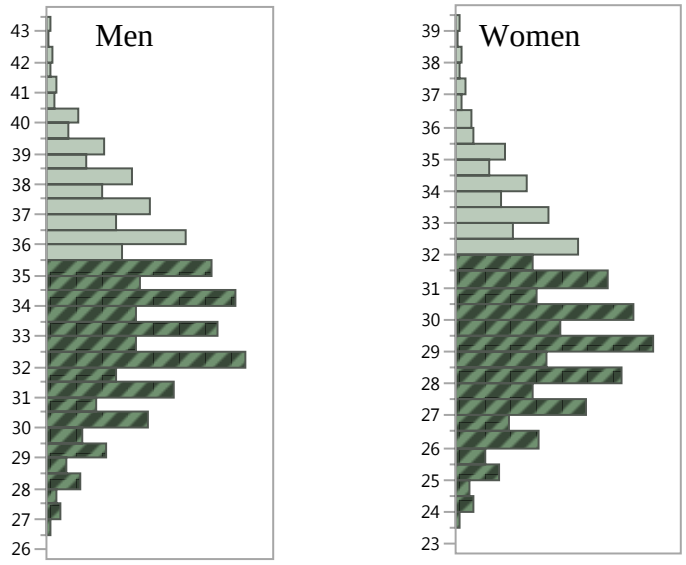


Figure 1: Body Composition Distribution Men and Women in the Air Force (highlight areas indicate a maximum score on the body composition section of the test)

Table 10: Healthy and Unhealthy Ranges for WtHR

Underweight	Healthy	Overweight	Obese
less than .4	.4-.499	.5-.599	.6 and higher

The ranges for WtHR show underweight, healthy, overweight, and obese cutoffs for both men and women. We consider that underweight Airmen show similar risk to overweight Airmen, while obese Airmen show the most risk (Browning, Hsieh, and Ashwell, 2010). Next, we apply the cutoffs to the population of Airmen to see the similarities and differences between a "healthy" waist circumference and a "healthy" WtHR. Figure 2 shows the healthy WtHR distribution cutoffs:

M F

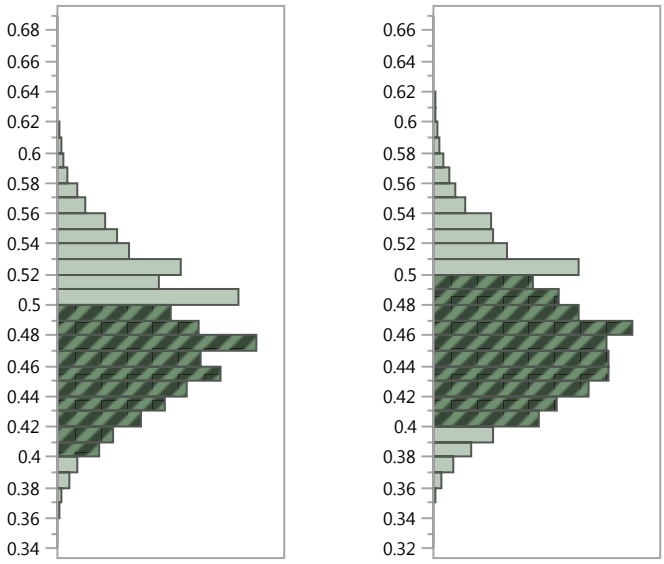


Figure 2: WtHR healthy ranges- the selected ranges are considered low risk.

Given these new standards, 64% of men and 72% of women would receive a maximum score. While there is a larger disparity between men and women in the current Air Force for optimal WtHR ranges, research has shown that these ranges indicate a low risk of health issues.

In Browning, Hsieh, and Ashwell's study on WtHR and its ability to screen health issues, they found that a linear increase in WtHR over the threshold correlates to increased risk. For this reason, we create the new scoring rubric to have the Airman's points to decrease proportionally to the Airman's distance away from the healthy WtHR range. The fitness assessment chart for WtHR is shown in Table 11. The rubric penalizes Airmen for being both unhealthily overweight and underweight. The range between .4 and .4999 WtHR are all max scores. The decrease in points is linearly proportional to the distance away from the healthy range of an Airman's WtHR.

Table 11: WtHR Scoring Rubric for the Air Force

0.3	0	0.5	19.0
0.305	1	0.505	18.1
0.31	2	0.51	17.1
0.315	3	0.515	16.2
0.32	4	0.52	15.2
0.325	5	0.525	14.3
0.33	6	0.53	13.3
0.335	7	0.535	12.4
0.34	8	0.54	11.4
0.345	9	0.545	10.5
0.35	10	0.55	9.5
0.355	11	0.555	8.6
0.36	12	0.56	7.6
0.365	13	0.565	6.7
0.37	14	0.57	5.7
0.375	15	0.575	4.8
0.38	16	0.58	3.8
0.385	17	0.585	2.9
0.39	18	0.59	1.9
0.395	19	0.595	1.0
.4-.4999	20	0.6	0

When enforcing the new rubric, we generate a distribution of scores for the men and women in the database, and we use these distributions and compare them to the current standards (using waist circumference) to see how the change would affect Airmen's scores. The comparison for both men and women is shown in Figure 3. It appears that the newly created rubric gives Airmen approximately .15 points less on average. We believe that this phenomenon is due to slightly lower scores for Airmen who are in the middle portion of the "underweight" and "overweight" categories as well as that the new rubric punishes Airmen who are "underweight," while the old rubric does not.

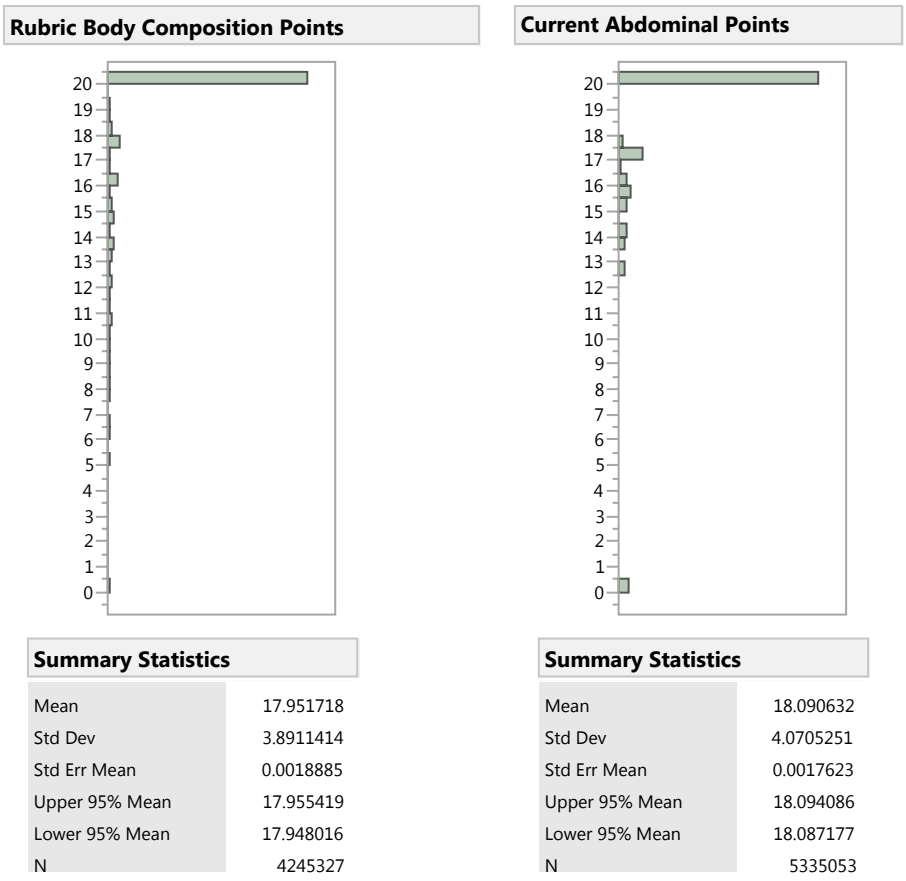


Figure 3: Comparing the New Body Composition Rubric to the Current Standards

Evaluating the Scoring Rubric

After applying WtHR to the fitness test, we look at the differences between gender and age to see if the way the Air Force scores the different events fairly and accurately both within and across fit groups. Body composition will not be evaluated, since research has shown that the healthy WtHR's for the genders are different. We start initially with gender, and then move to age. The descriptive statistics for the three events for each sex is shown in Table 12. It appears as if men and women perform very differently for each event in the fitness test.

Table 12: Differences in Gender for Fitness Test Performance

Men	Run Time	Push-ups	Sit-ups	Women	Run Time	Push-ups	Sit-ups
Minimum	531	18	18	Minimum	611	2	11
Mean	737.57	50.55	49.93	Mean	870.83	30.69	43.23
Median	730	50	51	Median	862	30	44
Maximum	1148	80	73	Maximum	1311	59	67
IQR	123	14	10	IQR	150	16	12
Range	617	62	55	Range	700	57	56
Standard Deviation	97.73	10.54	8.77	Standard Deviation	115.74	10.36	9.39
Variance	9552.10	110.99	76.86	Variance	13395.83	107.24	88.14

We use a t test to see if the means of the run time, push-ups, and sit-ups are significantly different based on the gender of an Airman. We use an α of 0.001 to evaluate the significance of the difference in means for this test as well as all the following tests. Table 13 shows the results of the t test:

Table 13: Two Sample T Test. Difference in Means of Run Time, Push-ups, and Sit-ups by Gender

Difference in Means	T-statistic	P-Value
Run Time	1052.95	<.001
Push-ups	-1674.93	<.001
Sit-ups	-638.18	<.001

As shown in Table 13, the means for all three events are statistically significant, with push-ups being the most significant and sit-ups being the least. The Air Force accounts for this difference already through its current fitness assessment charts.

Next, we want to see how men and women scored on the test using current standards to see if the test is equal for both genders and if the scoring rubric should be altered to provide a

specific distribution of scores. Table 14 shows the descriptive statistics of how men and women were scored.

Table 14: Differences in Gender for Fitness Test Scores.

Men	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	45.510344	8.7025077	8.1969886
Median	42.3	9.5	9.5
Maximum	60	10	10
IQR	13.4	1.5	1.5
Range	60	10	10
Standard Deviation	9.9557975	1.1234696	1.572284
Variance	99.117904	1.2621839	2.472077
N	4409783	4357302	4387426

Women	Run Time	Push-Ups	Sit-Ups
Minimum	0	0	0
Mean	47.54742	7.953718	7.804349
Median	43.5	8.75	9.5
Maximum	60	10	10
IQR	13.8	2	2
Range	60	10	10
Standard Deviation	10.15765	1.407484	1.678254
Variance	103.1778	1.98101	2.816537
N	967077	941463	959769

Despite the large sample size, there are noticeable differences in how men and women are scored. While the scores are close, a difference of 2 points on the run, 0.7 points on push-ups, and 0.4 points on sit-ups is serious given the sample size. The standard deviations were relatively similar, except for women on push-ups (.3 point difference). We conduct another two-sample T-test to see if the differences in means of scores were significant. The t-test results are shown in Table 15:

Table 15: Two Sample T Test. Difference in Means of Scores Between Genders.

Difference in Means	T-statistic	P-Value
Run Time	179.24	<.001
Push-ups	-483.96	<.001
Sit-ups	-209.93	<.001

All three tests show that there is a significant difference in every event on the Test. The coefficients above on the t-statistic show which gender has an advantage due to the scoring rubric. The test in mean differences (for both t-tests so far) show how many more points the

women have over the men in each event. The women have a significant advantage in run time, but a disadvantage on push-ups and sit-ups. The most significant difference in scoring is push-ups; based off their scoring rubric, the Air Force expects women to do more push-ups than they currently can do, in comparison to men, on average (from 2004-2014).

Table 16: Descriptive Statistics for All Male Fit Groups

M20	Run Time	Push-ups	Sit-ups
Minimum	531	18	18
Mean	719.785	53.5161	52.4297
Median	712	55	53
Maximum	1148	80	73
IQR	117	16	10
Range	617	62	55
Standard Deviation	92.4688	10.6008	8.26842
Variance	8550.48	112.376	68.3668
N	2379979	2337803	2355502

M30	Run Time	Push-ups	Sit-ups
Minimum	531	18	18
Mean	745.508	49.4971	48.6571
Median	741	50	50
Maximum	1148	80	73
IQR	114	12	10
Range	617	62	55
Standard Deviation	93.2743	8.91844	8.08399
Variance	8700.1	79.5386	65.3508
N	1312217	1285411	1297275

M40	Run Time	Push-ups	Sit-ups
Minimum	531	18	18
Mean	774.012	42.9361	44.469
Median	770	44	47
Maximum	1148	80	73
IQR	134	7	10
Range	617	62	55
Standard Deviation	102.831	8.02693	7.96326
Variance	10574.2	64.4316	63.4135
N	618804	603849	608765

M50	Run Time	Push-ups	Sit-ups
Minimum	531	18	18
Mean	832.144	40.148	40.5194
Median	830	40	42
Maximum	1148	80	73
IQR	157	11	11
Range	617	62	55
Standard Deviation	113.363	9.45541	8.55329
Variance	12851.3	89.4047	73.1587
N	97790	93787	94937

M60	Run Time	Push-ups	Sit-ups
Minimum	605	18	18
Mean	851.454	36.4835	39.9229
Median	845	35	42
Maximum	1144	80	64
IQR	151.5	11	10
Range	539	62	46
Standard Deviation	107.716	10.3837	8.48437
Variance	11602.8	107.821	71.9845
N	993	939	94937

For the next part of our analysis we look at the age groups to see if the groups are statistically significant from each other. We break the age groups up by gender to help nullify the differences in scores and performance due to sex. Table 16 shows some descriptive statistics for the different age groups.

As shown in the tables, as the age groups get older, the worse the Airmen perform. The Air Force already factors in age into their scoring rubric, but we perform two-sample t-tests anyway to make sure that the groups are all statistically different from each other. The two-sample t-tests are shown in Table 17:

Table 17: Two Sample T Test. Differences in Mean Performance for Fit Groups (Male Only)

M20 vs. M30	T-statistic	P-Value
Run Time	254.41	<.001
Push-ups	-383.29	<.001
Sit-ups	-423.38	<.001

M30 vs. M40	T-statistic	P-Value
Run Time	185.08	<.001
Push-ups	-505.32	<.001
Sit-ups	-336.89	<.001

M40 vs M50	T-statistic	P-Value
Run Time	150.85	<.001
Push-ups	-85.64	<.001
Sit-ups	-133.54	<.001

M50 vs M60	T-statistic	P-Value
Run Time	5.62	<.001
Push-ups	-10.77	<.001
Sit-ups	-15.25	<.001

Technically, all the models in Table 17 show a significant difference in means for every category. While the performance shows a significant decrease in abilities over time, the Air Force correctly attempted to create the correct rubric that accounts for this change. To test the current scoring standards, we perform the same analysis on the score cards of male Airmen based on their age group. The descriptive statistics of the scores are shown in Table 18:

Table 18: Descriptive Statistics of Men's Fitness Scores Based on Fit Groups

M20	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	45.9264	8.31184	8.18014
Median	52.4	8.8	9.2
Maximum	60	10	10
IQR	50.9	1.75	1.5
Range	60	10	10
Standard Deviation	17.7651	1.80971	2.86515
Variance	315.598	3.27506	8.20907
N	2379979	2337803	2355502

M30	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	43.8861	9.01266	8.17134
Median	49.2	9.3	9.4
Maximum	60	10	10
IQR	12.5	1	1.5
Range	60	10	10
Standard Deviation	17.5156	1.38549	3.00524
Variance	306.796	1.91958	9.03145
N	1312217	1285411	1297275

M40	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	46.9086	9.4446	8.29174
Median	53.1	10	9.5
Maximum	60	10	10
IQR	14	0.5	1.5
Range	60	10	10
Standard Deviation	17.2415	1.07492	2.88066
Variance	297.27	1.15546	8.29822
N	618804	603849	608765

M50	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	48.2426	9.40214	8.34886
Median	53.3	9.5	9.4
Maximum	60	10	10
IQR	15.5	0.75	1.75
Range	60	10	10
Standard Deviation	16.0923	0.78945	2.57408
Variance	258.963	0.62323	6.62587
N	97790	93787	94937

M60	Run Time	Push-ups	Sit-ups
Minimum	0	6	0
Mean	54.3813	9.67167	9.09176
Median	55.6	10	10
Maximum	60	10	10
IQR	25	0	1.25
Range	60	4	10
Standard Deviation	6.56812	0.87982	1.79058
Variance	43.1402	0.77408	3.20617
N	993	939	947

The differences in means are rather evident without statistical analysis. The current scoring rubric for men's scores appear to not align with how a male in the Air Force ages over time. We still run the statistical analysis, however, and conduct the tests with consecutive age

groups because we believe they would be the closest mean scores. These two-sample t-tests are shown in Table 19:

Table 19: Two Sample T Test. Differences in Mean Scores for Fit Groups (Male Only)

M20 vs. M30	T-statistic	P-Value
Run Time	-106.59	<.001
Push-ups	411.94	<.001
Sit-ups	-2.72	0.0058

M30 vs. M40	T-statistic	P-Value
Run Time	113.10	<.001
Push-ups	234.02	<.001
Sit-ups	26.53	<.001

M40 vs. M50	T-statistic	P-Value
Run Time	23.85	<.001
Push-ups	-14.52	<.001
Sit-ups	6.25	<.001

M50 vs. M60	T-statistic	P-Value
Run Time	28.59	<.001
Push-ups	9.35	<.001
Sit-ups	12.64	<.001

As shown in the table, almost every event in every age group above have significantly different means from the other age groups. The sole exception is sit-ups when comparing M20 and M30 age groups, as it showed that the current Air Force rubric scores for the two age groups for sit-ups are statistically the same (with an error rate of 0.001). Due to the sample size, one could argue the significance of sit-ups between M40 and M50 as well as push-ups between M50 and M60 is of low magnitude and could be considered insignificant. However, most of the events are statistically different by a wide margin. Given the lack of research in these scoring rubrics, it is understandable why all the age groups have statistically different means, but this database can help fix those differences.

We wanted to see if 10-year different age groups were small enough to score men evenly across the age group. To test this, we split M30 in two groups by age and looked at how each group was scored. For example, M30 is split into a group with men aging 30-34, and a group

aging 35-39. Then, we conduct a two-sample t-test of means for the two groups to see if the mean scores are significantly different. The descriptive statistics for the two groups are shown in Table 20.

Table 20: Descriptive Statistics of Men's Fitness Scores Within M30

M30-34	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	44.6849	9.10408	8.40084
Median	49.2	9.5	9.5
Maximum	60	10	10
IQR	13.4	1.1	1.5
Range	60	10	10
Standard Deviation	16.9089	1.32965	2.82587
Variance	285.911	1.76798	7.98555
N	704341	710971	717874

M35-39	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	42.9212	8.90184	7.89305
Median	49.2	9.2	9.2
Maximum	60	10	10
IQR	13.2	1	1.5
Range	60	10	10
Standard Deviation	18.1747	1.44254	3.18723
Variance	330.321	2.08093	10.1584
N	594343	581070	586304

Based off the descriptive statistics, it appears that there could be a significant decrease in all events. Seemingly, therefore, a ten-year gap between changing the fitness assessment chart could have a detrimental effect on Airmen's scores in the Air Force. We conduct two-sample t-test once again to determine if the differences are significant, which is represented in Table 21. Per the t test in Table 21, every event again proved significant. To be fair to all Airmen in the 10-year age group, we recommend that the Air Force change the rubric to 5-year increments instead of 10-year increments. While there will still be aging within groups, the differences between scores within an age group should be less significant.

Table 21: Two Sample T Test. Differences in Mean Scores for M30-34 and M35-39 Fit Groups

M30-34 vs. M35-39	T-statistic	P-Value
Run Time	-56.87	<.001
Push-ups	-82.10	<.001
Sit-ups	-95.20	<.001

We then perform the same analysis for women so as to see if the age group differences were evident for both genders. The descriptive statistics of run times, push-ups, and sit-ups for women can be found in Appendix E. The descriptive statistics of their scores are shown in Table 22. It appears as if the average scores for all events for women increase as women become older and go into older age groups in most cases. However, the number of women in the database is much smaller than men. Statistically, then, the tests will require a large difference in means to become significant. Table 23 shows the two-sample t-tests between consecutive age groups.

All events in all age groups are statistically different from each other (using an error rate of 0.001) besides F40 and F50 for run time. The magnitude of significance for women appears to be less than for men in most age groups, which could be due to the sample size differences or a smaller range of athletic performance in comparison to the fitness assessment chart. However, we conclude from these tests that the Air Force could do a better job scoring the women evenly across age groups for not only men, but also women.

We conclude that the current Air Force scoring sheet does attempt to account for differences in age and gender. However, the rubric needs to be amended in order to give Airmen an equal chance no matter their age or gender. While not drastic, the different age groups and genders tend to disproportionally give higher scores to certain age/gender groups, which would be giving an unfair advantage to some Airmen over others.

Table 22: Descriptive Statistics of Women's Fitness Scores Based on Fit Groups

F20	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	47.2388	7.82024	7.31943
Median	52.8	8.4	8.8
Maximum	60	10	10
IQR	12.2	1.5	2.25
Range	60	10	10
Standard Deviation	17.2973	2.36136	3.41592
Variance	299.197	5.57604	11.6685
N	583939	567868	576137

F30	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	46.9176	8.19893	8.4588
Median	51.2	8.8	9.5
Maximum	60	10	10
IQR	13.7	1.8	1.5
Range	60	10	10
Standard Deviation	15.6802	2.09523	2.61269
Variance	245.87	4.38997	6.82613
N	262109	251671	258326

F40	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	50.3411	8.10094	8.71921
Median	56	8.3	9.5
Maximum	60	10	10
IQR	15.8	1.5	1.2
Range	60	10	10
Standard Deviation	15.7385	2.06905	2.33952
Variance	247.701	4.28096	5.47333
N	101607	96557	99667

F50	Run Time	Push-ups	Sit-ups
Minimum	0	0	0
Mean	50.6499	7.93833	8.81865
Median	55.6	8.5	10
Maximum	60	10	10
IQR	16.3	1.7	1.25
Range	60	10	10
Standard Deviation	15.4828	2.30723	2.44138
Variance	239.718	5.32332	5.96031
N	19114	17599	18392

F60	Run Time	Push-ups	Sit-ups
Minimum	40.8	0	6.5
Mean	54.588	8.48529	9.4476
Median	55.8	9.5	10
Maximum	60	10	10
IQR	18	1.275	1
Range	19.2	10	3.5
Standard Deviation	4.4564	2.31041	0.74605
Variance	19.8595	5.33801	0.55659
N	308	272	292

Table 23: Two Sample T Test. Differences in Mean Scores for Women's Fit Groups

F20 vs. F30	T-statistic	P-Value
Run Time	-8.43	<.001
Push-ups	72.53	<.001
Sit-ups	166.77	<.001

F30 vs. F40	T-statistic	P-Value
Run Time	58.92	<.001
Push-ups	-12.47	<.001
Sit-ups	28.87	<.001

F40 vs. F50	T-statistic	P-Value
Run Time	2.52	0.0156
Push-ups	-8.73	<.001
Sit-ups	5.11	<.001

F50 vs. F60	T-statistic	P-Value
Run Time	14.19	<.001
Push-ups	3.87	0.0002
Sit-ups	13.32	<.001

Alternative to the Scoring Rubric

While we conclude that the scoring rubric needed to be amended, there was no clear direction as to what the Air Force believed the average scores should be for the different events. Therefore, to create each rubric, we treat each distribution of run time, push-ups, and sit-ups as normal distributions. We then find the standard deviation of the distributions and used ratios to determine a proportional standard deviation when looking at the corresponding score in the scoring rubric. Then, we create a formula to find the score of a person based on their run time. The formula we use is:

$$Score = 46 - \frac{\left(x - \mu(Age\ Group\ Run\ Time)\right)}{\sigma(Age\ Group\ Run\ Time)} * \frac{Range\ (Age\ Group\ Run\ Time)}{\sigma(Age\ Group\ Run\ Time)} + Balance$$

The second half of the formula finds the proportional standard deviation to use as scores. The variable "Balance" is used to force all fit groups to have the same average by lowering or raising the entire distribution up evenly. This scoring method creates a similar distribution in the database to run times, and helps give proportional scores to Airmen in different age/sex

categories, regardless of the shape of distribution in that specific group. Figure 4 shows the similarities in scoring structure and run times for all Airmen versus the current standards.

Figure 4 shows the same type of shape for the new scoring rubric and run times but a drastically different shape between the current standards and run times. The mean aerobic score for the new rubric in every fit group is adjusted to be 46 so that they would all be the same.

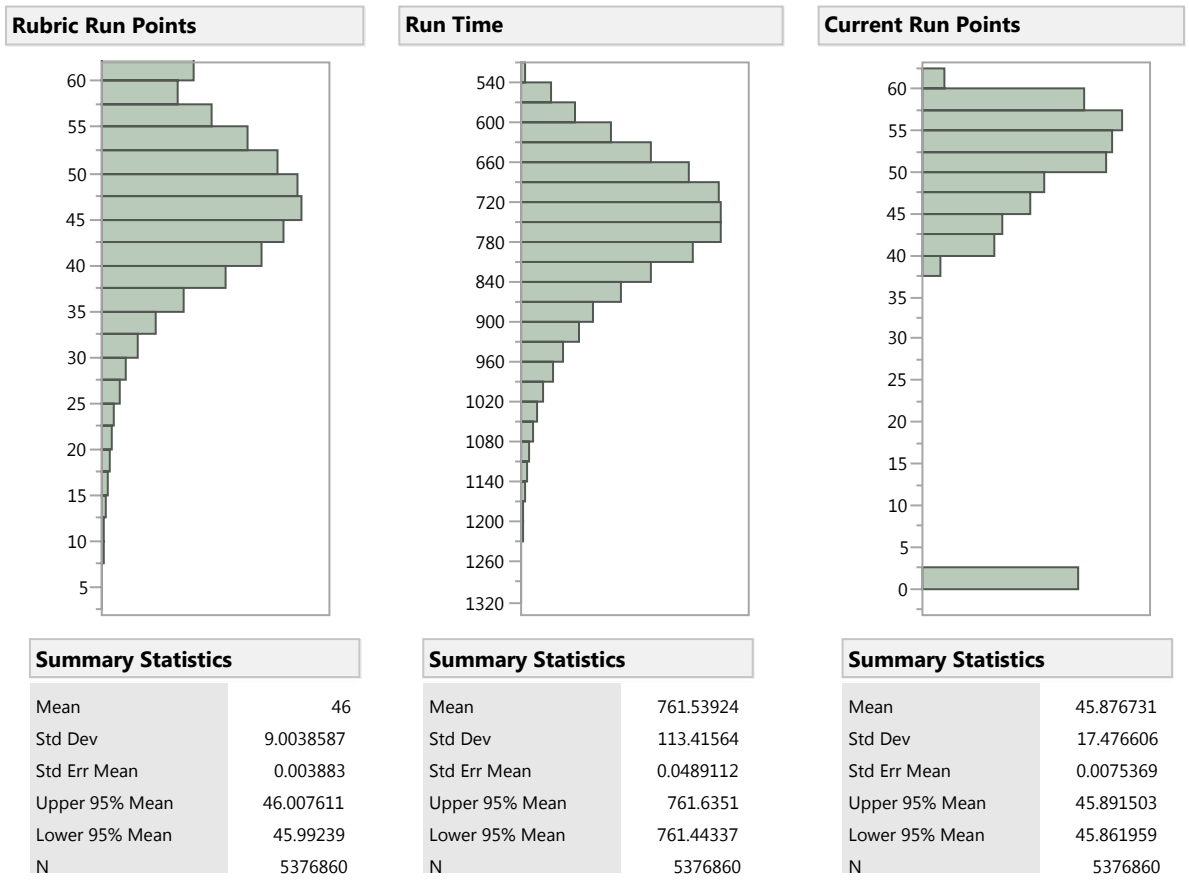


Figure 4: Distributions of Run Time and Run Points (New Rubric on Left and Current Standards on Right)

The biggest difference between the new rubric and the current standards is it is possible for Airmen to fail the event but still get points. The scoring structure is designed this way so that all age and gender groups receive the same opportunity to succeed. Recreated scoring rubrics are

made for all age groups for both genders, and we broke the groups up into 5-year increments. These rubrics for all fit groups and test events can be found in Appendix F. The rubric for M20 (all Airmen under 30) is shown in Table 24 as an example:

We include every percentile of Airmen as a line in the rubric (for example, the 99th percentile of Airmen in M20 scored a 59.5). The rubric can be condensed, but it will be at the expense of accuracy due to rounding. Also, the cutoff for zero points for M20 is much more lenient than the original, which allow Airmen that barely fail the aerobic section to obtain a better score than before.

After creating the rubrics, we look to see how the scores of Airmen measure up in comparison to the old standards. Figure 5 shows the distribution of the total scores of Airmen for the new rubric and the current standards based on AFI 36-2905. These total scores are from all age groups from the entire dataset (as long as there is enough information to calculate a total score). Per Figure 5, the average Airman in our database from 2004-2014 would score approximately .3 points higher on average when using our new created rubric. However, it is important to take note that our rubric greatly increases the scores of Airmen who did not reach the minimum standard. Airmen who failed received a 0 in current standards, but receive many more points in our rubric. We deem it necessary to look at the percentiles of Airmen that would fail and receive an "excellent score" given these two rubrics. This data is shown in Table 25.

Table 24: Created M20-30 Scoring Rubric for Run Time

Points	Run Time
60	0:09:36
59.5	0:09:42
58.8	0:09:49
58.2	0:09:55
57.7	0:10:00
57.3	0:10:04
56.8	0:10:09
56.5	0:10:13
56.1	0:10:17
55.8	0:10:20
55.4	0:10:24
55.1	0:10:27
54.8	0:10:30
54.5	0:10:33
54.2	0:10:36
53.8	0:10:40
53.6	0:10:42
53.3	0:10:45
53.1	0:10:48
52.9	0:10:50
52.6	0:10:53
52.3	0:10:56
52	0:10:59
51.8	0:11:01
51.6	0:11:03
51.3	0:11:06
51.1	0:11:08
50.9	0:11:10
50.6	0:11:13
50.4	0:11:15
50.1	0:11:18
49.9	0:11:20
49.7	0:11:23
49.6	0:11:24
49.3	0:11:27
49.1	0:11:29

Points	Run Time
49	0:11:30
48.7	0:11:33
48.5	0:11:35
48.3	0:11:37
48.1	0:11:39
47.9	0:11:41
47.7	0:11:43
47.5	0:11:45
47.2	0:11:48
47	0:11:50
46.8	0:11:52
46.6	0:11:54
46.3	0:11:57
46.2	0:11:58
46	0:12:01
45.8	0:12:03
45.5	0:12:06
45.3	0:12:08
45.1	0:12:10
44.9	0:12:12
44.6	0:12:15
44.4	0:12:17
44.1	0:12:20
43.9	0:12:22
43.6	0:12:25
43.4	0:12:27
43.1	0:12:30
42.9	0:12:32
42.7	0:12:34
42.5	0:12:37
42.2	0:12:40
42	0:12:42
41.7	0:12:45
41.4	0:12:48
41.2	0:12:50
40.9	0:12:53

Points	Run Time
40.7	0:12:55
40.3	0:12:59
40.1	0:13:01
39.7	0:13:05
39.4	0:13:08
39.1	0:13:12
38.8	0:13:15
38.5	0:13:18
38.1	0:13:22
37.7	0:13:26
37.3	0:13:30
36.9	0:13:34
36.5	0:13:38
35.8	0:13:45
35	0:13:54
34.4	0:14:00
33.4	0:14:10
32.5	0:14:19
31.6	0:14:29
30.2	0:14:43
28.6	0:14:59
26.6	0:15:20
23.4	0:15:53
18.1	0:16:47
4.4	0:19:08
1	0:19:43

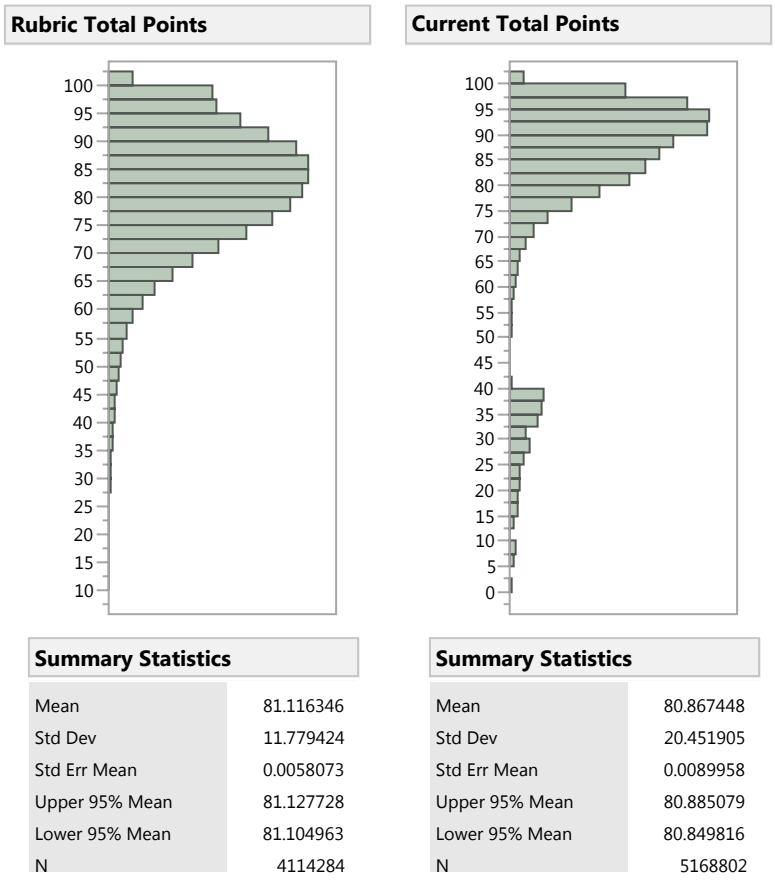


Figure 5: Distributions of Airmen's Score Based on the New Rubric (left) and Current Standards (Right)

Table 25: Failure and Excellent Rate with Different Scoring Rubrics

	Created Rubric	Current Standard	Difference
Failures (Less than 75)	26.20%	18.10%	8.10%
Excellents (Greater than 90)	23.50%	40.20%	-16.70%

The table showing all percentages of Airmen's total scores can be found in Appendix G. Despite a .3-point increase to Airmen's scores on average, a larger percent (8.1%) of Airmen would fail the fitness test and the percentage of Airmen that received excellent scores would

lower (16.7%). To understand how many Airmen score in each scoring bracket, we create Table 26. The scoring rubric we created for the fitness test reflects the shape of performance in the test and is consistent across all fit groups. However, as compared to the old rubric, the new scoring rubric lowers the average passing Airman's score. Considering 40.2% of Airmen were scoring an excellent on the fitness test, we believe that this lowering is an advantageous part of the new rubric. In our opinion, 40.2% of Airmen scoring excellent scores does not accurately reflect the actual fitness levels of Airmen in the Air Force. We must also take in to account, though, that lowering the average score of Airmen causes 8.1% of Airmen who previously passed the test to now fail the Test. To help correct his significant change, if the overall standard of 75 points is lowered to 73 points, only 3.1% more Airmen would fail. On the other hand, if the overall standard is lowered to 70 points, then 2.9% of Airmen who originally failed the test would actually pass with the new test standards. The potential benefits and issues with this difference is discussed further in the chapter 5, along with potential solutions that the Air Force could implement.

Table 26: Where Airmen Fall Within the New Rubric Standards Versus the Current Standard

Scores	New Rubric	Current Standards	Difference
Above 95%	10.50%	17.40%	-6.90%
90-95%	13.00%	22.80%	-9.80%
85-90%	17.30%	18.10%	-0.80%
80-85%	17.60%	14.70%	2.90%
75-80%	15.40%	8.90%	6.50%
70-75%	11.05%	3.60%	7.45%
Below 70%	15.15%	14.50%	0.65%

Summary

This chapter of the thesis dives into the figures, tables, and descriptive statistics of all of the tests and analyses we completed in our study. In this section, we show the descriptive statistics of the database, compare body composition models to determine the best body composition variable for fitness testing, create an alternate body composition scoring method using WtHR, evaluate the scoring sheets for the other three events, create an alternative scoring rubric for run time, push-ups, and sit-ups, and compare the created rubric to the current standard. Through this analysis, we recommend that the Air Force changes the way they conduct the body composition portion of the test as well as use our created scoring rubrics to score Airmen for the aerobic run component of the test as well as for the push-up and sit-up component of the Air Force fitness test.

V. Discussion and Conclusion

The Problem

The Air Force uses AFI 36-2905 to evaluate Airmen's overall fitness levels. Fit Airmen assist the Air Force with their ability to deploy and to do their jobs efficiently despite changing environments and various stressors applied to them. The Air Force also uses the fitness test in conjunction with promotions, awards, and force retainment. Despite the importance of the Air Force Fitness test, the Air Force has yet to use large data to evaluate whether the fitness test accurately evaluates Airmen. This thesis attempts to fill that research gap.

Answering Research Questions

Our research questions from Chapter 1:

Question 1: What Body Composition Metric best explains the variation of aerobic and total fitness among Airmen?

The AFFMS database contains 5.38 million fitness tests. After analyzing this data through model comparisons and non-parametric ranking, we find that using WtHR instead of Waist Circumference, on average, increases the amount of fitness explained by 105%. The total increase in variation explained is 3.65%, which is slightly higher than Dr. Ashwell, Gunn, and Gibson's findings in 2012 of 1-2%. We believe that this difference is due in part to the fact that our data explained fitness through run time, push-ups, and sit-ups, while their data explained health risk. Swiderski's also came to our same conclusion when he evaluated waist circumference and WtHR in his study of Airmen at Wright-Patterson Air Force Base.

Question 2: If another Body Composition Metric better explains fitness levels, how could the Air Force use that metric to better evaluate fitness levels in Airmen?

The scoring rubric we created for WtHR shows both the scoring method and cutoff points for WtHR levels. To maintain a perfect score, Airmen would divide their height by 2 to find their high cutoff for max points and multiply their height by .4 to find their low cutoff for minimum points. The new rubric, when compared to current standards, decreases the average Airman's scores by .15 points and penalizes Airmen who are underweight as well as Airmen who are overweight. Since being both underweight and overweight pose health risks, this change helps the fitness test remain fair and consistent.

Question 3: How well does the current scoring rubric for the 1.5-mile run, Push-ups, and Sit-ups reflect the performance of Airmen in each category?

We find through our analysis that the scoring sheet the Air Force currently uses does not adequately reflect the shape of performance in the 1.5-mile run, push-ups, and sit-up evaluations. We also find that the scoring sheet has statistically different means for different age and gender groups when using an error rate of .001. For these reasons, we conclude that the current scoring standards do not adequately reflect the performance of Airmen that take the Air Force fitness test.

Question 4: What alternative scoring rubrics could score Airmen based unbiasedly on their performance on the 1.5-mile run, Push-ups, and Sit-ups?

We successfully create an equation based on the performance of Airmen in their respective fit groups to create a scoring rubric that has the same means across all age and gender

groups and reflects the same shape of scores for Airmen's performance in each age group. The shape changes with each fit group, but reflects that fit group's individual shape. We also create a rubric using WtHR instead of Waist Circumference to evaluate body composition for the new fitness assessment standards.

Question 5: How would implementing a different Body Composition Metric and Scoring Rubric Affect the Air Force Fitness Test?

We find that using WtHR decreases the average points scored on the body composition portion of the test by approximately .15 points. We also find that implementing the new scoring rubric increases the average total score of an Airman by .3 points (including the new WtHR as the body composition variable), but 8.1% more of the population from 2004-2014 would fail the test and 16.7% less Airmen would receive excellent scores.

Discussion

In the literature review, studies clarified that body composition metrics should be used to assess potential health risk and nothing more. For this reason, the Air Force should use body composition to assess the health risk of Airmen, but not use the metrics to assess fitness levels. We recommend that body composition metrics should not be used in the fitness test because the metrics do not assess physical fitness. Instead, we recommend that Airmen get a yearly medical physical, part of which a body composition test would be applied, so that the Air Force can have an idea of the overall health of each Airman. However, the medical examination should not be linked to physical fitness. If an Airman is deemed unhealthy by medical standards, the Airman should be placed on a "get healthy" plan, which could be taken into consideration for promotion,

retention, or awards. However, this screening should be kept completely separate from a physical fitness test.

Until the body composition metric is taken out of the test, we recommend that WtHR should replace the waist circumference. However, we base this recommendation off of our analysis that WtHR explains more variation in aerobic and total fitness (we base that analysis off of using run time and total fitness as dependent variables).

The scoring rubric we created for the fitness test does reflect the shape of performance in the test and is consistent across all fit groups. However, the new scoring rubric does lower the average passing Airman's score. Considering 40.2% of Airmen were scoring excellent scores on the fitness test, we believe that this is an advantage to the new rubric. In our opinion, 40.2% of Airmen scoring excellent scores does not accurately reflect the actual fitness level of Airmen in the Air Force. However, lowering the average score of Airmen does cause 8.1% of Airmen to fail the test that previously passed. If the overall standard of 75 points is lowered to 73 points, only 3.1% more Airmen would fail, and lowering the overall standard to 70 points would cause 2.9% Airmen who originally failed the test to pass the test with the new standards. More Airmen failing the test could lead to increase in costs for the Air Force due to more Airmen in get well programs and training programs for new Airmen due to unfit Airmen being removed from the Air Force.

Also, given the new shape of the scores, the Air Force could categorize Airmen with failing scores into different groups based on how poorly they performed on the Test. The Air Force could then treat the Airmen differently based on those groups. For example, the Air Force could be less strict in their program to get Airmen with a score of 65-75 to pass the test than an Airman with a score of 10-65.

The benefits of replacing current standards with our new rubric far outweigh any concerns. WtHR, which would be used over waist circumference, better predicts the fitness of an individual and is not biased towards larger people. The change from waist circumference to WtHR costs the Air Force nothing, as everything required to assess WtHR is already currently being accomplished in the present fitness test. The scoring rubric for runtime, push-ups, and sit-ups accurately reflect the distribution of Airmen performance in each section of the test, and is unbiased towards both sex and age. The new rubric incentivizes Airmen to put forth maximum effort, which should lead to better data collection for future analysis and less cynicism about the fitness test. The new scoring method also provides a more accurate picture on the ways in which unfit Airmen can improve themselves to pass the fitness test. Finally, the new rubric offers the opportunity for the Air Force to recognize Airmen that exceed fitness expectations in a more distinguishable way.

Implementing the new scoring sheet will be easy to accomplish. A new AFI would need to be drafted and signed. The fitness test itself would not change and minimal training would be required for graders to make sure they are measuring height as accurately as possible and understand the new standards for scores. Airmen would need information on what the new fitness standards are and time to prepare for the new standards before they are implemented.

In summary, the concerns and issues with the new scoring rubric are easily manageable and the benefits of using the created rubric far outweigh the disadvantages. Fitness testing is too important to the Air Force and Airmen's lives for the test to not reflect Airmen's performance and to be biased towards certain age groups and genders over others. Implementation of the new scoring standards should be quick and testing procedures would remain unchanged. These

standards are available now for use by the Air Force, and could greatly benefit the Air Force in evaluating the fitness of Airmen.

Conclusion

In conclusion, the current Air Force fitness test methods and scoring standards are deemed inadequate by this research team. Our study, which utilizes 5.38 million fitness test records, concludes that changing the abdominal circumference section of the test to a WtHR evaluation and using our created scoring rubrics for the 1.5-mile run, Push-ups, and Sit-ups sections of the test would help the Air Force conduct an unbiased and more accurate evaluation of the fitness levels of the Airmen who take the Test. Implementation of these recommendations would require the Air Force to create a new AFI that replaces waist circumference with WtHR and uses our scoring rubrics as the new fitness assessment charts. It should be noted, however, that the actual way in which the Air Force conducts the fitness test would remain unchanged. Based on our research, we believe the Air Force would benefit from this change because the possession of a more accurate evaluation of fitness will allow the U.S. Air Force to better be able to assess their Airmen's levels of physical fitness.

Appendix A: Fitness Assessment Charts for all Age and Gender Groups

A10.1. Fitness Assessment Chart – Male: Age: < 30.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 9:12	Low-Risk	60.0	≤ 32.5	Low-Risk	20.0	≥ 67	10.0	≥ 58	10.0
9:13 - 9:34	Low-Risk	59.7	33.0	Low-Risk	20.0	62	9.5	55	9.5
9:35 - 9:45	Low-Risk	59.3	33.5	Low-Risk	20.0	61	9.4	54	9.4
9:46 - 9:58	Low-Risk	58.9	34.0	Low-Risk	20.0	60	9.3	53	9.2
9:59 - 10:10	Low-Risk	58.5	34.5	Low-Risk	20.0	59	9.2	52	9.0
10:11 - 10:23	Low-Risk	57.9	35.0	Low-Risk	20.0	58	9.1	51	8.8
10:24 - 10:37	Low-Risk	57.3	35.5	Moderate Risk	17.6	57	9.0	50	8.7
10:38 - 10:51	Low-Risk	56.6	36.0	Moderate Risk	17.0	56	8.9	49	8.5
10:52 - 11:06	Low-Risk	55.7	36.5	Moderate Risk	16.4	55	8.8	48	8.3
11:07 - 11:22	Low-Risk	54.8	37.0	Moderate Risk	15.8	54	8.8	47	8.0
11:23 - 11:38	Low-Risk	53.7	37.5 #	Moderate Risk	15.1	53	8.7	46 #	7.5
11:39 - 11:56	Low-Risk	52.4	38.0	Moderate Risk	14.4	52	8.6	45	7.0
11:57 - 12:14	Low-Risk	50.9	38.5	Moderate Risk	13.5	51	8.5	44	6.5
12:15 - 12:33	Low-Risk	49.2	39.0 *	Moderate Risk	12.6	50	8.4	43	6.3
12:34 - 12:53	Moderate Risk	47.2	39.5	High Risk	0	49	8.3	42 *	6.0
12:54 - 13:14 #	Moderate Risk	44.9	40.0	High Risk	0	48	8.1	41	0
13:15 - 13:36 *	Moderate Risk	42.3	40.5	High Risk	0	47	8.0	40	0
13:37 - 14:00	High Risk	0	41.0	High Risk	0	46	7.8	39	0
14:01 - 14:25	High Risk	0	41.5	High Risk	0	45	7.7	38	0
14:26 - 14:52	High Risk	0	42.0	High Risk	0	44 #	7.5	37	0
14:53 - 15:20	High Risk	0	42.5	High Risk	0	43	7.3	36	0
15:21 - 15:50	High Risk	0	43.0	High Risk	0	42	7.2	35	0
15:51 - 16:22	High Risk	0	≥ 43.5	High Risk	0	41	7.0	34	0
16:23 - 16:57	High Risk	0				40	6.8	33	0
≥ 16:58	High Risk	0				39	6.5	32	0
						38	6.3	31	0
NOTES:						37	6.0	30	0
Health Risk Category = low, moderate or high risk for current and future						36	5.8	≤ 29	0
cardiovascular disease, diabetes, certain cancers, and other health problems						35	5.5		
						34	5.3		
Passing Requirements - member ***must***: 1) meet minimum value in each of						33 *	5.0		
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						32	0		
						31	0		
* Minimum Component Values						30	0		
Run time ≤ 13:36 mins:secs / Abd Circ ≤ 39.0 inches						29	0		
Push-ups ≥ 33 repetitions/one minute / Sit-ups ≥ 42 repetitions/one minute						28	0		
						27	0		
# Target Component Values						26	0		
Member should attain or surpass these to achieve ≥ 75.0 composite score						25	0		
						24	0		
Composite Score Categories						23	0		
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0						22	0		
						21	0		
						20	0		
						19	0		
						18	0		
						≤ 17	0		

A10.2. Fitness Assessment Chart – Male: Age: 30 – 39.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 9:34	Low-Risk	60.0	≤ 32.5	Low-Risk	20.0	≥ 57	10.0	≥ 54	10.0
9:35 - 9:58	Low-Risk	59.3	33.0	Low-Risk	20.0	52	9.5	51	9.5
9:59 - 10:10	Low-Risk	58.6	33.5	Low-Risk	20.0	51	9.4	50	9.4
10:11 - 10:23	Low-Risk	57.9	34.0	Low-Risk	20.0	50	9.3	49	9.2
10:24 - 10:37	Low-Risk	57.3	34.5	Low-Risk	20.0	49	9.2	48	9.0
10:38 - 10:51	Low-Risk	56.6	35.0	Low-Risk	20.0	48	9.2	47	8.8
10:52 - 11:06	Low-Risk	55.7	35.5	Moderate Risk	17.6	47	9.1	46	8.7
11:07 - 11:22	Low-Risk	54.8	36.0	Moderate Risk	17.0	46	9.0	45	8.5
11:23 - 11:38	Low-Risk	53.7	36.5	Moderate Risk	16.4	45	8.9	44	8.3
11:39 - 11:56	Low-Risk	52.4	37.0	Moderate Risk	15.8	44	8.8	43	8.0
11:57 - 12:14	Low-Risk	50.9	37.5 #	Moderate Risk	15.1	43	8.7	42 #	7.5
12:15 - 12:33	Low-Risk	49.2	38.0	Moderate Risk	14.4	42	8.6	41	7.0
12:34 - 12:53	Low-Risk	47.2	38.5	Moderate Risk	13.5	41	8.5	40	6.5
12:54 - 13:14 #	Moderate Risk	44.9	39.0 *	Moderate Risk	12.6	40	8.3	39 *	6.0
13:15 - 13:36	Moderate Risk	42.3	39.5	High Risk	0	39	8.0	38	0
13:37 - 14:00 *	Moderate Risk	39.3	40.0	High Risk	0	38	7.8	37	0
14:01 - 14:25	High Risk	0	40.5	High Risk	0	37	7.7	36	0
14:26 - 14:52	High Risk	0	41.0	High Risk	0	36 #	7.5	35	0
14:53 - 15:20	High Risk	0	41.5	High Risk	0	35	7.3	34	0
15:21 - 15:50	High Risk	0	42.0	High Risk	0	34	7.0	33	0
15:51 - 16:22	High Risk	0	42.5	High Risk	0	33	6.8	32	0
16:23 - 16:57	High Risk	0	43.0	High Risk	0	32	6.7	31	0
≥ 16:58	High Risk	0	≥ 43.5	High Risk	0	31	6.5	30	0
						30	6.0	29	0
NOTES:						29	5.5	28	0
Health Risk Category = low, moderate or high risk for current and future						28	5.3	27	0
cardiovascular disease, diabetes, certain cancers, and other health problems						27 *	5.0	26	0
						26	0	≤ 25	0
Passing Requirements - member ***must***: 1) meet minimum value in each of						25	0		
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						24	0		
						23	0		
* Minimum Component Values						22	0		
Run time ≤ 14:00 mins:secs / Abd Circ ≤ 39.0 inches						21	0		
Push-ups ≥ 27 repetitions/one minute / Sit-ups ≥ 39 repetitions/one minute						20	0		
						19	0		
# Target Component Values						18	0		
Member should attain or surpass these to achieve ≥ 75.0 composite score						17	0		
						16	0		
Composite Score Categories						15	0		
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0						14	0		
						13	0		
						≤ 12	0		

A10.3. Fitness Assessment Chart – Male: Age: 40 - 49

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 9:45	Low-Risk	60.0	≤ 32.5	Low-Risk	20.0	≥ 44	10.0	≥ 50	10.0
9:46 - 10:10	Low-Risk	59.8	33.0	Low-Risk	20.0	40	9.5	47	9.5
10:11 - 10:23	Low-Risk	59.5	33.5	Low-Risk	20.0	39	9.4	46	9.4
10:24 - 10:37	Low-Risk	59.1	34.0	Low-Risk	20.0	38	9.2	45	9.2
10:38 - 10:51	Low-Risk	58.7	34.5	Low-Risk	20.0	37	9.1	44	9.1
10:52 - 11:06	Low-Risk	58.3	35.0	Low-Risk	20.0	36	9.0	43	9.0
11:07 - 11:22	Low-Risk	57.7	35.5	Moderate Risk	17.6	35	8.8	42	8.8
11:23 - 11:38	Low-Risk	57.1	36.0	Moderate Risk	17.0	34	8.5	41	8.7
11:39 - 11:56	Low-Risk	56.3	36.5	Moderate Risk	16.4	33	8.4	40	8.5
11:57 - 12:14	Low-Risk	55.4	37.0	Moderate Risk	15.8	32	8.3	39	8.0
12:15 - 12:33	Low-Risk	54.3	37.5 #	Moderate Risk	15.1	31	8.1	38	7.8
12:34 - 12:53	Low-Risk	53.1	38.0	Moderate Risk	14.4	30	8.0	37 #	7.5
12:54 - 13:14	Low-Risk	51.5	38.5	Moderate Risk	13.5	29 #	7.5	36	7.0
13:15 - 13:36	Low-Risk	49.8	39.0 *	Moderate Risk	12.6	28	7.3	35	6.5
13:37 - 14:00	Moderate Risk	47.7	39.5	High Risk	0	27	7.2	34 *	6.0
14:01 - 14:25 #	Moderate Risk	45.2	40.0	High Risk	0	26	7.0	33	0
14:26 - 14:52 *	Moderate Risk	42.3	40.5	High Risk	0	25	6.5	32	0
14:53 - 15:20	High Risk	0	41.0	High Risk	0	24	6.0	31	0
15:21 - 15:50	High Risk	0	41.5	High Risk	0	23	5.8	30	0
15:51 - 16:22	High Risk	0	42.0	High Risk	0	22	5.5	29	0
16:23 - 16:57	High Risk	0	42.5	High Risk	0	21 *	5.0	28	0
16:58 - 17:34	High Risk	0	43.0	High Risk	0	20	0	27	0
17:35 - 18:14	High Risk	0	≥ 43.5	High Risk	0	19	0	26	0
≥ 18:15	High Risk	0				18	0	25	0
						17	0	24	0
NOTES:						16	0	23	0
Health Risk Category = low, moderate or high risk for current and future						15	0	22	0
cardiovascular disease, diabetes, certain cancers, and other health problems						14	0	≤ 21	0
						13	0		
Passing Requirements - member ***must***: 1) meet minimum value in each of						12	0		
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						11	0		
						10	0		
* Minimum Component Values						9	0		
Run time ≤ 14:52 mins:secs / Abd Circ ≤ 39.0 inches						≤ 8	0		
Push-ups ≥ 21 repetitions/one minute / Sit-ups ≥ 34 repetitions/one minute									
# Target Component Values									
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.4. Fitness Assesment Chart – Male: Age: 50 – 59.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 10:37	Low-Risk	60.0	≤ 32.5	Low-Risk	20.0	≥ 44	10.0	≥ 46	10.0
10:38 - 11:06	Low-Risk	59.7	33.0	Low-Risk	20.0	39	9.5	43	9.5
11:07 - 11:22	Low-Risk	59.4	33.5	Low-Risk	20.0	38	9.4	42	9.4
11:23 - 11:38	Low-Risk	59.0	34.0	Low-Risk	20.0	37	9.4	41	9.2
11:39 - 11:56	Low-Risk	58.5	34.5	Low-Risk	20.0	36	9.3	40	9.1
11:57 - 12:14	Low-Risk	58.0	35.0	Low-Risk	20.0	35	9.3	39	9.0
12:15 - 12:33	Low-Risk	57.3	35.5	Moderate Risk	17.6	34	9.2	38	8.8
12:34 - 12:53	Low-Risk	56.5	36.0	Moderate Risk	17.0	33	9.2	37	8.7
12:54 - 13:14	Low-Risk	55.6	36.5	Moderate Risk	16.4	32	9.1	36	8.5
13:15 - 13:36	Low-Risk	54.5	37.0	Moderate Risk	15.8	31	9.1	35	8.0
13:37 - 14:00	Low-Risk	53.3	37.5 #	Moderate Risk	15.1	30	9.0	34	7.8
14:01 - 14:25	Low-Risk	51.8	38.0	Moderate Risk	14.4	29	8.8	33 #	7.5
14:26 - 14:52	Low-Risk	50.0	38.5	Moderate Risk	13.5	28	8.5	32	7.3
14:53 - 15:20	Moderate Risk	47.9	39.0 *	Moderate Risk	12.6	27	8.3	31	7.0
15:21 - 15:50 #	Moderate Risk	45.4	39.5	High Risk	0	26	8.2	30	6.5
15:51 - 16:22 *	Moderate Risk	42.4	40.0	High Risk	0	25	8.0	29	6.3
16:23 - 16:57	High Risk	0	40.5	High Risk	0	24 #	7.5	28 *	6.0
16:58 - 17:34	High Risk	0	41.0	High Risk	0	23	7.3	27	0
17:35 - 18:14	High Risk	0	41.5	High Risk	0	22	7.2	26	0
18:15 - 18:56	High Risk	0	42.0	High Risk	0	21	7.0	25	0
18:57 - 19:43	High Risk	0	42.5	High Risk	0	20	6.5	24	0
19:44 - 20:33	High Risk	0	43.0	High Risk	0	19	6.0	23	0
≥ 20:34	High Risk	0	≥ 43.5	High Risk	0	18	5.8	22	0
						17	5.5	21	0
NOTES:						16	5.3	20	0
Health Risk Category = low, moderate or high risk for current and future						15 *	5.0	19	0
cardiovascular disease, diabetes, certain cancers, and other health problems						14	0	18	0
						13	0	17	0
Passing Requirements - member ***must***: 1) meet minimum value in each of						12	0	16	0
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						11	0	15	0
						10	0	≤ 14	0
* Minimum Component Values						9	0		
Run time ≤ 16:22 mins:secs / Abd Circ ≤ 39.0 inches						8	0		
Push-ups ≥ 15 repetitions/one minute / Sit-ups ≥ 28 repetitions/one minute						7	0		
						6	0		
# Target Component Values						≤ 5	0		
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.5. Fitness Assessment Chart – Female: Male: AGE: 60+.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 11:22	Low-Risk	60.0	≤ 32.5	Low-Risk	20.0	≥ 30	10.0	≥ 42	10.0
11:23 - 11:56	Low-Risk	59.7	33.0	Low-Risk	20.0	28	9.5	39	9.5
11:57 - 12:14	Low-Risk	59.4	33.5	Low-Risk	20.0	27	9.3	38	9.4
12:15 - 12:33	Low-Risk	59.0	34.0	Low-Risk	20.0	26	9.0	37	9.2
12:34 - 12:53	Low-Risk	58.5	34.5	Low-Risk	20.0	25	8.8	36	9.1
12:54 - 13:14	Low-Risk	58.0	35.0	Low-Risk	20.0	24	8.5	35	9.0
13:15 - 13:36	Low-Risk	57.3	35.5	Moderate Risk	17.6	23	8.0	34	8.9
13:37 - 14:00	Low-Risk	56.5	36.0	Moderate Risk	17.0	22 #	7.5	33	8.8
14:01 - 14:25	Low-Risk	55.6	36.5	Moderate Risk	16.4	21	7.0	32	8.6
14:26 - 14:52	Low-Risk	54.5	37.0	Moderate Risk	15.8	20	6.5	31	8.5
14:53 - 15:20	Low-Risk	53.3	37.5 #	Moderate Risk	15.1	19	6.3	30	8.0
15:21 - 15:50	Low-Risk	51.8	38.0	Moderate Risk	14.4	18	6.0	29	7.8
15:51 - 16:22	Low-Risk	50.0	38.5	Moderate Risk	13.5	17	5.8	28 #	7.5
16:23 - 16:57	Moderate Risk	47.9	39.0 *	Moderate Risk	12.6	16	5.5	27	7.3
16:58 - 17:34 #	Moderate Risk	45.4	39.5	High Risk	0	15	5.3	26	7.0
17:35 - 18:14 *	Moderate Risk	42.4	40.0	High Risk	0	14 *	5.0	25	6.8
18:15 - 18:56	High Risk	0	40.5	High Risk	0	13	0	24	6.5
18:57 - 19:43	High Risk	0	41.0	High Risk	0	12	0	23	6.3
19:44 - 20:33	High Risk	0	41.5	High Risk	0	11	0	22 *	6.0
20:34 - 21:28	High Risk	0	42.0	High Risk	0	10	0	21	0
21:29 - 22:28	High Risk	0	42.5	High Risk	0	9	0	20	0
22:29 - 23:34	High Risk	0	43.0	High Risk	0	8	0	19	0
≥ 23:35	High Risk	0	≥ 43.5	High Risk	0	7	0	18	0
						6	0	17	0
NOTES:						5	0	16	0
Health Risk Category = low, moderate or high risk for current and future						4	0	15	0
cardiovascular disease, diabetes, certain cancers, and other health problems						≤ 3	0	14	0
								13	0
Passing Requirements - member ***must***: 1) meet minimum value in each of								12	0
the four components, ***and*** 2) achieve a composite point total ≥ 75 points								11	0
								10	0
* Minimum Component Values								≤ 9	0
Run time ≤ 18:14 mins:secs / Abd Circ ≤ 39.0 inches									
Push-ups ≥ 14 repetitions/one minute / Sit-ups ≥ 22 repetitions/one minute									
# Target Component Values									
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.6. Fitness Assessment Chart – Female: Age: < 30.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 10:23	Low-Risk	60.0	≤ 29.0	Low Risk	20.0	≥ 47	10.0	≥ 54	10.0
10:24 - 10:51	Low-Risk	59.9	29.5	Low Risk	20.0	42	9.5	51	9.5
10:52 - 11:06	Low-Risk	59.5	30.0	Low Risk	20.0	41	9.4	50	9.4
11:07 - 11:22	Low-Risk	59.2	30.5	Low Risk	20.0	40	9.3	49	9.0
11:23 - 11:38	Low-Risk	58.9	31.0	Low Risk	20.0	39	9.2	48	8.9
11:39 - 11:56	Low-Risk	58.6	31.5	Low Risk	20.0	38	9.1	47	8.8
11:57 - 12:14	Low-Risk	58.1	32.0	Moderate Risk	17.6	37	9.0	46	8.6
12:15 - 12:33	Low-Risk	57.6	32.5	Moderate Risk	17.1	36	8.9	45	8.5
12:34 - 12:53	Low-Risk	57.0	33.0	Moderate Risk	16.5	35	8.8	44	8.0
12:54 - 13:14	Low-Risk	56.2	33.5	Moderate Risk	15.9	34	8.6	43	7.8
13:15 - 13:36	Low-Risk	55.3	34.0 #	Moderate Risk	15.2	33	8.5	42 #	7.5
13:37 - 14:00	Low-Risk	54.2	34.5	Moderate Risk	14.5	32	8.4	41	7.0
14:01 - 14:25	Low-Risk	52.8	35.0	Moderate Risk	13.7	31	8.3	40	6.8
14:26 - 14:52	Low-Risk	51.2	35.5 *	Moderate Risk	12.8	30	8.2	39	6.5
14:53 - 15:20	Moderate Risk	49.3	36.0	High Risk	0	29	8.1	38 *	6.0
15:21 - 15:50 #	Moderate Risk	46.9	36.5	High Risk	0	28	8.0	37	0
15:51 - 16:22 *	Moderate Risk	44.1	37.0	High Risk	0	27 #	7.5	36	0
16:23 - 16:57	High Risk	0	37.5	High Risk	0	26	7.3	35	0
16:58 - 17:34	High Risk	0	38.0	High Risk	0	25	7.2	34	0
17:35 - 18:14	High Risk	0	38.5	High Risk	0	24	7.0	33	0
18:15 - 18:56	High Risk	0	39.0	High Risk	0	23	6.5	32	0
18:57 - 19:43	High Risk	0	39.5	High Risk	0	22	6.3	31	0
19:44 - 20:33	High Risk	0	≥ 40.0	High Risk	0	21	6.0	30	0
≥ 20:34	High Risk	0				20	5.8	29	0
						19	5.5	28	0
NOTES:						18 *	5.0	27	0
Health Risk Category = low, moderate or high risk for current and future						17	0	26	0
cardiovascular disease, diabetes, certain cancers, and other health problems						16	0	25	0
						15	0	24	0
Passing Requirements - member ***must***: 1) meet minimum value in each of						14	0	23	0
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						13	0	≤ 22	0
						12	0		
* Minimum Component Values						11	0		
Run time ≤ 16:22 mins:secs / Abd Circ ≤ 35.5 inches						10	0		
Push-ups ≥ 18 repetitions/one minute / Sit-ups ≥ 38 repetitions/one minute						9	0		
						8	0		
# Target Component Values						≤ 7	0		
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.7. Fitness Assessment Chart – Female: Age: 30-39.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 10:51	Low-Risk	60.0	≤ 29.0	Low Risk	20.0	≥ 46	10.0	≥ 45	10.0
10:52 - 11:22	Low-Risk	59.5	29.5	Low Risk	20.0	40	9.5	42	9.5
11:23 - 11:38	Low-Risk	59.0	30.0	Low Risk	20.0	39	9.4	41	9.4
11:39 - 11:56	Low-Risk	58.6	30.5	Low Risk	20.0	38	9.3	40	9.0
11:57 - 12:14	Low-Risk	58.1	31.0	Low Risk	20.0	37	9.3	39	8.8
12:15 - 12:33	Low-Risk	57.6	31.5	Low Risk	20.0	36	9.2	38	8.5
12:34 - 12:53	Low-Risk	57.0	32.0	Moderate Risk	17.6	35	9.1	37	8.3
12:54 - 13:14	Low-Risk	56.2	32.5	Moderate Risk	17.1	34	9.1	36	8.2
13:15 - 13:36	Low-Risk	55.3	33.0	Moderate Risk	16.5	33	9.0	35	8.0
13:37 - 14:00	Low-Risk	54.2	33.5	Moderate Risk	15.9	32	8.9	34	7.8
14:01 - 14:25	Low-Risk	52.8	34.0 #	Moderate Risk	15.2	31	8.9	33 #	7.5
14:26 - 14:52	Low-Risk	51.2	34.5	Moderate Risk	14.5	30	8.8	32	7.0
14:53 - 15:20	Low-Risk	49.3	35.0	Moderate Risk	13.7	29	8.7	31	6.8
15:21 - 15:50 #	Moderate Risk	46.9	35.5 *	Moderate Risk	12.8	28	8.6	30	6.5
15:51 - 16:22	Moderate Risk	44.1	36.0	High Risk	0	27	8.6	29 *	6.0
16:23 - 16:57 *	Moderate Risk	40.8	36.5	High Risk	0	26	8.5	28	0
16:58 - 17:34	High Risk	0	37.0	High Risk	0	25	8.3	27	0
17:35 - 18:14	High Risk	0	37.5	High Risk	0	24	8.2	26	0
18:15 - 18:56	High Risk	0	38.0	High Risk	0	23	8.0	25	0
18:57 - 19:43	High Risk	0	38.5	High Risk	0	22	7.9	24	0
19:44 - 20:33	High Risk	0	39.0	High Risk	0	21	7.8	23	0
≥ 20:34	High Risk	0	39.5	High Risk	0	20	7.6	22	0
			≥ 40.0	High Risk	0	19 #	7.5	21	0
						18	7.0	20	0
NOTES:						17	6.8	19	0
Health Risk Category = low, moderate or high risk for current and future						16	6.5	18	0
cardiovascular disease, diabetes, certain cancers, and other health problems						15	6.0	17	0
						14 *	5.0	16	0
Passing Requirements - member ***must***: 1) meet minimum value in each of						13	0	15	0
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						12	0	≤ 14	0
						11	0		
* Minimum Component Values						10	0		
Run time ≤ 16:57 mins:secs / Abd Circ ≤ 35.5 inches						9	0		
Push-ups ≥ 14 repetitions/one minute / Sit-ups ≥ 29 repetitions/one minute						8	0		
						7	0		
# Target Component Values						6	0		
Member should attain or surpass these to achieve ≥ 75.0 composite score						≤ 5	0		
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.8. Fitness Assessment Chart – Female: Age: 40-49.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 11:22	Low-Risk	60.0	≤ 29.0	Low Risk	20.0	≥ 38	10.0	≥ 41	10.0
11:23 - 11:56	Low-Risk	59.9	29.5	Low Risk	20.0	33	9.5	38	9.5
11:57 - 12:14	Low-Risk	59.8	30.0	Low Risk	20.0	32	9.4	37	9.4
12:15 - 12:33	Low-Risk	59.6	30.5	Low Risk	20.0	31	9.2	36	9.2
12:34 - 12:53	Low-Risk	59.4	31.0	Low Risk	20.0	30	9.1	35	9.1
12:54 - 13:14	Low-Risk	59.1	31.5	Low Risk	20.0	29	9.0	34	9.0
13:15 - 13:36	Low-Risk	58.7	32.0	Moderate Risk	17.6	28	8.9	33	8.8
13:37 - 14:00	Low-Risk	58.2	32.5	Moderate Risk	17.1	27	8.8	32	8.5
14:01 - 14:25	Low-Risk	57.7	33.0	Moderate Risk	16.5	26	8.7	31	8.3
14:26 - 14:52	Low-Risk	56.9	33.5	Moderate Risk	15.9	25	8.6	30	8.2
14:53 - 15:20	Low-Risk	56.0	34.0 #	Moderate Risk	15.2	24	8.6	29	8.0
15:21 - 15:50	Low-Risk	54.8	34.5	Moderate Risk	14.5	23	8.5	28 #	7.5
15:51 - 16:22	Low-Risk	53.3	35.0	Moderate Risk	13.7	22	8.4	27	7.0
16:23 - 16:57	Moderate Risk	51.4	35.5 *	Moderate Risk	12.8	21	8.3	26	6.8
16:58 - 17:34	Moderate Risk	49.0	36.0	High Risk	0	20	8.2	25	6.4
17:35 - 18:14 *#	Moderate Risk	45.9	36.5	High Risk	0	19	8.1	24 *	6.0
18:15 - 18:56	High Risk	0	37.0	High Risk	0	18	8.0	23	0
18:57 - 19:43	High Risk	0	37.5	High Risk	0	17	7.8	22	0
19:44 - 20:33	High Risk	0	38.0	High Risk	0	16 #	7.5	21	0
20:34 - 21:28	High Risk	0	38.5	High Risk	0	15	7.0	20	0
21:29 - 22:28	High Risk	0	39.0	High Risk	0	14	6.5	19	0
≥ 22:29	High Risk	0	39.5	High Risk	0	13	6.0	18	0
			≥ 40.0	High Risk	0	12	5.5	17	0
						11 *	5.0	16	0
NOTES:						10	0	15	0
Health Risk Category = low, moderate or high risk for current and future						9	0	14	0
cardiovascular disease, diabetes, certain cancers, and other health problems						8	0	13	0
						7	0	12	0
Passing Requirements - member ***must***: 1) meet minimum value in each of						6	0	11	0
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						5	0	10	0
						4	0	≤ 9	0
* Minimum Component Values						≤ 3	0		
Run time ≤ 18:14 mins:secs / Abd Circ ≤ 35.5 inches									
Push-ups ≥ 11 repetitions/one minute / Sit-ups ≥ 24 repetitions/one minute									
# Target Component Values									
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.9. Fitness Assessment Chart – Female: Age: 50-59.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 12:53	Low-Risk	60.0	≤ 29.0	Low Risk	20.0	≥ 35	10.0	≥ 32	10.0
12:54 - 13:36	Low-Risk	59.8	29.5	Low Risk	20.0	30	9.5	30	9.5
13:37 - 14:00	Low-Risk	59.6	30.0	Low Risk	20.0	29	9.4	29	9.0
14:01 - 14:25	Low-Risk	59.3	30.5	Low Risk	20.0	28	9.3	28	8.9
14:26 - 14:52	Low-Risk	58.9	31.0	Low Risk	20.0	27	9.2	27	8.8
14:53 - 15:20	Low-Risk	58.4	31.5	Low Risk	20.0	26	9.1	26	8.6
15:21 - 15:50	Low-Risk	57.7	32.0	Moderate Risk	17.6	25	9.0	25	8.5
15:51 - 16:22	Low-Risk	56.8	32.5	Moderate Risk	17.1	24	8.8	24	8.0
16:23 - 16:57	Low-Risk	55.6	33.0	Moderate Risk	16.5	23	8.7	23 #	7.5
16:58 - 17:34	Low-Risk	54.0	33.5	Moderate Risk	15.9	22	8.6	22	7.0
17:35 - 18:14	Low-Risk	51.9	34.0 #	Moderate Risk	15.2	21	8.6	21	6.5
18:15 - 18:56	Moderate Risk	49.2	34.5	Moderate Risk	14.5	20	8.5	20 *	6.0
18:57 - 19:43 *#	Moderate Risk	45.5	35.0	Moderate Risk	13.7	19	8.4	19	0
19:44 - 20:33	High Risk	0	35.5 *	Moderate Risk	12.8	18	8.3	18	0
20:34 - 21:28	High Risk	0	36.0	High Risk	0	17	8.2	17	0
21:29 - 22:28	High Risk	0	36.5	High Risk	0	16	8.1	16	0
22:29 - 23:34	High Risk	0	37.0	High Risk	0	15	8.0	15	0
≥ 23:35	High Risk	0	37.5	High Risk	0	14 #	7.5	14	0
			38.0	High Risk	0	13	7.0	13	0
			38.5	High Risk	0	12	6.5	12	0
			39.0	High Risk	0	11	6.0	11	0
			39.5	High Risk	0	10	5.5	10	0
			≥ 40.0	High Risk	0	9 *	5.0	9	0
						8	0	8	0
NOTES:						7	0	7	0
Health Risk Category = low, moderate or high risk for current and future						6	0	6	0
cardiovascular disease, diabetes, certain cancers, and other health problems						5	0	≤ 5	0
						4	0		
Passing Requirements - member ***must***: 1) meet minimum value in each of						3	0		
the four components, ***and*** 2) achieve a composite point total ≥ 75 points						≤2	0		
* Minimum Component Values									
Run time ≤ 19:43 mins:secs / Abd Circ ≤ 35.5 inches									
Push-ups ≥ 9 repetitions/one minute / Sit-ups ≥ 20 repetitions/one minute									
# Target Component Values									
Member should attain or surpass these to achieve ≥ 75.0 composite score									
Composite Score Categories									
Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0									

A10.10. Fitness Assessment Chart – Female: Age: 60+.

Cardiorespiratory Endurance			Body Composition			Muscle Fitness			
Run Time (mins:secs)	Health Risk Category	Points	AC (inches)	Health Risk Category	Points	Push-ups (reps/min)	Points	Sit-ups (reps/min)	Points
≤ 14:00	Low-Risk	60.0	≤ 29.0	Low Risk	20.0	≥ 21	10.0	≥ 31	10.0
14:01 - 14:52	Low-Risk	59.8	29.5	Low Risk	20.0	19	9.5	28	9.5
14:53 - 15:20	Low-Risk	59.5	30.0	Low Risk	20.0	18	9.4	27	9.4
15:21 - 15:50	Low-Risk	59.1	30.5	Low Risk	20.0	17	9.0	26	9.0
15:51 - 16:22	Low-Risk	58.6	31.0	Low Risk	20.0	16	8.8	25	8.9
16:23 - 16:57	Low-Risk	57.9	31.5	Low Risk	20.0	15	8.5	24	8.8
16:58 - 17:34	Low-Risk	57.0	32.0	Moderate Risk	17.6	14	8.0	23	8.7
17:35 - 18:14	Low-Risk	55.8	32.5	Moderate Risk	17.1	13 #	7.5	22	8.6
18:15 - 18:56	Low-Risk	54.2	33.0	Moderate Risk	16.5	12	7.0	21	8.5
18:57 - 19:43	Low-Risk	52.1	33.5	Moderate Risk	15.9	11	6.5	20	8.4
19:44 - 20:33	Moderate Risk	49.3	34.0 #	Moderate Risk	15.2	10	6.0	19	8.3
20:34 - 21:28 #	Moderate Risk	45.6	34.5	Moderate Risk	14.5	9	5.7	18	8.2
21:29 - 22:28 *	Moderate Risk	40.8	35.0	Moderate Risk	13.7	8	5.3	17	8.0
22:29 - 23:34	High Risk	0	35.5 *	Moderate Risk	12.8	7 *	5.0	16	7.8
23:35 - 24:46	High Risk	0	36.0	High Risk	0	6	0	15 #	7.5
24:47 - 26:06	High Risk	0	36.5	High Risk	0	5	0	14	7.3
≥ 26:07	High Risk	0	37.0	High Risk	0	4	0	13	7.0
			37.5	High Risk	0	3	0	12	6.5
			38.0	High Risk	0	2	0	11 *	6.0
			38.5	High Risk	0	≤1	0	10	0
			39.0	High Risk	0			9	0
			39.5	High Risk	0			8	0
			≥ 40.0	High Risk	0			7	0
								6	0
								5	0
								4	0
								3	0
								2	0
								≤ 1	0

NOTES:

Health Risk Category = low, moderate or high risk for current and future cardiovascular disease, diabetes, certain cancers, and other health problems

Passing Requirements - member ***must***: 1) meet minimum value in each of the four components, ***and*** 2) achieve a composite point total ≥ 75 points

* Minimum Component Values

Run time ≤ 22:28 mins:secs / Abd Circ ≤ 35.5 inches

Push-ups ≥ 7 repetitions/one minute / Sit-ups ≥ 11 repetitions/one minute

Target Component Values

Member should attain or surpass these to achieve ≥ 75.0 composite score

Composite Score Categories

Excellent ≥ 90.0 pts / Satisfactory = 75.0 - 89.9 / Unsatisfactory < 75.0

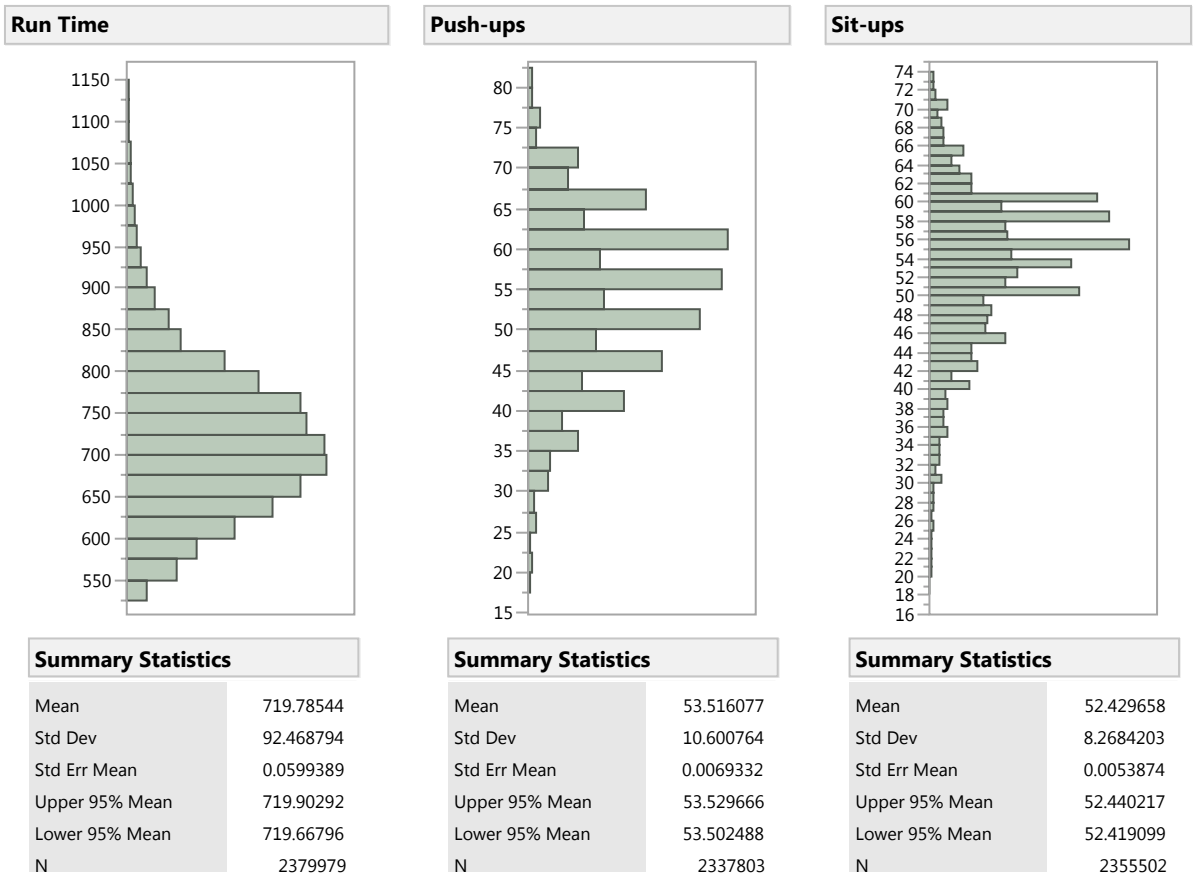
Appendix B: Description of Raw Database Columns

Collumn Name	Actions	Explanation
PERSONNEL_RECORD_ID	Altered then Kept	Identificantion of the Airman
HEIGHT	Kept and Cleaned	Height of Airman
WEIGHT	Kept and Cleaned	Weight of Airman
ABD_CIRC	Kept and Cleaned	Abdominal Circumference of Airman
ABD_EXEMPT	Not Used	If the Airman was exempt
AERO_TEST_NAME	Only the 1.5 Mile Run Records were kept	The name of the Aerobic test taken
AERO_SCORE	Kept and Cleaned	The Airman's score for the Aerobic test
AERO_EXEMPT	Not Used	If the Airman was exempt
PUSHUP_COUNT	Kept and Cleaned	Number of push-ups the Airman performed
PUSHUP_EXEMPT	Not Used	If the Airman was exempt
CRUNCH_COUNT	Kept and Cleaned	Number of sit-ups the Airman performed
CRUNCH_EXEMPT	Not Used	If the Airman was exempt
ASSIGNED_UNIT	Removed to Avoid Giving Away Personal Information	Unit the Airman was currently assigned to
TEST_DATETIME	Kept and Cleaned	Test Date
FITNESS_LEVEL	Not Used	Fitness Level of the Airman
TEST_EXEMPT	Not Used	If the Airman was exempt
TEST_EXEMPT_JUSTIFICATION	Not Used	Justification for exemption
TEST_EXEMPT_NOTE	Not Used	Note about exemption justification
LAST_CHANGED_BY_PR_ID	Removed to Avoid Giving Away Personal Information	The ID of the Airman who last updated the record
LAST_CHANGED_BY_DATE	Removed	The date of the last update to the record
LAST_CHANGED_BY_LNAME	Removed to Avoid Giving Away Personal Information	The last name of the Airman who last updated the record
ACTIVE	Kept and Cleaned	If the Airman was active duty
BODY_MASS_INDEX	Kept and Cleaned	Body Mass Index of the Airman
ASSIGNED_PASCODE	Removed to Avoid Giving Away Personal Information	Passcode of the Airman
CURRENT_RECORD_FLAG	Not Used	If the record was flagged

Collumn Name	Actions	Explanation
TEST_DATE	Kept and Cleaned	Test Date
NEXT_TEST_DUE_DATE	Not Used	Next Due Date for the Airman to take the test
TEST_EXEMPT_EXPIRE_DATE	Not Used	When the Airman's Test Exemption Form expires
ABD_EXEMPT_EXPIRE_DATE	Not Used	When the Airman's Test Exemption Form expires
ABD_EXEMPT_START_DATE	Not Used	When the Airman's Test Exemption Form started
AERO_EXEMPT_EXPIRE_DATE	Not Used	When the Airman's Test Exemption Form expires
AERO_EXEMPT_START_DATE	Not Used	When the Airman's Test Exemption Form started
CRUNCH_EXEMPT_EXPIRE_DATE	Not Used	When the Airman's Test Exemption Form expires
CRUNCH_EXEMPT_START_DATE	Not Used	When the Airman's Test Exemption Form started
PUSHUP_EXEMPT_EXPIRE_DATE	Not Used	When the Airman's Test Exemption Form expires
PUSHUP_EXEMPT_START_DATE	Not Used	When the Airman's Test Exemption Form started
COMPOSITE_SCORE	Kept and Cleaned	Total Score the Airman received
ABD_POINTS	Kept and Cleaned	Total Points from the abdominal cicumference section
AERO_POINTS	Kept and Cleaned	Total Points from the abdominal aerobic section
PUSHUP_POINTS	Kept and Cleaned	Total Points from the abdominal push-up section
CRUNCH_POINTS	Kept and Cleaned	Total Points from the abdominal sit-up section
CATEGORY	Not Used	Not explained
SEX	Kept and Cleaned	Sex of the Airman
GRADE	Not Used	Grade of the Airman
DOB	Check Age With DOB then removed	Date of Birth of the Airman
AGE	Kept and Cleaned	Age of the Airman
FITGROUP	Kept and Cleaned	Fitgroup the Airman was currently in
PUSHUP_PF	Not Used	If the Airman passed the push-up portion
CRUNCH_PF	Not Used	If the Airman passed the push-up portion
AERO_PF	Not Used	If the Airman passed the push-up portion
ABD_PF	Not Used	If the Airman passed the push-up portion
PASSFAIL	Not Used	If the Airman passed the test
seqno	Not Used	Not explained

Appendix C: M20 Example of Rubric Creation Process

First, we find the descriptive statistics for M20. These are shown below:



Summary Statistics	
Mean	719.78544
Std Dev	92.468794
Std Err Mean	0.0599389
Upper 95% Mean	719.90292
Lower 95% Mean	719.66796
N	2379979

Summary Statistics	
Mean	53.516077
Std Dev	10.600764
Std Err Mean	0.0069332
Upper 95% Mean	53.529666
Lower 95% Mean	53.502488
N	2337803

Summary Statistics	
Mean	52.429658
Std Dev	8.2684203
Std Err Mean	0.0053874
Upper 95% Mean	52.440217
Lower 95% Mean	52.419099
N	2355502

Next, we created a column in JMP using the formula for M20 Run Time:

$$Score = 46 - \frac{\left(x - \mu(Age\ Group\ Run\ Time)\right)}{\sigma(Age\ Group\ Run\ Time)} * \frac{Range\ (Age\ Group\ Run\ Time)}{\sigma(Age\ Group\ Run\ Time)}$$

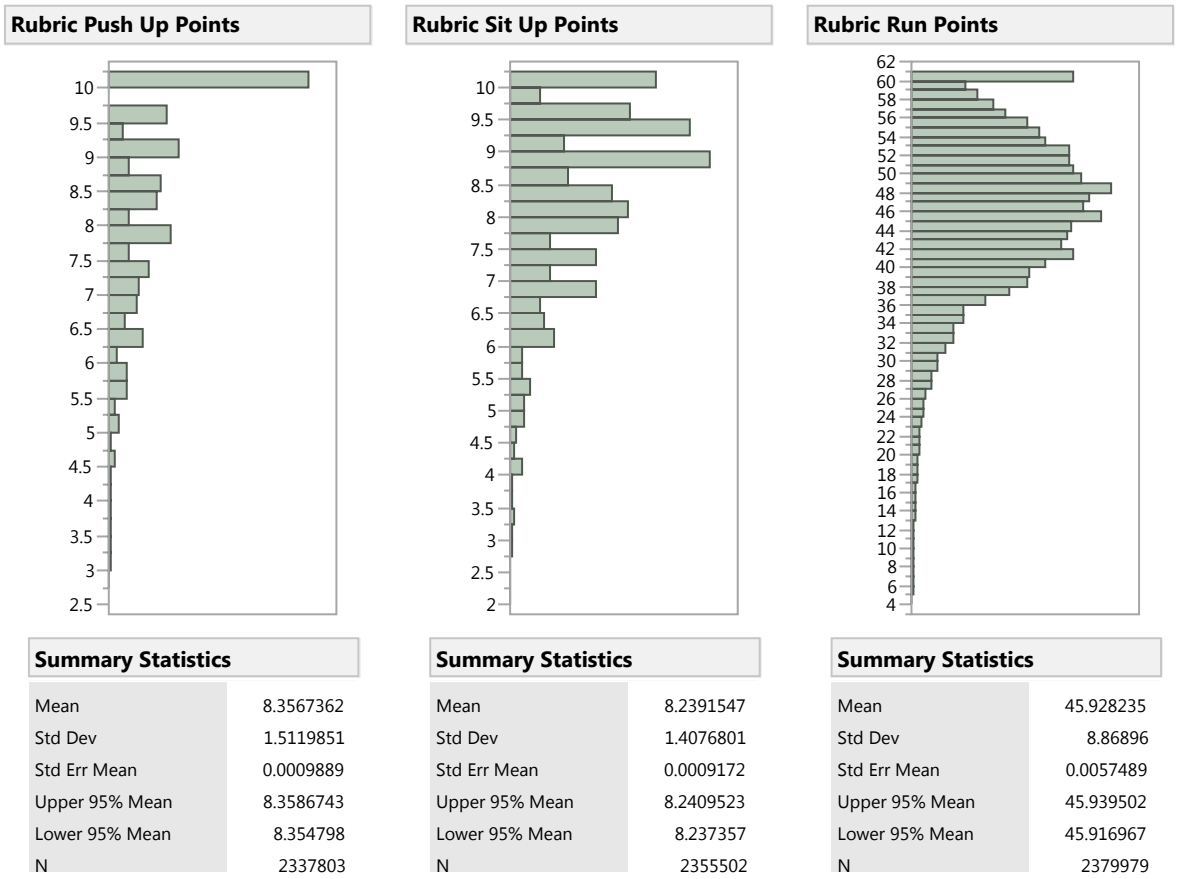
The formula for push-ups was

$$Score = 8.5 - \frac{\left(x - \mu(Age\ Group\ Push - Up)\right)}{\sigma(Age\ Group\ Push - Up)} * \frac{Range\ (Age\ Group\ Push - Up)}{\sigma(Age\ Group\ Push - Up)}$$

The formula for sit-ups:

$$Score = 8.5 - \frac{\left(x - \mu(Age\ Group\ Sit - Up)\right)}{\sigma(Age\ Group\ Sit - Up)} * \frac{Range\ (Age\ Group\ Sit - Up)}{\sigma(Age\ Group\ Sit - Up)}$$

In JMP, we created a conditional formula that used the formulas above if the Airman did not hit the threshold needed to achieve a maximum score. This threshold was calculated using the formulas above, and inserting the maximum score in it. Next, we look at the distribution of rubric scores based on our formulas:



Summary Statistics	
Mean	8.3567362
Std Dev	1.5119851
Std Err Mean	0.0009889
Upper 95% Mean	8.3586743
Lower 95% Mean	8.354798
N	2337803

Summary Statistics	
Mean	8.2391547
Std Dev	1.4076801
Std Err Mean	0.0009172
Upper 95% Mean	8.2409523
Lower 95% Mean	8.237357
N	2355502

Summary Statistics	
Mean	45.928235
Std Dev	8.86896
Std Err Mean	0.0057489
Upper 95% Mean	45.939502
Lower 95% Mean	45.916967
N	2379979

These distributions generally have the same shape of run time (flipped because lower run times equal better scores), push-ups, and sit-ups above. However, the average scores are not exactly 46, 8.5, and 8.3. This is due to the top part of the distributions being cut off (maximum scores were 62, 12, and 12 respectively). This is where the Balance variable comes in. We applied the formula below to fix this issue:

$$Balance = \frac{(Average\ Score\ Desired - Average\ Score\ for\ Fit\ Group)}{\frac{(Total\ Airmen\ in\ Fit\ Group - Total\ Airmen\ Who\ Received\ a\ Max\ Score)}{Total\ Airmen\ in\ Fit\ Group}}$$

The total airmen who received a max score was found by selecting all rows that got a score of 62 or higher and recording the number. This number for M20 run time was 19,973. The other numbers needed can be found in the descriptive statistics for run time. As an example, we plugged the formula in for Run Time:

$$Balance = \frac{(46-45.92824)}{\frac{(2379979-101019)}{2379979}} = 0.07494611267201$$

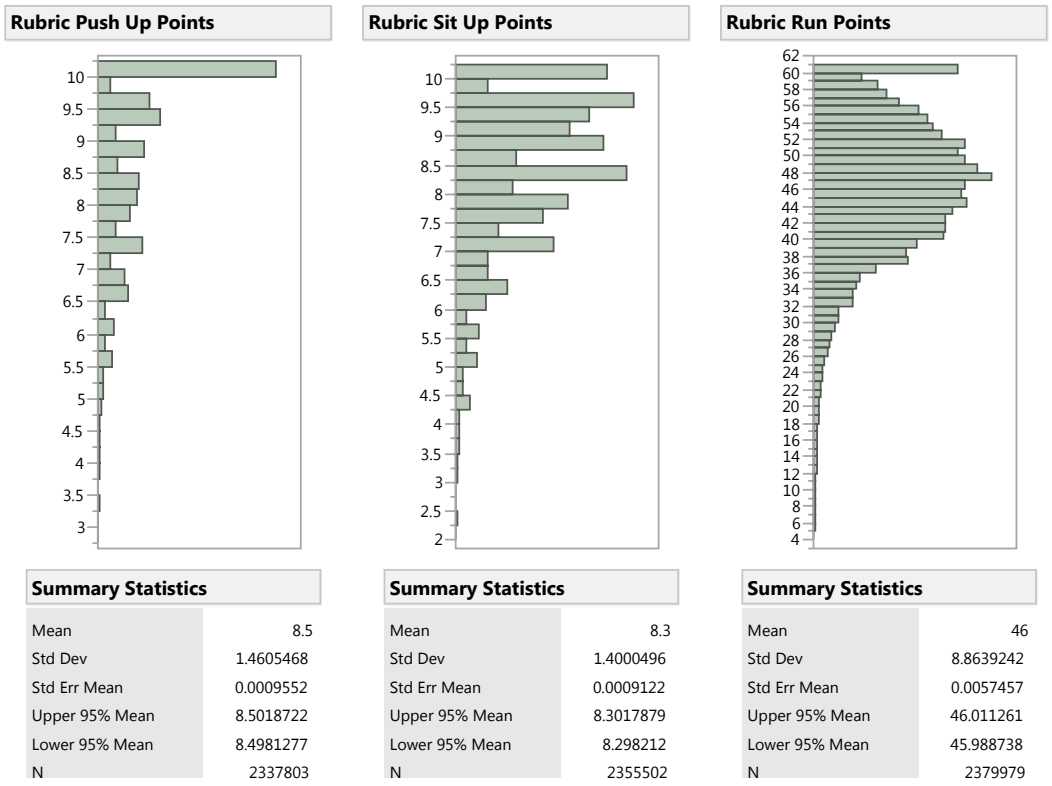
The Balance values for the run time, push-ups, and sit-ups for M20 are shown below:

Run Time	Push-ups	Sit-ups
0.0749461	0.1919081	0.0670358

These values were then used in the equation to create the rubrics:

$$Score = 46 - \frac{\left(x - \mu(Age\ Group\ Run\ Time)\right)}{\sigma(Age\ Group\ Run\ Time)} * \frac{Range\ (Age\ Group\ Run\ Time)}{\sigma(Age\ Group\ Run\ Time)} + Balance$$

Now the rubric scores have the correct mean scores while still maintaining the same shape.



The table below shows all Values used to create the variable Balance for every fit group:

	Pushup	Total	Max	Balance	Situp	Total	Max	Balance	Run	Total	Max	Balance
M20	8.356736	2337803	592579	0.19190805388386	8.239155	2355502	217521	0.06703578087953	45.92824	2379979	101019	0.07494611267201
M20-24	8.35647	1349329	386092	0.20106036891367	8.234174	1356969	150621	0.07404483730565	45.95344	1372341	48132	0.04825442331384
M25-29	8.359572	988474	206487	0.17750873827749	8.251094	998533	82077	0.05328565183500	45.89493	1007638	48904	0.11042845775992
M30	8.428009	1285411	155713	0.08191406184848	8.253041	1297275	119714	0.05173264700725	45.86633	1312217	68892	0.14107658608168
M30-34	8.434853	704341	91762	0.07490542742193	8.257348	710971	66484	0.04705211631298	45.87761	717874	37374	0.12911393770463
M35-39	8.433863	581070	124745	0.08421729911357	8.252699	586304	49985	0.05170913134310	45.85539	594343	31714	0.15276025033726
M40	8.406011	603849	51780	0.10280480305125	8.250069	608765	41486	0.05358253207857	45.76569	618804	48408	0.25419201542087
M40-44	8.406941	407684	35965	0.10206253599951	8.254659	410901	33820	0.04940780474540	45.78134	417377	31381	0.23643570773532
M45-49	8.404538	196165	15815	0.10383333774882	8.246836	197864	14241	0.05728770703017	45.73797	201427	16481	0.28538232599786
M50	8.3809	93787	15962	0.14352731053775	8.228824	94937	14156	0.08364847465246	45.55729	97790	11064	0.49918724615456
M50-54	8.390769	73366	12418	0.13148677920851	8.237159	74155	11721	0.07463805151840	45.58193	76150	8330	0.46941837732233
M55-59	8.351691	20421	3533	0.17933514700971	8.210284	20782	3178	0.10591276431493	45.53557	21640	2509	0.52533698813444
M60	8.273399	939	195	0.28599188629032	8.159974	947	175	0.17176752240933	45.40161	993	138	0.69496760000000
F20	8.326833	567868	165787	0.24456833794683	8.228662	576137	86831	0.08399793127573	45.86151	583939	33168	0.14682683055753
F20-24	8.322403	338063	83860	0.23618502065160	8.228316	342089	37814	0.08059246953282	45.88347	346337	17156	0.12259901167443
F25-29	8.317657	229805	67296	0.25785238426795	8.230225	234048	46654	0.08714607933232	45.82477	237602	15871	0.18777685063433
F30	8.300121	251671	65335	0.26996231256869	8.235277	258326	19488	0.07000440129209	45.80516	262109	18069	0.20926510183167
F30-34	8.300974	148541	43558	0.28160293634207	8.232255	152280	13802	0.07449720409018	45.81368	154345	10285	0.19962317607247
F35-39	8.316714	103130	20451	0.22862281602342	8.241503	106046	11034	0.06529052610828	45.79553	107764	7560	0.21989753746357
F40	8.288505	96557	20374	0.26805641713243	8.222035	99667	9856	0.08652089040652	45.61846	101607	10775	0.42679705345033
F40-44	8.298641	64644	13872	0.25637409080596	8.227531	66648	6710	0.08058238906870	45.64919	67827	6828	0.39007724787291
F45-49	8.270462	31913	6889	0.29272882808504	8.211839	33019	3596	0.09893636163885	45.56843	33780	3791	0.48613169828938
F50	8.274277	17599	4002	0.29215996741928	8.170606	18392	2388	0.14870134261435	45.39888	19114	2543	0.69336724192867
F50-54	8.280663	13696	3209	0.28645431486603	8.198139	14326	2863	0.12730218824043	45.41794	14830	1985	0.67200970260802
F55-59	8.263499	3903	904	0.30779078822941	8.153294	4066	707	0.17758433545698	45.42811	4284	538	0.65402590603310
F60	8.260436	272	71	0.32418570348259	8.171863	292	54	0.15721059159664	44.82867	308	50	1.39833790697674

Appendix D: Descriptive Statistics of Women's Scores

F20	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	854.939	32.5198	45.6319
Median	847	32	47
Maximum	1311	59	67
IQR	142	16	12
Range	700	57	56
Standard Deviation	109.841	10.0442	9.11404
Variance	12065	100.887	83.0657
N	583939	567868	576137
Standard Deviation fo	9.41492	1.76215	1.62751

F20-24	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	850.458	32.8445	46.0314
Median	840	32	47
Maximum	1311	59	67
IQR	139	14	12
Range	700	57	56
Standard Deviation	108.468	9.89609	9.00152
Variance	11765.4	97.9327	81.0273
N	346337	338063	342089
Standard Deviation f	9.2973	1.73616	1.60741

F25-29	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	861.47	32.0422	45.0479
Median	857	32	47
Maximum	1311	59	67
IQR	145	16	12
Range	700	57	56
Standard Deviation	111.489	10.2396	9.24506
Variance	12429.8	104.85	85.4712
N	237602	229805	234048
Standard Deviation fo	9.55621	1.79643	1.6509

F30	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	876.437	29.7175	40.939
Median	873	30	42
Maximum	1311	59	67
IQR	142	14	10
Range	700	57	56
Standard Deviation	110.698	10.0213	8.27563
Variance	12254	100.426	68.4861
N	262109	251671	258326
Standard Deviation f	9.4884	1.75812	1.47779

F30	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	876.437	29.7175	40.939
Median	873	30	42
Maximum	1311	59	67
IQR	142	14	10
Range	700	57	56
Standard Deviation	110.698	10.0213	8.27563
Variance	12254	100.426	68.4861
N	262109	251671	258326
Standard Deviation fo	9.4884	1.75812	1.47779

F30-34	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	871.809	30.4608	41.592
Median	869	30	42
Maximum	1311	59	67
IQR	142	17	9
Range	700	57	56
Standard Deviation	109.685	10.3183	8.33088
Variance	12030.8	106.467	69.4035
N	154345	148541	152280
Standard Deviation f	9.40158	1.81023	1.48766

F35-39	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	883.064	28.6468	40.0013
Median	880	30	40
Maximum	1311	59	67
IQR	140	12	9
Range	700	57	56
Standard Deviation	111.8	9.47536	8.10418
Variance	12499.3	89.7824	65.6777
N	107764	103130	106046
Standard Deviation fo	9.58287	1.66234	1.44718

F40	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	923.564	24.2681	37.4078
Median	920	21	39
Maximum	1311	59	67
IQR	174	11	9
Range	700	57	56
Standard Deviation	125.579	9.24117	8.20406
Variance	15770	85.3993	67.3066
N	101607	96557	99667
Standard Deviation f	10.7639	1.62126	1.46501

F40-44	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	915.051	24.5755	37.8671
Median	911	22	39
Maximum	1311	59	67
IQR	171	10	8
Range	700	57	56
Standard Deviation	123.877	9.11165	8.04401
Variance	15345.6	83.0221	64.7061
N	67827	64644	66648
Standard Deviation f	10.618	1.59853	1.43643

F45-49	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	940.656	23.6453	36.4807
Median	938	20	37
Maximum	1311	59	67
IQR	177	12	10
Range	700	57	56
Standard Deviation	127.221	9.46773	8.44231
Variance	16185.1	89.638	71.2725
N	33780	31913	33019
Standard Deviation fo	10.9046	1.66101	1.50755

F50	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	996.162	21.2158	32.1421
Median	998	20	32
Maximum	1311	59	67
IQR	191	12	9
Range	700	57	56
Standard Deviation	133.347	9.52164	8.54348
Variance	17781.4	90.6617	72.991
N	19114	17599	18392
Standard Deviation fo	11.4297	1.67046	1.52562

F50-54	Run Time	Push-ups	Sit-ups
Minimum	611	2	11
Mean	986.55	21.5338	32.5635
Median	987	20	32
Maximum	1311	59	67
IQR	192	11	8
Range	700	57	56
Standard Deviation	133.599	9.45265	8.4252
Variance	17848.7	89.3526	70.984
N	14830	13696	14326
Standard Deviation f	11.4514	1.65836	1.5045

F55-59	Run Time	Push-ups	Sit-ups
Minimum	614	2	11
Mean	1029.43	20.0999	30.6572
Median	1035	18	30
Maximum	1310	59	65
IQR	184.75	11	10
Range	696	57	54
Standard Deviation	126.985	9.67879	8.78921
Variance	16125.1	93.6789	77.2502
N	4284	3903	4066
Standard Deviation fo	10.9469	1.69803	1.62763

F60	Run Time	Push-ups	Sit-ups
Minimum	703	2	12
Mean	1068.25	19.5919	30.8562
Median	1076.5	20	31
Maximum	1300	50	66
IQR	177.75	11	9
Range	597	48	54
Standard Deviation	127.593	8.83421	8.54299
Variance	16279.9	78.0432	72.9827
N	308	272	292
Standard Deviation f	12.8234	1.84046	1.58204

Appendix E: Table of Regression Model Results and Ranks

Section 1: Linear Body Composition Variables, Dependent Variable: Run Time

Model	Abdominal Circumference	Height to Weight Ratio	BMI	Waist to Height Ratio	Model Weight
R^2:D-Run Time	0.014633	0.015058	0.059852	0.087626	
T Ratio:D-Run Time	281.47	254.67	521.41	638.54	
Rank	4	3	2	1	0.25
R^2:D-Run Time I-Sex	0.340461	0.320047	0.333971	0.354783	
T Ratio:D-Run Time I-Sex	1041.9	836.22	894.39	978.56	
Rank	2	4	3	1	0.05
R^2:D-Run Time I-Age	0.046071	0.056207	0.088493	0.106059	
T Ratio:D-Run Time I-Age	139.01	138.62	413.57	509	
Rank	4	3	2	1	0.05
R^2:D-Run Time I-Sex, Interaction	0.34051	0.321203	0.334506	0.354833	
T Ratio:D-Run Time, I-Sex, interaction	16.02	14.21	12.96	13.41	
Rank	2	4	3	1	0.05
R^2:D-Run Time I-Age, Interaction	0.046076	0.056283	0.08859	0.106061	
T Ratio:D-Run Time, I-Age, Interaction	139.02	138.69	413.98	509	
Rank	4	3	2	1	0.05
R^2:D-Run Time I-Age, Sex	0.354591	0.349504	0.362022	0.372699	
T Ratio:D-Run Time I-Age Sex	883.95	710.28	770.02	821.66	
Rank	3	4	2	1	0.3
R^2:D-Run Time I-Age, Sex, Pushups, Situps	0.428057	0.445811	0.46043	0.449811	
T Ratio:D-Run Time I-Age Sex, Pushups, Situps	674.36	649.82	736.1	680.81	
Rank	4	3	1	2	0.25

Section 2: Linear Body Composition Variables, Dependent Variable: Total Fitness

Model	Abdominal Circumference	Height to Weight Ratio	BMI	Waist to Height Ratio	Model Weight
R^2:D-Total Fitness	0.014633	0.008355	0.045746	0.082662	
T Ratio:D-Total Fitness	281.47	186.1	445.3	608.9	
Rank	3	4	2	1	0.4
R^2:D-Total Fitness I-Sex	0.393416	0.355208	0.363808	0.39879	
T Ratio:D-Total Fitness I-Sex	1102	810.9	848.1	997.8	
Rank	2	4	3	1	0.1
R^2:D-Total Fitness I-Age	0.061831	0.071742	0.093412	0.115456	
T Ratio:D-Total Fitness I-Age	78.77	47.42	317.2	455	
Rank	4	3	2	1	0.1
R^2:D-Total Fitness I-Age, Sex	0.419875	0.403714	0.411272	0.431404	
T Ratio:D-Total Fitness I-Age, Sex	909.3	663.7	702.1	810	
Rank	2	4	3	1	0.4

Section 3: Quadratic Body Composition Variables, Dependent Variable: Run Time

Model	Quadratic Abdominal	Quadratic H/W Ratio	Quadratic BMI	Quadratic WtHR	Weight
R^2:D-Run Time	0.018205	0.019254	0.06453	0.091799	
T Ratio:D-Run Time	314.53	288.59	542.75	655.07	
Rank	4	3	2	1	0.3
R^2:D-Run Time I-Sex	0.343282	0.322772	0.337665	0.358212	
T Ratio:D-Run Time I-Sex	1055.1	848.03	910.06	992.66	
Rank	2	4	3	1	0.05
R^2:D-Run Time I-Age	0.047966	0.058778	0.092666	0.109703	
T Ratio:D-Run Time I-Age	173.63	175.66	437.57	526.79	
Rank	4	3	2	1	0.05
R^2:D-Run Time I-Age, Sex	0.357189	0.352369	0.365808	0.375895	
T Ratio:D-Run Time I-Age Sex	897.82	724.92	788.65	836.85	
Rank	3	4	2	1	0.3
R^2:D-Run Time I-Age, Sex, Pushups, Situps	0.429465	0.447687	0.462978	0.451669	
T Ratio:D-Run Time I-Age Sex, Pushups, Situps	684.57	661.56	751.03	692.11	
Rank	4	3	1	2	0.3

Section 4: Quadratic Body Composition Variables, Dependent Variable: Total Fitness

Model	Quadratic Abdominal	Quadratic H/W Ratio	Quadratic BMI	Quadratic WtHR	Weight
R^2:D-Total Fitness	0.015391	0.011642	0.049775	0.082139	
T Ratio:D-Total Fitness	284.3	220	465.5	531.42	
Rank	3	4	2	1	0.4
R^2:D-Total Fitness I-Sex	0.396272	0.357499	0.36695	0.402093	
T Ratio:D-Total Fitness I-Sex	1116	821.4	862.2	1012	
Rank	2	4	3	1	0.1
R^2:D-Total Fitness I-Age	0.063106	0.072879	0.096718	0.118827	
T Ratio:D-Total Fitness I-Age	115.1	85.4	340.7	472.8	
Rank	4	3	2	1	0.1
R^2:D-Total Fitness I-Age, Sex	0.422439	0.406195	0.414524	0.434413	
T Ratio:D-Total Fitness I-Age, Sex	923.9	677.9	720.2	825.5	
Rank	2	4	3	1	0.4

Appendix F: Scoring Rubrics for Every Fit Group

FIT GROUP: M20-Run Time

Points	Run Time
60	0:09:36
59.5	0:09:42
58.8	0:09:49
58.2	0:09:55
57.7	0:10:00
57.3	0:10:04
56.8	0:10:09
56.5	0:10:13
56.1	0:10:17
55.8	0:10:20
55.4	0:10:24
55.1	0:10:27
54.8	0:10:30
54.5	0:10:33
54.2	0:10:36
53.8	0:10:40
53.6	0:10:42
53.3	0:10:45
53.1	0:10:48
52.9	0:10:50
52.6	0:10:53
52.3	0:10:56
52	0:10:59
51.8	0:11:01
51.6	0:11:03
51.3	0:11:06
51.1	0:11:08
50.9	0:11:10
50.6	0:11:13
50.4	0:11:15
50.1	0:11:18
49.9	0:11:20
49.7	0:11:23
49.6	0:11:24
49.3	0:11:27
49.1	0:11:29

Points	Run Time
49	0:11:30
48.7	0:11:33
48.5	0:11:35
48.3	0:11:37
48.1	0:11:39
47.9	0:11:41
47.7	0:11:43
47.5	0:11:45
47.2	0:11:48
47	0:11:50
46.8	0:11:52
46.6	0:11:54
46.3	0:11:57
46.2	0:11:58
46	0:12:01
45.8	0:12:03
45.5	0:12:06
45.3	0:12:08
45.1	0:12:10
44.9	0:12:12
44.6	0:12:15
44.4	0:12:17
44.1	0:12:20
43.9	0:12:22
43.6	0:12:25
43.4	0:12:27
43.1	0:12:30
42.9	0:12:32
42.7	0:12:34
42.5	0:12:37
42.2	0:12:40
42	0:12:42
41.7	0:12:45
41.4	0:12:48
41.2	0:12:50
40.9	0:12:53

Points	Run Time
40.7	0:12:55
40.3	0:12:59
40.1	0:13:01
39.7	0:13:05
39.4	0:13:08
39.1	0:13:12
38.8	0:13:15
38.5	0:13:18
38.1	0:13:22
37.7	0:13:26
37.3	0:13:30
36.9	0:13:34
36.5	0:13:38
35.8	0:13:45
35	0:13:54
34.4	0:14:00
33.4	0:14:10
32.5	0:14:19
31.6	0:14:29
30.2	0:14:43
28.6	0:14:59
26.6	0:15:20
23.4	0:15:53
18.1	0:16:47
4.4	0:19:08
4.4	0:19:08
1	0:19:43

FIT GROUP: M20: Push-Ups and Sit-Ups

Points	Push Ups
10	62
9.9	61
9.7	60
9.6	59
9.4	58
9.3	57
9.1	56
8.9	55
8.8	54
8.6	53
8.4	52
8.3	51
8.1	50
8	49
7.8	48
7.6	47
7.5	46
7.3	45
7.2	44
7	43
6.8	42
6.7	41
6.5	40
6.4	39
6.2	38
6	37
5.9	36
5.7	35
5.5	34
5.4	33
5.2	32
5.1	31
4.9	30
4.7	29
4.6	28
4.4	27

Points	Push-Ups
4.3	26
4.1	25
3.9	24
3.8	23
3.6	22
3.4	21
3.3	20
3.1	19
3	18
2.8	17
2.6	16
2.5	15
2.3	14
2.2	13
2	12
1.8	11
1.7	10
1.5	9
1.4	8
1.2	7
1	6
0.9	5
0.7	4
0.5	3
0.4	2
0.2	1

Points	Sit-Ups
10	62
9.9	61
9.7	60
9.6	59
9.4	58
9.2	57
9	56
8.8	55
8.7	54
8.5	53
8.3	52
8.1	51
7.9	50
7.7	49
7.6	48
7.4	47
7.2	46
7	45
6.8	44
6.7	43
6.5	42
6.3	41
6.1	40
5.9	39
5.7	38
5.6	37
5.4	36
5.2	35
5	34
4.8	33
4.7	32
4.5	31
4.3	30
4.1	29
3.9	28
3.7	27

Points	Sit-Ups
3.6	26
3.4	25
3.2	24
3	23
2.8	22
2.7	21
2.5	20
2.3	19
2.1	18
1.9	17
1.7	16
1.6	15
1.4	14
1.2	13
1	12
0.8	11
0.7	10
0.5	9
0.3	8
0.1	7

FIT GROUP: M20-24: Run Time

Points	Run Time
60	0:09:28
59.7	0:09:30
59	0:09:38
58.4	0:09:44
57.9	0:09:49
57.4	0:09:54
56.9	0:09:59
56.5	0:10:03
56.1	0:10:08
55.9	0:10:10
55.5	0:10:14
55.2	0:10:17
54.9	0:10:20
54.6	0:10:23
54.3	0:10:26
53.9	0:10:30
53.7	0:10:32
53.4	0:10:35
53.2	0:10:37
52.9	0:10:40
52.7	0:10:42
52.5	0:10:45
52.3	0:10:47
52	0:10:50
51.8	0:10:52
51.5	0:10:55
51.3	0:10:57
51.1	0:10:59
50.9	0:11:01
50.7	0:11:03
50.5	0:11:05
50.2	0:11:08
50	0:11:10
49.8	0:11:12
49.5	0:11:15
49.4	0:11:16

Points	Run Time
49.1	0:11:19
48.8	0:11:23
48.6	0:11:25
48.4	0:11:27
48.2	0:11:29
48	0:11:31
47.8	0:11:33
47.6	0:11:35
47.4	0:11:37
47.2	0:11:39
47	0:11:41
46.8	0:11:43
46.6	0:11:45
46.4	0:11:47
46.1	0:11:50
45.9	0:11:52
45.7	0:11:54
45.5	0:11:57
45.3	0:11:59
45.1	0:12:01
44.9	0:12:03
44.6	0:12:06
44.4	0:12:08
44.1	0:12:11
43.9	0:12:13
43.6	0:12:16
43.3	0:12:19
43.1	0:12:21
42.8	0:12:24
42.5	0:12:27
42.2	0:12:30
42	0:12:33
41.8	0:12:35
41.5	0:12:38
41.2	0:12:41
40.9	0:12:44

Points	Run Time
40.6	0:12:47
40.3	0:12:50
40	0:12:53
39.7	0:12:56
39.3	0:13:00
39	0:13:03
38.7	0:13:06
38.4	0:13:10
38	0:13:14
37.6	0:13:18
37.2	0:13:22
36.7	0:13:27
36.3	0:13:31
35.8	0:13:36
35	0:13:44
34.4	0:13:51
33.5	0:14:00
32.5	0:14:10
31.5	0:14:20
30.3	0:14:33
28.6	0:14:50
26.7	0:15:10
23.7	0:15:41
18.4	0:16:35
3.5	0:19:08
1	0:19:34

FIT GROUP: M20-24: Push-Ups and Sit-Ups

Points	Push-Ups
10	62
9.9	61
9.7	60
9.6	59
9.4	58
9.2	57
9.1	56
8.9	55
8.8	54
8.6	53
8.4	52
8.3	51
8.1	50
7.9	49
7.8	48
7.6	47
7.5	46
7.3	45
7.1	44
7	43
6.8	42
6.7	41
6.5	40
6.3	39
6.2	38
6	37
5.9	36
5.7	35
5.5	34
5.4	33
5.2	32
5	31
4.9	30
4.7	29
4.6	28
4.4	27

Points	Push-Ups
4.1	26
4	25
3.8	24
3.6	23
3.5	22
3.3	21
3.1	20
3	19
2.8	18
2.7	17
2.5	16
2.3	15
2.2	14
2	13
1.9	12
1.7	11
1.5	10
1.4	9
1.2	8
1	7
0.9	6
0.7	5
0.6	4
0.4	3
0.2	2
0.1	1

Points	Sit-Ups
10	62
9.9	61
9.7	60
9.5	59
9.3	58
9.1	57
8.9	56
8.8	55
8.6	54
8.4	53
8.2	52
8	51
7.9	50
7.7	49
7.5	48
7.3	47
7.1	46
6.9	45
6.8	44
6.6	43
6.4	42
6.2	41
6	40
5.9	39
5.7	38
5.5	37
5.3	36
5.1	35
4.9	34
4.8	33
4.6	32
4.4	31
4.2	30
4	29
3.9	28
3.7	27

Points	Sit-Ups
3.5	26
3.3	25
3.1	24
2.9	23
2.8	22
2.6	21
2.4	20
2.2	19
2	18
1.9	17
1.7	16
1.5	15
1.3	14
1.1	13
0.9	12
0.8	11
0.6	10
0.4	9
0.2	8

Fit Group: M25-29 Run Time

Points	Run Time
60	0:09:49
59.9	0:09:50
59.2	0:09:57
58.6	0:10:03
58.1	0:10:09
57.5	0:10:15
57.1	0:10:19
56.6	0:10:24
56.2	0:10:28
55.8	0:10:32
55.5	0:10:35
55.1	0:10:39
54.8	0:10:43
54.5	0:10:46
54.1	0:10:50
53.8	0:10:53
53.5	0:10:56
53.2	0:10:59
52.9	0:11:02
52.6	0:11:05
52.4	0:11:07
52.1	0:11:10
51.8	0:11:13
51.6	0:11:15
51.4	0:11:18
51.2	0:11:20
50.9	0:11:23
50.7	0:11:25
50.4	0:11:28
50.2	0:11:30
50	0:11:32
49.7	0:11:35
49.5	0:11:37
49.3	0:11:39
49.1	0:11:41
48.9	0:11:43

Points	Run Time
48.6	0:11:46
48.4	0:11:48
48.2	0:11:50
48	0:11:52
47.8	0:11:55
47.6	0:11:57
47.4	0:11:59
47.2	0:12:01
47	0:12:03
46.8	0:12:05
46.6	0:12:07
46.4	0:12:09
46.2	0:12:11
46	0:12:13
45.8	0:12:15
45.5	0:12:18
45.3	0:12:20
45.1	0:12:22
44.8	0:12:25
44.6	0:12:27
44.4	0:12:30
44.3	0:12:31
44.1	0:12:33
43.9	0:12:35
43.7	0:12:37
43.4	0:12:40
43.2	0:12:42
43	0:12:44
42.8	0:12:46
42.5	0:12:49
42.3	0:12:51
42.1	0:12:53
41.9	0:12:55
41.6	0:12:58
41.4	0:13:00
41.1	0:13:03

Points	Run Time
40.9	0:13:06
40.6	0:13:09
40.4	0:13:11
40.1	0:13:14
39.8	0:13:17
39.5	0:13:20
39.1	0:13:24
38.8	0:13:27
38.5	0:13:30
38.1	0:13:34
37.8	0:13:37
37.3	0:13:43
36.6	0:13:50
35.9	0:13:57
35	0:14:06
34.4	0:14:12
33.7	0:14:20
32.9	0:14:28
31.7	0:14:40
30.3	0:14:55
28.7	0:15:11
26.5	0:15:34
23.3	0:16:06
18.1	0:17:00
5.6	0:19:09
1	0:19:56

Fit Group: M25-29 Push-Ups and Sit-Ups

Points	Push-Ups
10	62
9.9	61
9.8	60
9.6	59
9.5	58
9.3	57
9.1	56
9	55
8.8	54
8.6	53
8.5	52
8.3	51
8.2	50
8	49
7.8	48
7.7	47
7.5	46
7.4	45
7.2	44
7	43
6.9	42
6.7	41
6.6	40
6.4	39
6.2	38
6.1	37
5.9	36
5.7	35
5.6	34
5.4	33
5.3	32
5.1	31
4.9	30
4.8	29
4.6	28
4.5	27

Points	Push-Ups
4.3	26
4.1	25
4	24
3.8	23
3.6	22
3.5	21
3.3	20
3.2	19
3	18
2.8	17
2.7	16
2.5	15
2.4	14
2.2	13
2	12
1.9	11
1.7	10
1.6	9
1.4	8
1.2	7
1.1	6
0.9	5
0.7	4
0.6	3
0.4	2
0.3	1

Points	Sit-Ups
10	61
9.8	60
9.7	59
9.5	58
9.3	57
9.1	56
8.9	55
8.7	54
8.6	53
8.4	52
8.2	51
8	50
7.8	49
7.7	48
7.5	47
7.3	46
7.1	45
6.9	44
6.7	43
6.6	42
6.4	41
6.2	40
6	39
5.8	38
5.7	37
5.5	36
5.3	35
5.1	34
4.9	33
4.7	32
4.6	31
4.4	30
4.2	29
4	28
3.8	27
3.7	26

Points	Sit-Ups
3.5	25
3.3	24
3.1	23
2.9	22
2.7	21
2.6	20
2.4	19
2.2	18
2	17
1.8	16
1.7	15
1.5	14
1.3	13
1.1	12
0.9	11
0.7	10
0.6	9
0.4	8
0.2	7

Fit Group: M30 Run Time

Points	Run Time
60	0:10:02
59.9	0:10:04
58.8	0:10:15
58.2	0:10:22
57.8	0:10:26
57.3	0:10:31
56.8	0:10:36
56.3	0:10:41
55.9	0:10:45
55.5	0:10:49
55.1	0:10:53
54.8	0:10:56
54.5	0:11:00
54.2	0:11:03
53.8	0:11:07
53.5	0:11:10
53.2	0:11:13
52.9	0:11:16
52.6	0:11:19
52.3	0:11:22
52.1	0:11:24
51.8	0:11:27
51.5	0:11:30
51.3	0:11:32
51.1	0:11:35
50.9	0:11:37
50.6	0:11:40
50.4	0:11:42
50.1	0:11:45
49.9	0:11:47
49.7	0:11:49
49.5	0:11:51
49.3	0:11:53
49.1	0:11:55
48.8	0:11:58
48.6	0:12:00

Points	Run Time
48.4	0:12:02
48.2	0:12:04
47.9	0:12:07
47.7	0:12:09
47.6	0:12:11
47.4	0:12:13
47.2	0:12:15
47	0:12:17
46.7	0:12:20
46.6	0:12:21
46.3	0:12:24
46.1	0:12:26
45.9	0:12:28
45.7	0:12:30
45.5	0:12:32
45.3	0:12:34
45.1	0:12:36
44.9	0:12:38
44.7	0:12:40
44.4	0:12:43
44.2	0:12:45
44.1	0:12:46
43.9	0:12:49
43.7	0:12:51
43.5	0:12:53
43.3	0:12:55
43	0:12:58
42.8	0:13:00
42.6	0:13:02
42.3	0:13:05
42.1	0:13:07
41.8	0:13:10
41.6	0:13:12
41.3	0:13:15
41	0:13:18
40.8	0:13:20

Points	Run Time
40.6	0:13:22
40.3	0:13:26
40	0:13:29
39.8	0:13:31
39.5	0:13:34
39.3	0:13:36
38.9	0:13:40
38.4	0:13:45
37.9	0:13:50
37.5	0:13:54
37	0:14:00
36.5	0:14:05
35.9	0:14:11
35	0:14:20
34.7	0:14:23
34	0:14:30
33	0:14:41
31.8	0:14:53
30.4	0:15:07
28.7	0:15:25
26.4	0:15:49
23	0:16:23
18	0:17:15
7	0:19:08
1	0:20:10

Fit Group: M30 Push-Ups and Sit-Ups

Points	Push-Ups
10	58
9.8	57
9.6	56
9.4	55
9.3	54
9.1	53
9	52
8.8	51
8.6	50
8.5	49
8.3	48
8.1	47
8	46
7.8	45
7.7	44
7.5	43
7.3	42
7.2	41
7	40
6.9	39
6.7	38
6.5	37
6.4	36
6.2	35
6.1	34
5.9	33
5.7	32
5.6	31
5.4	30
5.2	29
5.1	28
4.9	27
4.8	26
4.6	25
4.4	24
4.3	23

Points	Push-Ups
4.1	22
4	21
3.8	20
3.6	19
3.5	18
3.3	17
3.1	16
3	15
2.8	14
2.7	13
2.5	12
2.3	11
2.2	10
2	9
1.9	8
1.7	7
1.5	6
1.4	5
1.2	4
1.1	3
0.9	2
0.7	1

Points	Sit-Ups
10	58
9.9	57
9.7	56
9.5	55
9.3	54
9.1	53
9	52
8.8	51
8.6	50
8.4	49
8.2	48
8.1	47
7.9	46
7.7	45
7.5	44
7.3	43
7.1	42
7	41
6.8	40
6.6	39
6.4	38
6.2	37
6.1	36
5.9	35
5.7	34
5.5	33
5.3	32
5.1	31
5	30
4.8	29
4.6	28
4.4	27
4.2	26
4.1	25
3.9	24
3.7	23

Points	Sit-Ups
3.5	22
3.3	21
3.1	20
3	19
2.8	18
2.6	17
2.4	16
2.2	15
2.1	14
1.9	13
1.7	12
1.5	11
1.3	10
1.1	9
1	8
0.8	7
0.6	6
0.4	5
0.2	4
0.1	3

Fit Group: M30-34 Run Time

Points	Run Time
60	0:09:58
59.3	0:10:05
58.8	0:10:10
58.2	0:10:17
57.7	0:10:22
57.1	0:10:28
56.7	0:10:32
56.2	0:10:37
55.8	0:10:41
55.4	0:10:45
55.1	0:10:49
54.8	0:10:52
54.4	0:10:56
54.1	0:10:59
53.7	0:11:03
53.4	0:11:06
53.1	0:11:09
52.8	0:11:12
52.5	0:11:15
52.2	0:11:18
52	0:11:20
51.7	0:11:24
51.6	0:11:25
51.3	0:11:28
51.1	0:11:30
50.8	0:11:33
50.6	0:11:35
50.3	0:11:38
50.1	0:11:40
49.9	0:11:42
49.6	0:11:45
49.4	0:11:47
49.2	0:11:49
49	0:11:51
48.8	0:11:53
48.6	0:11:55

Points	Run Time
48.3	0:11:58
48.2	0:11:59
48	0:12:02
47.8	0:12:04
47.5	0:12:07
47.3	0:12:09
47.1	0:12:11
46.9	0:12:13
46.7	0:12:15
46.5	0:12:17
46.2	0:12:20
46.1	0:12:21
45.8	0:12:24
45.6	0:12:26
45.4	0:12:28
45.2	0:12:30
45.1	0:12:31
44.8	0:12:34
44.7	0:12:35
44.5	0:12:38
44.3	0:12:40
44.1	0:12:42
43.8	0:12:45
43.6	0:12:47
43.4	0:12:49
43.2	0:12:51
43	0:12:53
42.8	0:12:55
42.5	0:12:58
42.3	0:13:00
42	0:13:03
41.8	0:13:05
41.5	0:13:08
41.3	0:13:10
41.1	0:13:13
40.9	0:13:15

Points	Run Time
40.6	0:13:18
40.3	0:13:21
40	0:13:24
39.7	0:13:27
39.4	0:13:30
39.2	0:13:32
38.9	0:13:35
38.5	0:13:39
38.1	0:13:43
37.6	0:13:49
37.2	0:13:53
36.7	0:13:58
36.2	0:14:03
35.5	0:14:10
35	0:14:15
34.2	0:14:23
33.4	0:14:32
32.1	0:14:45
30.7	0:14:59
29.2	0:15:15
26.8	0:15:40
23.5	0:16:13
18.4	0:17:06
6.5	0:19:08
1	0:20:05

Fit Group: M30-34 Push-Ups and Sit-Ups

Points	Push-Ups
10	60
9.9	59
9.8	58
9.6	57
9.5	56
9.3	55
9.1	54
9	53
8.8	52
8.7	51
8.5	50
8.3	49
8.2	48
8	47
7.9	46
7.7	45
7.5	44
7.4	43
7.2	42
7	41
6.9	40
6.7	39
6.6	38
6.4	37
6.2	36
6.1	35
5.9	34
5.8	33
5.6	32
5.4	31
5.3	30
5.1	29
4.9	28
4.8	27
4.6	26
4.5	25

Points	Push-Ups
4.3	24
4.1	23
4	22
3.8	21
3.7	20
3.5	19
3.3	18
3.2	17
3	16
2.9	15
2.7	14
2.5	13
2.4	12
2.2	11
2	10
1.9	9
1.7	8
1.6	7
1.4	6
1.2	5
1.1	4
0.9	3
0.8	2
0.6	1

Points	Sit-Ups
10	59
9.9	58
9.7	57
9.5	56
9.3	55
9.1	54
9	53
8.8	52
8.6	51
8.4	50
8.2	49
8.1	48
7.9	47
7.7	46
7.5	45
7.3	44
7.1	43
7	42
6.8	41
6.6	40
6.4	39
6.2	38
6.1	37
5.9	36
5.7	35
5.5	34
5.3	33
5.1	32
5	31
4.8	30
4.6	29
4.4	28
4.2	27
4.1	26
3.9	25
3.7	24

Points	Sit-Ups
3.5	23
3.3	22
3.1	21
3	20
2.8	19
2.6	18
2.4	17
2.2	16
2.1	15
1.9	14
1.7	13
1.5	12
1.3	11
1.1	10
1	9
0.8	8
0.6	7
0.4	6
0.2	5
0.1	4

Fit Group: M35-39 Run Time

Points	Run Time
60	0:10:08
59.6	0:10:13
58.9	0:10:20
58.3	0:10:26
57.7	0:10:32
57.3	0:10:37
56.8	0:10:42
56.4	0:10:46
56	0:10:50
55.6	0:10:54
55.2	0:10:58
54.8	0:11:02
54.5	0:11:05
54.1	0:11:09
53.9	0:11:12
53.6	0:11:15
53.3	0:11:18
53	0:11:21
52.7	0:11:24
52.4	0:11:27
52.1	0:11:30
51.9	0:11:32
51.6	0:11:35
51.3	0:11:38
51.1	0:11:40
50.9	0:11:42
50.6	0:11:45
50.5	0:11:46
50.2	0:11:50
50	0:11:52
49.8	0:11:54
49.6	0:11:56
49.4	0:11:58
49.2	0:12:00
48.9	0:12:03
48.7	0:12:05

Points	Run Time
48.5	0:12:07
48.2	0:12:10
48	0:12:12
47.8	0:12:14
47.6	0:12:16
47.4	0:12:18
47.2	0:12:20
47	0:12:22
46.8	0:12:25
46.6	0:12:27
46.4	0:12:29
46.3	0:12:30
46.1	0:12:32
45.8	0:12:35
45.6	0:12:37
45.4	0:12:39
45.2	0:12:41
44.9	0:12:44
44.8	0:12:45
44.5	0:12:48
44.3	0:12:50
44.1	0:12:52
43.9	0:12:54
43.7	0:12:56
43.5	0:12:58
43.3	0:13:01
43.1	0:13:03
42.9	0:13:05
42.6	0:13:08
42.4	0:13:10
42.1	0:13:13
41.9	0:13:15
41.6	0:13:18
41.4	0:13:20
41.1	0:13:23
40.8	0:13:26

Points	Run Time
40.5	0:13:29
40.3	0:13:31
40	0:13:34
39.9	0:13:36
39.5	0:13:40
39.1	0:13:44
38.7	0:13:48
38.3	0:13:52
37.8	0:13:57
37.4	0:14:01
36.8	0:14:07
36.3	0:14:13
35.8	0:14:18
35	0:14:26
34.6	0:14:30
33.6	0:14:40
32.7	0:14:50
31.5	0:15:02
30.1	0:15:16
28.3	0:15:35
25.8	0:16:00
22.5	0:16:34
17.6	0:17:25
7.6	0:19:08
1	0:20:16

Fit Group: M35-39 Push-Ups and Sit-Ups

Points	Push-Ups
10	57
9.8	56
9.7	55
9.5	54
9.3	53
9.2	52
9	51
8.9	50
8.7	49
8.5	48
8.4	47
8.2	46
8.1	45
7.9	44
7.7	43
7.6	42
7.4	41
7.2	40
7.1	39
6.9	38
6.8	37
6.6	36
6.4	35
6.3	34
6.1	33
6	32
5.8	31
5.6	30
5.5	29
5.3	28
5.1	27
5	26
4.8	25
4.7	24
4.5	23
4.3	22

Points	Push-Ups
4.2	21
4	20
3.9	19
3.7	18
3.5	17
3.4	16
3.2	15
3.1	14
2.9	13
2.7	12
2.6	11
2.4	10
2.2	9
2.1	8
1.9	7
1.8	6
1.6	5
1.4	4
1.3	3
1.1	2
1	1

Points	Sit-Ups
10	57
9.9	56
9.7	55
9.5	54
9.3	53
9.2	52
9	51
8.8	50
8.6	49
8.4	48
8.3	47
8.1	46
7.9	45
7.7	44
7.5	43
7.3	42
7.2	41
7	40
6.8	39
6.6	38
6.4	37
6.3	36
6.1	35
5.9	34
5.7	33
5.5	32
5.3	31
5.2	30
5	29
4.8	28
4.6	27
4.4	26
4.3	25
4.1	24
3.9	23
3.7	22

Points	Sit-Ups
3.5	21
3.3	20
3.2	19
3	18
2.8	17
2.6	16
2.4	15
2.3	14
2.1	13
1.9	12
1.7	11
1.5	10
1.3	9
1.2	8
1	7
0.8	6
0.6	5
0.4	4
0.3	3

Fit Group: M40 Run Time

Points	Run Time
60	0:10:32
59.9	0:10:34
59.3	0:10:40
58.8	0:10:45
58.3	0:10:50
57.8	0:10:55
57.3	0:11:00
57	0:11:04
56.5	0:11:09
56.1	0:11:13
55.7	0:11:17
55.4	0:11:20
55	0:11:24
54.7	0:11:27
54.3	0:11:31
54	0:11:34
53.7	0:11:37
53.5	0:11:40
53.2	0:11:43
52.9	0:11:46
52.6	0:11:49
52.3	0:11:52
52	0:11:55
51.8	0:11:57
51.5	0:12:00
51.2	0:12:03
50.9	0:12:06
50.6	0:12:09
50.4	0:12:11
50.1	0:12:14
50	0:12:15
49.7	0:12:19
49.4	0:12:22
49.2	0:12:24
48.9	0:12:27
48.6	0:12:30

Points	Run Time
48.5	0:12:31
48.2	0:12:34
47.9	0:12:37
47.6	0:12:40
47.4	0:12:42
47.1	0:12:45
46.9	0:12:47
46.6	0:12:50
46.4	0:12:53
46.2	0:12:55
45.9	0:12:58
45.7	0:13:00
45.5	0:13:02
45.2	0:13:05
44.9	0:13:08
44.7	0:13:10
44.5	0:13:12
44.2	0:13:15
43.9	0:13:18
43.7	0:13:20
43.4	0:13:23
43.2	0:13:25
42.9	0:13:29
42.8	0:13:30
42.5	0:13:33
42.2	0:13:36
41.9	0:13:39
41.7	0:13:41
41.3	0:13:45
41	0:13:48
40.7	0:13:51
40.4	0:13:54
40.1	0:13:57
39.8	0:14:00
39.5	0:14:03
39.2	0:14:07

Points	Run Time
38.9	0:14:10
38.5	0:14:14
38.2	0:14:17
37.9	0:14:20
37.6	0:14:23
37.2	0:14:27
36.8	0:14:31
36.2	0:14:37
35.8	0:14:42
35	0:14:50
34.6	0:14:54
33.9	0:15:01
33.1	0:15:09
32.5	0:15:15
31.6	0:15:25
30.3	0:15:38
28.8	0:15:53
27	0:16:12
24.8	0:16:35
21.7	0:17:07
17.4	0:17:51
9.9	0:19:08
1	0:20:39

Fit Group: M40 Push-Ups and Sit-Ups

Points	Push-Ups
10	52
9.9	51
9.7	50
9.6	49
9.4	48
9.3	47
9.1	46
8.9	45
8.8	44
8.6	43
8.5	42
8.3	41
8.1	40
8	39
7.8	38
7.6	37
7.5	36
7.3	35
7.2	34
7	33
6.8	32
6.7	31
6.5	30
6.4	29
6.2	28
6	27
5.9	26
5.7	25
5.5	24
5.4	23
5.2	22
5.1	21
4.9	20
4.7	19
4.6	18
4.4	17

Points	Push-Ups
4.3	16
4.1	15
3.9	14
3.8	13
3.6	12
3.5	11
3.3	10
3.1	9
3	8
2.8	7
2.6	6
2.5	5
2.3	4
2.2	3
2	2
1.8	1

Points	Sit-Ups
10	54
9.9	53
9.7	52
9.5	51
9.4	50
9.2	49
9	48
8.8	47
8.6	46
8.5	45
8.3	44
8.1	43
7.9	42
7.7	41
7.5	40
7.4	39
7.2	38
7	37
6.8	36
6.6	35
6.5	34
6.3	33
6.1	32
5.9	31
5.7	30
5.5	29
5.4	28
5.2	27
5	26
4.8	25
4.6	24
4.5	23
4.3	22
4.1	21
3.9	20
3.7	19

Points	Sit-Ups
3.5	18
3.4	17
3.2	16
3	15
2.8	14
2.6	13
2.5	12
2.3	11
2.1	10
1.9	9
1.7	8
1.5	7
1.4	6
1.2	5
1	4
0.8	3
0.6	2
0.5	1

Fit Group: M40-44 Run Time

Points	Run Time
60	0:10:27
59.8	0:10:30
59.2	0:10:36
58.6	0:10:42
58.1	0:10:47
57.7	0:10:52
57.3	0:10:56
56.8	0:11:01
56.4	0:11:05
56	0:11:09
55.6	0:11:13
55.2	0:11:17
54.9	0:11:20
54.5	0:11:24
54.3	0:11:27
54	0:11:30
53.6	0:11:34
53.3	0:11:37
53	0:11:40
52.7	0:11:43
52.5	0:11:45
52.2	0:11:48
51.9	0:11:51
51.6	0:11:54
51.4	0:11:56
51.1	0:11:59
50.9	0:12:02
50.7	0:12:04
50.4	0:12:07
50.1	0:12:10
49.9	0:12:12
49.6	0:12:15
49.4	0:12:17
49.1	0:12:20
48.9	0:12:22
48.6	0:12:25

Points	Run Time
48.4	0:12:27
48.1	0:12:30
47.9	0:12:32
47.6	0:12:35
47.4	0:12:38
47.2	0:12:40
47	0:12:42
46.7	0:12:45
46.5	0:12:47
46.2	0:12:50
46	0:12:52
45.7	0:12:55
45.4	0:12:58
45.2	0:13:00
44.9	0:13:03
44.7	0:13:05
44.4	0:13:08
44.2	0:13:10
44	0:13:12
43.8	0:13:15
43.5	0:13:18
43.3	0:13:20
43	0:13:23
42.7	0:13:26
42.4	0:13:29
42.2	0:13:31
41.9	0:13:34
41.7	0:13:36
41.4	0:13:39
41.1	0:13:42
40.8	0:13:45
40.4	0:13:49
40.2	0:13:52
39.9	0:13:55
39.5	0:13:59
39.2	0:14:02

Points	Run Time
38.9	0:14:05
38.5	0:14:09
38.2	0:14:12
37.8	0:14:16
37.4	0:14:20
37.2	0:14:22
36.8	0:14:27
36.5	0:14:30
35.9	0:14:36
35	0:14:45
34.6	0:14:49
34	0:14:55
33.3	0:15:02
32.5	0:15:11
31.8	0:15:18
30.6	0:15:30
29.2	0:15:45
27.3	0:16:04
25.2	0:16:26
22.1	0:16:58
17.6	0:17:44
9.4	0:19:08
1	0:20:35

Fit Group: M40-44 Push-Ups and Sit-Ups

Points	Push-Ups
10	52
9.9	51
9.7	50
9.6	49
9.4	48
9.2	47
9.1	46
8.9	45
8.7	44
8.6	43
8.4	42
8.3	41
8.1	40
7.9	39
7.8	38
7.6	37
7.5	36
7.3	35
7.1	34
7	33
6.8	32
6.6	31
6.5	30
6.3	29
6.2	28
6	27
5.8	26
5.7	25
5.5	24
5.4	23
5.2	22
5	21
4.9	20
4.7	19
4.6	18
4.4	17

Points	Push-Ups
4.2	16
4.1	15
3.9	14
3.7	13
3.6	12
3.4	11
3.3	10
3.1	9
2.9	8
2.8	7
2.6	6
2.5	5
2.3	4
2.1	3
2	2
1.8	1

Points	Sit-Ups
10	53
9.7	52
9.5	51
9.3	50
9.1	49
8.9	48
8.7	47
8.6	46
8.4	45
8.2	44
8	43
7.8	42
7.7	41
7.5	40
7.3	39
7.1	38
6.9	37
6.7	36
6.6	35
6.4	34
6.2	33
6	32
5.8	31
5.7	30
5.5	29
5.3	28
5.1	27
4.9	26
4.7	25
4.6	24
4.4	23
4.2	22
4	21
3.8	20
3.7	19
3.5	18

Points	Sit-Ups
3.3	17
3.1	16
2.9	15
2.7	14
2.6	13
2.4	12
2.2	11
2	10
1.8	9
1.7	8
1.5	7
1.3	6
1.1	5
0.9	4
0.7	3
0.6	2
0.4	1

Fit Group: M45-49 Run Time

Points	Run Time
60	0:10:42
59.6	0:10:47
59	0:10:53
58.5	0:10:58
58	0:11:03
57.5	0:11:08
57.1	0:11:12
56.6	0:11:17
56.3	0:11:20
56	0:11:24
55.6	0:11:28
55.2	0:11:32
54.9	0:11:35
54.5	0:11:39
54.2	0:11:42
53.9	0:11:45
53.6	0:11:48
53.3	0:11:51
53	0:11:54
52.7	0:11:57
52.5	0:12:00
52.2	0:12:03
51.9	0:12:06
51.5	0:12:10
51.3	0:12:12
51	0:12:15
50.7	0:12:18
50.4	0:12:21
50.2	0:12:23
49.9	0:12:26
49.6	0:12:29
49.4	0:12:31
49.1	0:12:34
49	0:12:36
48.7	0:12:39
48.4	0:12:42

Points	Run Time
48.2	0:12:44
47.9	0:12:47
47.6	0:12:50
47.4	0:12:52
47.1	0:12:55
46.9	0:12:57
46.6	0:13:00
46.4	0:13:02
46.1	0:13:05
45.8	0:13:08
45.6	0:13:10
45.5	0:13:12
45.2	0:13:15
44.9	0:13:18
44.7	0:13:20
44.4	0:13:23
44.2	0:13:25
43.9	0:13:28
43.7	0:13:30
43.4	0:13:33
43.2	0:13:35
42.9	0:13:38
42.7	0:13:40
42.3	0:13:44
42.1	0:13:46
41.8	0:13:50
41.6	0:13:52
41.3	0:13:55
41	0:13:58
40.7	0:14:01
40.4	0:14:04
40.1	0:14:07
39.8	0:14:10
39.5	0:14:13
39.2	0:14:16
38.8	0:14:20

Points	Run Time
38.6	0:14:22
38.4	0:14:25
38	0:14:29
37.7	0:14:32
37.2	0:14:37
36.7	0:14:42
36.2	0:14:47
35.7	0:14:52
35	0:14:59
34.5	0:15:05
33.9	0:15:11
33.2	0:15:18
32.2	0:15:28
31.1	0:15:40
29.8	0:15:53
28.2	0:16:09
26.6	0:16:26
24.3	0:16:50
21.3	0:17:20
17.3	0:18:01
10.8	0:19:08
1	0:20:49

Fit Group: M45-49 Push-Ups and Sit-Ups

Points	Push-Ups
10	51
9.8	50
9.6	49
9.5	48
9.3	47
9.2	46
9	45
8.8	44
8.7	43
8.5	42
8.4	41
8.2	40
8	39
7.9	38
7.7	37
7.5	36
7.4	35
7.2	34
7.1	33
6.9	32
6.7	31
6.6	30
6.4	29
6.3	28
6.1	27
5.9	26
5.8	25
5.6	24
5.5	23
5.3	22
5.1	21
5	20
4.8	19
4.6	18
4.5	17
4.3	16

Points	Push-Ups
4.2	15
4	14
3.8	13
3.7	12
3.5	11
3.4	10
3.2	9
3	8
2.9	7
2.7	6
2.5	5
2.4	4
2.2	3
2.1	2
1.9	1

Points	Sit-Ups
10	53
9.9	52
9.7	51
9.5	50
9.3	49
9.1	48
8.9	47
8.8	46
8.6	45
8.4	44
8.2	43
8	42
7.9	41
7.7	40
7.5	39
7.3	38
7.1	37
6.9	36
6.8	35
6.6	34
6.4	33
6.2	32
6	31
5.9	30
5.7	29
5.5	28
5.3	27
5.1	26
4.9	25
4.8	24
4.6	23
4.4	22
4.2	21
4	20
3.9	19
3.7	18

Points	Sit-Ups
3.5	17
3.3	16
3.1	15
2.9	14
2.8	13
2.6	12
2.4	11
2.2	10
2	9
1.9	8
1.7	7
1.5	6
1.3	5
1.1	4
0.9	3
0.8	2
0.6	1

Fit Group: M50 Run Time

Points	Run Time
60	0:11:33
59.6	0:11:37
59.2	0:11:42
58.7	0:11:47
58.2	0:11:52
57.8	0:11:56
57.4	0:12:00
56.9	0:12:05
56.5	0:12:09
56.1	0:12:13
55.8	0:12:17
55.5	0:12:20
55.1	0:12:24
54.7	0:12:28
54.4	0:12:31
54	0:12:35
53.7	0:12:38
53.3	0:12:42
53	0:12:45
52.7	0:12:48
52.3	0:12:52
52.1	0:12:55
51.8	0:12:58
51.5	0:13:01
51.1	0:13:05
50.8	0:13:08
50.5	0:13:11
50.2	0:13:14
49.9	0:13:17
49.6	0:13:20
49.3	0:13:23
49	0:13:26
48.7	0:13:30
48.5	0:13:32
48.2	0:13:35
47.9	0:13:38

Points	Run Time
47.6	0:13:41
47.3	0:13:44
47	0:13:47
46.7	0:13:50
46.4	0:13:53
46.1	0:13:56
45.8	0:13:59
45.5	0:14:02
45.2	0:14:06
45	0:14:08
44.7	0:14:11
44.4	0:14:14
44.1	0:14:17
43.8	0:14:20
43.5	0:14:23
43.3	0:14:25
42.9	0:14:29
42.6	0:14:32
42.3	0:14:35
42	0:14:38
41.7	0:14:41
41.4	0:14:45
41.1	0:14:48
40.8	0:14:51
40.4	0:14:55
40.1	0:14:58
39.8	0:15:01
39.4	0:15:05
39.1	0:15:08
38.7	0:15:12
38.4	0:15:15
38.2	0:15:17
37.8	0:15:22
37.4	0:15:26
37	0:15:30
36.5	0:15:35

Points	Run Time
36.1	0:15:39
35.6	0:15:44
35.2	0:15:48
35	0:15:50
34.2	0:15:59
33.6	0:16:05
33	0:16:11
32.3	0:16:18
31.6	0:16:25
30.7	0:16:35
29.7	0:16:45
28.7	0:16:55
27.4	0:17:09
25.8	0:17:25
24	0:17:44
21.9	0:18:05
19.3	0:18:32
15.8	0:19:08
1	0:21:40

Fit Group: M50 Push-Ups and Sit-Ups

Points	Push-Ups
10	49
9.9	48
9.7	47
9.6	46
9.4	45
9.3	44
9.1	43
8.9	42
8.8	41
8.6	40
8.5	39
8.3	38
8.1	37
8	36
7.8	35
7.7	34
7.5	33
7.3	32
7.2	31
7	30
6.8	29
6.7	28
6.5	27
6.4	26
6.2	25
6	24
5.9	23
5.7	22
5.6	21
5.4	20
5.2	19
5.1	18
4.9	17
4.7	16
4.6	15
4.4	14

Points	Push-Ups
4.3	13
4.1	12
3.9	11
3.8	10
3.6	9
3.5	8
3.3	7
3.1	6
3	5
2.8	4
2.7	3
2.5	2
2.3	1

Points	Sit-Ups
10	50
9.9	49
9.7	48
9.6	47
9.4	46
9.2	45
9	44
8.8	43
8.7	42
8.5	41
8.3	40
8.1	39
7.9	38
7.7	37
7.6	36
7.4	35
7.2	34
7	33
6.8	32
6.7	31
6.5	30
6.3	29
6.1	28
5.9	27
5.7	26
5.6	25
5.4	24
5.2	23
5	22
4.8	21
4.7	20
4.5	19
4.3	18
4.1	17
3.9	16
3.7	15

Points	Sit-Ups
3.6	14
3.4	13
3.2	12
3	11
2.8	10
2.7	9
2.5	8
2.3	7
2.1	6
1.9	5
1.7	4
1.6	3
1.4	2
1.2	1

Fit Group: M50-54 Run Time

Points	Run Time
60	0:11:24
59.5	0:11:30
59	0:11:35
58.5	0:11:40
58.1	0:11:45
57.6	0:11:50
57.2	0:11:54
56.8	0:11:58
56.4	0:12:02
56	0:12:06
55.6	0:12:10
55.3	0:12:13
54.9	0:12:17
54.6	0:12:20
54.3	0:12:24
53.9	0:12:28
53.6	0:12:31
53.3	0:12:34
52.9	0:12:38
52.6	0:12:41
52.3	0:12:44
52	0:12:47
51.7	0:12:50
51.3	0:12:54
51.1	0:12:56
50.8	0:13:00
50.5	0:13:03
50.1	0:13:07
49.8	0:13:10
49.5	0:13:13
49.2	0:13:16
48.9	0:13:19
48.6	0:13:22
48.3	0:13:25
48.1	0:13:27
47.8	0:13:30

Points	Run Time
47.5	0:13:34
47.3	0:13:36
47	0:13:39
46.7	0:13:42
46.4	0:13:45
46.1	0:13:48
45.9	0:13:50
45.6	0:13:53
45.2	0:13:57
44.9	0:14:00
44.7	0:14:02
44.4	0:14:05
44.1	0:14:08
43.9	0:14:11
43.5	0:14:15
43.2	0:14:18
43	0:14:20
42.7	0:14:23
42.4	0:14:26
42	0:14:30
41.8	0:14:32
41.4	0:14:36
41.1	0:14:39
40.8	0:14:42
40.5	0:14:45
40.2	0:14:49
39.9	0:14:52
39.5	0:14:56
39.1	0:15:00
38.8	0:15:03
38.4	0:15:07
38.1	0:15:10
37.7	0:15:14
37.4	0:15:17
37	0:15:21
36.7	0:15:25

Points	Run Time
36.2	0:15:30
35.8	0:15:34
35.2	0:15:40
35	0:15:42
34.4	0:15:48
33.8	0:15:54
33.3	0:16:00
32.6	0:16:07
31.8	0:16:15
31.1	0:16:22
30	0:16:33
28.9	0:16:45
27.7	0:16:57
26.3	0:17:12
24.3	0:17:32
21.8	0:17:58
19	0:18:27
15	0:19:08
1	0:21:32

Fit Group: M50-54 Push-Ups and Sit-Ups

Points	Push-Ups
10	49
9.8	48
9.7	47
9.5	46
9.3	45
9.2	44
9	43
8.9	42
8.7	41
8.5	40
8.4	39
8.2	38
8	37
7.9	36
7.7	35
7.6	34
7.4	33
7.2	32
7.1	31
6.9	30
6.8	29
6.6	28
6.4	27
6.3	26
6.1	25
5.9	24
5.8	23
5.6	22
5.5	21
5.3	20
5.1	19
5	18
4.8	17
4.7	16
4.5	15
4.3	14

Points	Push-Ups
4.2	13
4	12
3.9	11
3.7	10
3.5	9
3.4	8
3.2	7
3	6
2.9	5
2.7	4
2.6	3
2.4	2
2.2	1

Points	Sit-Ups
10	50
9.8	49
9.7	48
9.5	47
9.3	46
9.1	45
8.9	44
8.7	43
8.6	42
8.4	41
8.2	40
8	39
7.8	38
7.7	37
7.5	36
7.3	35
7.1	34
6.9	33
6.7	32
6.6	31
6.4	30
6.2	29
6	28
5.8	27
5.7	26
5.5	25
5.3	24
5.1	23
4.9	22
4.7	21
4.6	20
4.4	19
4.2	18
4	17
3.8	16
3.7	15

Points	Sit-Ups
3.5	14
3.3	13
3.1	12
2.9	11
2.7	10
2.6	9
2.4	8
2.2	7
2	6
1.8	5
1.7	4
1.5	3
1.3	2
1.1	1

Fit Group: M55-59 Run Time

Points	Run Time
60	0:12:02
59.7	0:12:05
59.3	0:12:09
58.8	0:12:15
58.3	0:12:20
57.8	0:12:25
57.3	0:12:30
57	0:12:33
56.5	0:12:38
56.1	0:12:42
55.8	0:12:45
55.4	0:12:49
55.1	0:12:53
54.8	0:12:56
54.4	0:13:00
54.1	0:13:03
53.7	0:13:07
53.4	0:13:10
53	0:13:14
52.7	0:13:17
52.3	0:13:21
52	0:13:24
51.6	0:13:28
51.3	0:13:31
51.1	0:13:34
50.8	0:13:37
50.5	0:13:40
50.2	0:13:43
49.9	0:13:46
49.5	0:13:50
49.2	0:13:53
48.9	0:13:56
48.6	0:13:59
48.3	0:14:02
48	0:14:05
47.7	0:14:08

Points	Run Time
47.4	0:14:11
47.2	0:14:14
46.9	0:14:17
46.6	0:14:20
46.4	0:14:22
46.1	0:14:25
45.8	0:14:28
45.5	0:14:31
45.2	0:14:34
44.9	0:14:37
44.6	0:14:40
44.3	0:14:43
44	0:14:46
43.7	0:14:49
43.4	0:14:52
43.2	0:14:55
42.9	0:14:58
42.6	0:15:01
42.3	0:15:04
42	0:15:07
41.7	0:15:10
41.5	0:15:12
41.2	0:15:15
40.9	0:15:18
40.6	0:15:21
40.2	0:15:25
39.9	0:15:28
39.5	0:15:32
39.3	0:15:34
38.9	0:15:39
38.5	0:15:43
38.2	0:15:46
37.8	0:15:50
37.4	0:15:54
36.9	0:15:59
36.4	0:16:04

Points	Run Time
36	0:16:08
35.5	0:16:13
35	0:16:19
34.7	0:16:22
34	0:16:29
33.4	0:16:35
32.6	0:16:43
31.9	0:16:50
31.2	0:16:58
30.5	0:17:05
29.4	0:17:16
28.2	0:17:28
27.3	0:17:37
25.8	0:17:53
24.4	0:18:07
22.7	0:18:25
20.8	0:18:44
18.5	0:19:08
1	0:22:07

Fit Group: M55-59 Push-Ups and Sit-Ups

Points	Push-Ups
10	47
9.9	46
9.7	45
9.6	44
9.4	43
9.3	42
9.1	41
8.9	40
8.8	39
8.6	38
8.5	37
8.3	36
8.1	35
8	34
7.8	33
7.7	32
7.5	31
7.3	30
7.2	29
7	28
6.8	27
6.7	26
6.5	25
6.4	24
6.2	23
6	22
5.9	21
5.7	20
5.6	19
5.4	18
5.2	17
5.1	16
4.9	15
4.7	14
4.6	13
4.4	12

Points	Push-Ups
4.3	11
4.1	10
3.9	9
3.8	8
3.6	7
3.5	6
3.3	5
3.1	4
3	3
2.8	2
2.7	1

Points	Sit-Ups
10	48
9.9	47
9.7	46
9.5	45
9.3	44
9.1	43
9	42
8.8	41
8.6	40
8.4	39
8.2	38
8.1	37
7.9	36
7.7	35
7.5	34
7.3	33
7.1	32
7	31
6.8	30
6.6	29
6.4	28
6.2	27
6.1	26
5.9	25
5.7	24
5.5	23
5.3	22
5.1	21
5	20
4.8	19
4.6	18
4.4	17
4.2	16
4.1	15
3.9	14
3.7	13

Points	Sit-Ups
3.5	12
3.3	11
3.1	10
3	9
2.8	8
2.6	7
2.4	6
2.2	5
2.1	4
1.9	3
1.7	2
1.5	1

Fit Group: M60 Run Time

Points	Run Time
60	0:12:11
59.5	0:12:16
59.1	0:12:20
58.5	0:12:25
58.1	0:12:29
58	0:12:30
57.4	0:12:35
57	0:12:39
56.4	0:12:44
56.1	0:12:47
55.7	0:12:51
55.5	0:12:52
55.2	0:12:55
54.6	0:13:00
54.4	0:13:02
54.1	0:13:05
53.7	0:13:09
53.3	0:13:12
53	0:13:15
52.6	0:13:18
52.2	0:13:22
51.8	0:13:26
51.4	0:13:29
51.2	0:13:31
50.9	0:13:34
50.6	0:13:36
50.3	0:13:39
49.9	0:13:43
49.6	0:13:45
49.3	0:13:48
49.1	0:13:50
48.6	0:13:54
48.4	0:13:56
48.2	0:13:58
48	0:14:00
47.5	0:14:04

Points	Run Time
47.4	0:14:05
47.1	0:14:08
46.9	0:14:10
46.5	0:14:13
46.3	0:14:15
46	0:14:18
45.8	0:14:19
45.4	0:14:23
44.9	0:14:28
44.5	0:14:31
43.9	0:14:37
43.5	0:14:40
43	0:14:45
42.7	0:14:47
42.4	0:14:50
41.8	0:14:55
41.6	0:14:57
41.3	0:15:00
41.1	0:15:02
40.8	0:15:04
40.4	0:15:08
40	0:15:12
39.8	0:15:13
39.4	0:15:17
39.1	0:15:20
38.6	0:15:24
38.2	0:15:28
37.5	0:15:34
36.9	0:15:39
36.3	0:15:45
36	0:15:48
35.4	0:15:53
35	0:15:57
34.6	0:16:00
34.4	0:16:02
33.3	0:16:12

Points	Run Time
32.4	0:16:20
31.9	0:16:24
31.5	0:16:28
30.7	0:16:35
30	0:16:41
29	0:16:50
28.7	0:16:53
27.9	0:17:00
27.1	0:17:07
26.3	0:17:15
24.8	0:17:28
23	0:17:44
21.4	0:17:59
19.7	0:18:14
14.1	0:19:04
1	0:21:02

Fit Group: M60 Push-Ups and Sit-Ups

Points	Push-Ups
10	44
9.8	43
9.7	42
9.5	41
9.4	40
9.2	39
9	38
8.9	37
8.7	36
8.5	35
8.4	34
8.2	33
8.1	32
7.9	31
7.7	30
7.6	29
7.4	28
7.3	27
7.1	26
6.9	25
6.8	24
6.6	23
6.4	22
6.3	21
6.1	20
6	19
5.8	18
5.6	17
5.5	16
5.3	15
5.2	14
5	13
4.8	12
4.7	11
4.5	10
4.4	9

Points	Push-Ups
4.2	8
4	7
3.9	6
3.7	5
3.5	4
3.4	3
3.2	2
3.1	1

Points	Sit-Ups
10	47
9.8	46
9.6	45
9.4	44
9.1	43
8.9	42
8.7	41
8.5	40
8.3	39
8.1	38
7.8	37
7.6	36
7.4	35
7.2	34
7	33
6.7	32
6.5	31
6.3	30
6.1	29
5.9	28
5.7	27
5.4	26
5.2	25
5	24
4.8	23
4.6	22
4.4	21
4.1	20
3.9	19
3.7	18
3.5	17
3.3	16
3.1	15
2.8	14
2.6	13
2.4	12

Points	Sit-Ups
2.2	11
2	10
1.7	9
1.5	8
1.3	7
1.1	6
0.9	5
0.7	4
0.4	3
0.2	2

Fit Group: F20 Run Time

Points	Run Time
60	0:11:33
59.8	0:11:36
59.2	0:11:43
58.6	0:11:50
58.1	0:11:55
57.7	0:12:00
57.3	0:12:05
56.9	0:12:09
56.4	0:12:15
56	0:12:20
55.7	0:12:23
55.3	0:12:28
55.1	0:12:30
54.7	0:12:35
54.4	0:12:39
54	0:12:43
53.8	0:12:46
53.4	0:12:50
53.2	0:12:53
52.9	0:12:56
52.7	0:12:58
52.4	0:13:02
52.1	0:13:05
51.9	0:13:08
51.6	0:13:11
51.4	0:13:14
51.2	0:13:16
50.9	0:13:19
50.7	0:13:22
50.4	0:13:25
50.2	0:13:28
50	0:13:30
49.7	0:13:33
49.5	0:13:36
49.3	0:13:38
49.1	0:13:40

Points	Run Time
48.9	0:13:43
48.6	0:13:46
48.5	0:13:47
48.2	0:13:51
47.9	0:13:54
47.8	0:13:56
47.5	0:13:59
47.3	0:14:01
47.1	0:14:04
46.8	0:14:07
46.6	0:14:10
46.4	0:14:12
46.1	0:14:15
45.9	0:14:18
45.7	0:14:20
45.5	0:14:22
45.2	0:14:26
44.9	0:14:29
44.8	0:14:31
44.4	0:14:35
44.3	0:14:36
44	0:14:40
43.7	0:14:43
43.4	0:14:47
43.1	0:14:50
43	0:14:52
42.7	0:14:55
42.4	0:14:59
42.1	0:15:02
41.9	0:15:04
41.6	0:15:08
41.3	0:15:11
41	0:15:15
40.7	0:15:18
40.5	0:15:21
40.1	0:15:25

Points	Run Time
39.8	0:15:29
39.5	0:15:32
39.2	0:15:36
38.9	0:15:39
38.5	0:15:44
38.2	0:15:48
37.8	0:15:52
37.4	0:15:57
37	0:16:02
36.5	0:16:07
36	0:16:13
35.5	0:16:19
35	0:16:25
34.4	0:16:32
33.6	0:16:41
32.9	0:16:49
31.9	0:17:01
30.8	0:17:14
29.5	0:17:29
28.1	0:17:45
26.1	0:18:09
23.2	0:18:43
18.7	0:19:35
7.1	0:21:50
1	0:23:02

Fit Group: F20 Push-Ups and Sit-Ups

Points	Push-Ups
10	40
9.9	39
9.7	38
9.5	37
9.4	36
9.2	35
9	34
8.8	33
8.7	32
8.5	31
8.3	30
8.1	29
8	28
7.8	27
7.6	26
7.4	25
7.2	24
7.1	23
6.9	22
6.7	21
6.5	20
6.4	19
6.2	18
6	17
5.8	16
5.7	15
5.5	14
5.3	13
5.1	12
5	11
4.8	10
4.6	9
4.4	8
4.3	7
4.1	6
3.9	5

Points	Push-Ups
3.7	4
3.6	3
3.4	2
3.2	1

Points	Sit-Ups
10	55
9.9	54
9.7	53
9.5	52
9.3	51
9.2	50
9	49
8.8	48
8.6	47
8.4	46
8.3	45
8.1	44
7.9	43
7.7	42
7.6	41
7.4	40
7.2	39
7	38
6.8	37
6.7	36
6.5	35
6.3	34
6.1	33
5.9	32
5.8	31
5.6	30
5.4	29
5.2	28
5.1	27
4.9	26
4.7	25
4.5	24
4.3	23
4.2	22
4	21
3.8	20

Points	Sit-Ups
3.6	19
3.4	18
3.3	17
3.1	16
2.9	15
2.7	14
2.6	13
2.4	12
2.2	11
2	10
1.8	9
1.7	8
1.5	7
1.3	6
1.1	5
0.9	4
0.8	3
0.6	2
0.4	1

Fit Group: F20-24 Run Time

Points	Run Time
60	0:11:28
59.4	0:11:36
58.8	0:11:43
58.2	0:11:50
57.7	0:11:55
57.3	0:12:00
56.9	0:12:05
56.4	0:12:11
56.1	0:12:14
55.8	0:12:18
55.4	0:12:22
55.1	0:12:26
54.7	0:12:30
54.5	0:12:33
54.1	0:12:37
53.9	0:12:40
53.6	0:12:43
53.3	0:12:47
53	0:12:50
52.8	0:12:53
52.5	0:12:56
52.2	0:13:00
52.1	0:13:01
51.8	0:13:04
51.6	0:13:07
51.3	0:13:10
51.1	0:13:12
50.9	0:13:15
50.6	0:13:18
50.4	0:13:21
50.2	0:13:23
49.9	0:13:26
49.8	0:13:28
49.6	0:13:30
49.3	0:13:33
49.2	0:13:35

Points	Run Time
48.9	0:13:38
48.7	0:13:40
48.5	0:13:43
48.3	0:13:45
48.1	0:13:47
47.9	0:13:50
47.7	0:13:52
47.4	0:13:56
47.3	0:13:57
47	0:14:00
46.8	0:14:03
46.6	0:14:05
46.3	0:14:08
46.2	0:14:10
45.9	0:14:13
45.6	0:14:17
45.4	0:14:19
45.2	0:14:21
45	0:14:24
44.7	0:14:27
44.4	0:14:31
44.2	0:14:33
43.9	0:14:36
43.7	0:14:39
43.4	0:14:42
43.2	0:14:45
42.8	0:14:49
42.6	0:14:52
42.3	0:14:55
42	0:14:59
41.7	0:15:02
41.4	0:15:06
41.1	0:15:09
40.8	0:15:13
40.6	0:15:15
40.2	0:15:20

Points	Run Time
39.9	0:15:23
39.6	0:15:27
39.3	0:15:30
38.9	0:15:35
38.5	0:15:39
38.2	0:15:43
37.8	0:15:48
37.4	0:15:52
36.9	0:15:58
36.5	0:16:03
36	0:16:09
35.4	0:16:16
35	0:16:20
34.3	0:16:28
33.6	0:16:37
32.8	0:16:46
31.9	0:16:56
30.8	0:17:09
29.5	0:17:24
28.2	0:17:40
26.1	0:18:04
23.2	0:18:38
18.7	0:19:30
6.6	0:21:52
23.1	0:18:39
18.7	0:19:30
6.6	0:21:52
1	0:22:57

Fit Group: F20-24 Push-Ups and Sit-Ups

Points	Push-Ups
10	40
9.8	39
9.6	38
9.5	37
9.3	36
9.1	35
8.9	34
8.8	33
8.6	32
8.4	31
8.2	30
8.1	29
7.9	28
7.7	27
7.5	26
7.4	25
7.2	24
7	23
6.8	22
6.7	21
6.5	20
6.3	19
6.1	18
6	17
5.8	16
5.6	15
5.4	14
5.3	13
5.1	12
4.9	11
4.7	10
4.6	9
4.4	8
4.2	7
4	6
3.9	5

Points	Push-Ups
3.7	4
3.5	3
3.3	2
3.1	1

Points	Sit-Ups
10	55
9.8	54
9.6	53
9.4	52
9.3	51
9.1	50
8.9	49
8.7	48
8.6	47
8.4	46
8.2	45
8	44
7.8	43
7.7	42
7.5	41
7.3	40
7.1	39
6.9	38
6.8	37
6.6	36
6.4	35
6.2	34
6.1	33
5.9	32
5.7	31
5.5	30
5.3	29
5.2	28
5	27
4.8	26
4.6	25
4.4	24
4.3	23
4.1	22
3.9	21
3.7	20

Points	Sit-Ups
3.6	19
3.4	18
3.2	17
3	16
2.8	15
2.7	14
2.5	13
2.3	12
2.1	11
1.9	10
1.8	9
1.6	8
1.4	7
1.2	6
1.1	5
0.9	4
0.7	3
0.5	2
0.3	1

Fit Group: F25-29 Run Time

Points	Run Time
60	0:11:42
59.8	0:11:43
59.2	0:11:50
58.7	0:11:55
58.1	0:12:02
57.7	0:12:07
57.3	0:12:12
56.9	0:12:16
56.4	0:12:22
56	0:12:27
55.7	0:12:30
55.3	0:12:35
55	0:12:39
54.6	0:12:43
54.3	0:12:47
54	0:12:50
53.7	0:12:54
53.3	0:12:58
53.1	0:13:01
52.8	0:13:04
52.5	0:13:08
52.2	0:13:11
52	0:13:14
51.7	0:13:17
51.5	0:13:19
51.1	0:13:24
50.9	0:13:26
50.6	0:13:30
50.4	0:13:32
50.2	0:13:35
49.9	0:13:38
49.7	0:13:40
49.4	0:13:44
49.1	0:13:47
48.9	0:13:50
48.7	0:13:52

Points	Run Time
48.5	0:13:54
48.2	0:13:58
48	0:14:00
47.8	0:14:03
47.5	0:14:06
47.3	0:14:08
47	0:14:12
46.8	0:14:14
46.6	0:14:17
46.3	0:14:20
46.1	0:14:22
45.9	0:14:25
45.6	0:14:28
45.5	0:14:29
45.2	0:14:33
44.9	0:14:36
44.7	0:14:39
44.4	0:14:42
44.2	0:14:45
43.9	0:14:48
43.7	0:14:50
43.5	0:14:53
43.2	0:14:56
43	0:14:59
42.7	0:15:02
42.5	0:15:04
42.2	0:15:08
42	0:15:10
41.8	0:15:13
41.5	0:15:16
41.3	0:15:18
41	0:15:22
40.7	0:15:25
40.4	0:15:29
40.1	0:15:32
39.9	0:15:35

Points	Run Time
39.5	0:15:39
39.2	0:15:43
38.9	0:15:46
38.6	0:15:50
38.3	0:15:53
37.8	0:15:59
37.5	0:16:03
37.1	0:16:07
36.6	0:16:13
36.1	0:16:19
35.8	0:16:23
35	0:16:32
34.5	0:16:38
33.7	0:16:47
32.9	0:16:56
31.9	0:17:08
30.9	0:17:20
29.7	0:17:34
28.1	0:17:52
26.2	0:18:15
23.1	0:18:51
18.5	0:19:44
7.7	0:21:50
1	0:23:09

Fit Group: F25-29 Push-Ups and Sit-Ups

Points	Push-Ups
10	39
9.8	38
9.6	37
9.5	36
9.3	35
9.1	34
8.9	33
8.8	32
8.6	31
8.4	30
8.2	29
8	28
7.9	27
7.7	26
7.5	25
7.3	24
7.2	23
7	22
6.8	21
6.6	20
6.5	19
6.3	18
6.1	17
5.9	16
5.8	15
5.6	14
5.4	13
5.2	12
5.1	11
4.9	10
4.7	9
4.5	8
4.4	7
4.2	6
4	5
3.8	4

Points	Push-Ups
3.7	3
3.5	2
3.3	1

Points	Sit-Ups
10	54
9.8	53
9.6	52
9.4	51
9.3	50
9.1	49
8.9	48
8.7	47
8.5	46
8.4	45
8.2	44
8	43
7.8	42
7.6	41
7.5	40
7.3	39
7.1	38
6.9	37
6.8	36
6.6	35
6.4	34
6.2	33
6	32
5.9	31
5.7	30
5.5	29
5.3	28
5.1	27
5	26
4.8	25
4.6	24
4.4	23
4.3	22
4.1	21
3.9	20
3.7	19

Points	Sit-Ups
3.5	18
3.4	17
3.2	16
3	15
2.8	14
2.6	13
2.5	12
2.3	11
2.1	10
1.9	9
1.8	8
1.6	7
1.4	6
1.2	5
1	4
0.9	3
0.7	2
0.5	1

Fit Group: F30 Run Time

Points	Run Time
60	0:11:55
59.3	0:12:04
58.8	0:12:10
58.2	0:12:17
57.6	0:12:24
57.2	0:12:28
56.8	0:12:33
56.4	0:12:38
55.9	0:12:43
55.6	0:12:47
55.2	0:12:52
54.8	0:12:56
54.5	0:13:00
54.2	0:13:03
53.9	0:13:07
53.5	0:13:11
53.2	0:13:15
52.9	0:13:18
52.7	0:13:21
52.3	0:13:25
52.1	0:13:28
51.8	0:13:31
51.6	0:13:34
51.3	0:13:37
51	0:13:41
50.8	0:13:43
50.5	0:13:46
50.3	0:13:49
50	0:13:52
49.8	0:13:55
49.5	0:13:58
49.3	0:14:00
49.1	0:14:03
48.8	0:14:06
48.6	0:14:09
48.3	0:14:12

Points	Run Time
48	0:14:16
47.9	0:14:17
47.6	0:14:20
47.4	0:14:23
47.2	0:14:25
46.9	0:14:28
46.8	0:14:30
46.5	0:14:33
46.2	0:14:37
46	0:14:39
45.7	0:14:42
45.6	0:14:44
45.3	0:14:47
45	0:14:51
44.9	0:14:52
44.6	0:14:55
44.4	0:14:58
44.2	0:15:00
43.9	0:15:03
43.7	0:15:06
43.4	0:15:09
43.2	0:15:12
43	0:15:14
42.7	0:15:17
42.6	0:15:19
42.3	0:15:22
42	0:15:26
41.8	0:15:28
41.5	0:15:31
41.3	0:15:34
41	0:15:37
40.8	0:15:40
40.5	0:15:43
40.2	0:15:47
40	0:15:49
39.6	0:15:54

Points	Run Time
39.3	0:15:57
39	0:16:01
38.6	0:16:05
38.3	0:16:09
37.9	0:16:13
37.5	0:16:18
37.2	0:16:22
36.8	0:16:26
36.3	0:16:32
35.8	0:16:38
35	0:16:47
34.6	0:16:52
34	0:16:59
33.1	0:17:09
32.2	0:17:20
31.2	0:17:32
30	0:17:46
28.4	0:18:04
26.4	0:18:28
23.4	0:19:03
19.1	0:19:53
9	0:21:51
1	0:23:24

Fit Group: F30 Push-Ups and Sit-Ups

Points	Push-Ups
10	37
9.9	36
9.7	35
9.5	34
9.3	33
9.2	32
9	31
8.8	30
8.6	29
8.5	28
8.3	27
8.1	26
7.9	25
7.8	24
7.6	23
7.4	22
7.2	21
7.1	20
6.9	19
6.7	18
6.5	17
6.4	16
6.2	15
6	14
5.8	13
5.7	12
5.5	11
5.3	10
5.1	9
5	8
4.8	7
4.6	6
4.4	5
4.3	4
4.1	3
3.9	2

Points	Push-Ups
3.7	1

Points	Sit-Ups
10	51
9.8	49
9.6	48
9.5	47
9.3	46
9.1	45
8.9	44
8.7	43
8.6	42
8.4	41
8.2	40
8	39
7.8	38
7.7	37
7.5	36
7.3	35
7.1	34
7	33
6.8	32
6.6	31
6.4	30
6.2	29
6.1	28
5.9	27
5.7	26
5.5	25
5.3	24
5.2	23
5	22
4.8	21
4.6	20
4.5	19
4.3	18
4.1	17
3.9	16
3.7	15

Points	Sit-Ups
3.6	14
3.4	13
3.2	12
3	11
2.8	10
2.7	9
2.5	8
2.3	7
2.1	6
2	5
1.8	4
1.6	3
1.4	2
1.2	1

Fit Group: F30-34 Run Time

Points	Run Time
60	0:11:50
59.8	0:11:53
59.2	0:12:00
58.7	0:12:06
58.1	0:12:13
57.7	0:12:18
57.2	0:12:23
56.7	0:12:29
56.3	0:12:34
55.9	0:12:39
55.5	0:12:43
55.2	0:12:47
54.8	0:12:51
54.5	0:12:55
54.1	0:13:00
53.8	0:13:03
53.5	0:13:07
53.2	0:13:10
52.9	0:13:14
52.6	0:13:17
52.3	0:13:21
52	0:13:24
51.8	0:13:26
51.5	0:13:30
51.2	0:13:33
51	0:13:36
50.7	0:13:39
50.5	0:13:42
50.2	0:13:45
50	0:13:47
49.7	0:13:51
49.4	0:13:54
49.3	0:13:56
49	0:13:59
48.8	0:14:01
48.5	0:14:05

Points	Run Time
48.2	0:14:08
48.1	0:14:10
47.8	0:14:13
47.6	0:14:15
47.3	0:14:19
47.1	0:14:21
46.9	0:14:24
46.7	0:14:26
46.4	0:14:29
46.2	0:14:32
45.9	0:14:35
45.8	0:14:36
45.5	0:14:40
45.2	0:14:43
45.1	0:14:45
44.8	0:14:48
44.6	0:14:50
44.4	0:14:53
44.1	0:14:56
43.9	0:14:59
43.7	0:15:01
43.4	0:15:04
43.2	0:15:07
42.9	0:15:10
42.8	0:15:11
42.5	0:15:15
42.2	0:15:18
42	0:15:21
41.7	0:15:24
41.5	0:15:27
41.2	0:15:30
41	0:15:32
40.7	0:15:36
40.4	0:15:39
40.2	0:15:42
39.9	0:15:45

Points	Run Time
39.7	0:15:48
39.3	0:15:52
39	0:15:56
38.6	0:16:00
38.3	0:16:04
38	0:16:07
37.5	0:16:13
37.2	0:16:17
36.8	0:16:21
36.4	0:16:26
35.9	0:16:32
35.3	0:16:39
35	0:16:42
34.1	0:16:53
33.4	0:17:01
32.5	0:17:12
31.4	0:17:24
30.4	0:17:36
28.8	0:17:55
26.7	0:18:19
23.9	0:18:52
19.6	0:19:42
8.6	0:21:50
1	0:23:19

Fit Group: F30-34 Push-Ups and Sit-Ups

Points	Push-Ups
10	38
9.9	37
9.8	36
9.6	35
9.4	34
9.2	33
9.1	32
8.9	31
8.7	30
8.5	29
8.3	28
8.2	27
8	26
7.8	25
7.6	24
7.5	23
7.3	22
7.1	21
6.9	20
6.8	19
6.6	18
6.4	17
6.2	16
6.1	15
5.9	14
5.7	13
5.5	12
5.4	11
5.2	10
5	9
4.8	8
4.7	7
4.5	6
4.3	5
4.1	4
4	3

Points	Push-Ups
3.8	2
3.6	1

Points	Sit-Ups
10	51
9.9	50
9.7	49
9.5	48
9.3	47
9.2	46
9	45
8.8	44
8.6	43
8.4	42
8.3	41
8.1	40
7.9	39
7.7	38
7.6	37
7.4	36
7.2	35
7	34
6.8	33
6.7	32
6.5	31
6.3	30
6.1	29
5.9	28
5.8	27
5.6	26
5.4	25
5.2	24
5.1	23
4.9	22
4.7	21
4.5	20
4.3	19
4.2	18
4	17
3.8	16

Points	Sit-Ups
3.6	15
3.4	14
3.3	13
3.1	12
2.9	11
2.7	10
2.6	9
2.4	8
2.2	7
2	6
1.8	5
1.7	4
1.5	3
1.3	2
1.1	1

Fit Group: F35-39 Run Time

Points	Run Time
60	0:12:02
59.3	0:12:10
58.7	0:12:17
58.1	0:12:24
57.7	0:12:29
57.3	0:12:34
56.8	0:12:40
56.3	0:12:45
56	0:12:49
55.6	0:12:54
55.2	0:12:58
54.9	0:13:02
54.5	0:13:06
54.2	0:13:10
53.9	0:13:13
53.6	0:13:17
53.3	0:13:20
53	0:13:24
52.7	0:13:27
52.4	0:13:31
52.1	0:13:34
51.9	0:13:37
51.6	0:13:40
51.4	0:13:43
51	0:13:47
50.8	0:13:50
50.5	0:13:53
50.3	0:13:55
50.1	0:13:58
49.8	0:14:01
49.6	0:14:04
49.3	0:14:07
49.1	0:14:09
48.9	0:14:12
48.6	0:14:15
48.4	0:14:18

Points	Run Time
48.2	0:14:20
47.9	0:14:23
47.7	0:14:26
47.4	0:14:29
47.3	0:14:30
47	0:14:34
46.7	0:14:37
46.5	0:14:40
46.3	0:14:42
46.1	0:14:44
45.8	0:14:48
45.6	0:14:50
45.4	0:14:53
45.1	0:14:56
44.9	0:14:58
44.7	0:15:01
44.4	0:15:04
44.3	0:15:05
44	0:15:09
43.7	0:15:12
43.5	0:15:15
43.3	0:15:17
43.1	0:15:19
42.9	0:15:22
42.6	0:15:25
42.4	0:15:28
42.1	0:15:31
41.9	0:15:33
41.3	0:15:40
41.1	0:15:43
40.8	0:15:46
40.7	0:15:47
40.7	0:15:47
40.3	0:15:52
40	0:15:56
39.6	0:16:00

Points	Sit-Ups
39.4	0:16:03
38.9	0:16:08
38.6	0:16:12
38.3	0:16:15
37.9	0:16:20
37.7	0:16:22
37.2	0:16:28
36.7	0:16:34
36.2	0:16:40
35.7	0:16:46
35	0:16:54
34.5	0:17:00
33.7	0:17:09
32.9	0:17:18
31.9	0:17:30
31.1	0:17:39
29.5	0:17:58
28.1	0:18:14
25.9	0:18:40
22.9	0:19:15
18.8	0:20:03
9.5	0:21:51
1	0:23:31

Fit Group: F35-39 Push-Ups and Sit-Ups

Points	Push-Ups
10	36
9.8	35
9.7	34
9.5	33
9.3	32
9.1	31
9	30
8.8	29
8.6	28
8.4	27
8.3	26
8.1	25
7.9	24
7.7	23
7.6	22
7.4	21
7.2	20
7	19
6.9	18
6.7	17
6.5	16
6.3	15
6.2	14
6	13
5.8	12
5.6	11
5.5	10
5.3	9
5.1	8
4.9	7
4.8	6
4.6	5
4.4	4
4.2	3
4.1	2
3.9	1

Points	Sit-Ups
10	49
9.8	48
9.6	47
9.4	46
9.3	45
9.1	44
8.9	43
8.7	42
8.5	41
8.4	40
8.2	39
8	38
7.8	37
7.7	36
7.5	35
7.3	34
7.1	33
6.9	32
6.8	31
6.6	30
6.4	29
6.2	28
6	27
5.9	26
5.7	25
5.5	24
5.3	23
5.2	22
5	21
4.8	20
4.6	19
4.4	18
4.3	17
4.1	16
3.9	15
3.7	14

Points	Sit-Ups
3.5	13
3.4	12
3.2	11
3	10
2.8	9
2.7	8
2.5	7
2.3	6
2.1	5
1.9	4
1.8	3
1.6	2
1.4	1

Fit Group: F40 Run Time

Points	Run Time
60	0:12:45
59.8	0:12:48
59.2	0:12:55
58.7	0:13:00
58.3	0:13:05
57.9	0:13:10
57.4	0:13:16
57	0:13:20
56.6	0:13:25
56.2	0:13:30
55.9	0:13:33
55.5	0:13:38
55.1	0:13:42
54.8	0:13:46
54.4	0:13:51
54.1	0:13:54
53.8	0:13:58
53.5	0:14:01
53.2	0:14:05
52.8	0:14:09
52.5	0:14:13
52.2	0:14:16
51.9	0:14:20
51.6	0:14:23
51.3	0:14:27
51	0:14:30
50.7	0:14:34
50.4	0:14:37
50.1	0:14:41
49.8	0:14:44
49.5	0:14:48
49.2	0:14:51
49	0:14:54
48.7	0:14:57
48.4	0:15:01
48.1	0:15:04

Points	Run Time
47.8	0:15:08
47.6	0:15:10
47.3	0:15:13
47	0:15:17
46.7	0:15:20
46.5	0:15:23
46.2	0:15:26
45.9	0:15:30
45.7	0:15:32
45.4	0:15:36
45.1	0:15:39
44.8	0:15:43
44.5	0:15:46
44.2	0:15:50
43.9	0:15:53
43.6	0:15:57
43.3	0:16:00
43	0:16:04
42.7	0:16:07
42.4	0:16:11
42.1	0:16:14
41.8	0:16:18
41.5	0:16:21
41.2	0:16:25
40.9	0:16:28
40.6	0:16:32
40.2	0:16:36
39.9	0:16:40
39.5	0:16:44
39.2	0:16:48
38.4	0:16:57
38.4	0:16:57
38.2	0:17:00
37.7	0:17:05
37.3	0:17:10
36.9	0:17:15

Points	Run Time
36.4	0:17:21
36	0:17:25
35.6	0:17:30
35	0:17:37
34.7	0:17:40
34.3	0:17:45
33.7	0:17:52
33.1	0:17:59
32.7	0:18:04
32.1	0:18:11
31.4	0:18:19
30.4	0:18:31
29.3	0:18:43
28	0:18:59
26.5	0:19:16
24.7	0:19:37
22.5	0:20:03
19.2	0:20:41
13.2	0:21:51
1	0:24:14

Fit Group: F40 Push-Ups and Sit-Ups

Points	Push-Ups
10	32
9.9	31
9.8	30
9.6	29
9.4	28
9.2	27
9.1	26
8.9	25
8.7	24
8.5	23
8.4	22
8.2	21
8	20
7.8	19
7.7	18
7.5	17
7.3	16
7.1	15
7	14
6.8	13
6.6	12
6.4	11
6.3	10
6.1	9
5.9	8
5.7	7
5.6	6
5.4	5
5.2	4
5	3
4.9	2
4.7	1

Points	Sit-Ups
10	47
9.9	46
9.7	45
9.6	44
9.4	43
9.2	42
9	41
8.8	40
8.7	39
8.5	38
8.3	37
8.1	36
8	35
7.8	34
7.6	33
7.4	32
7.2	31
7.1	30
6.9	29
6.7	28
6.5	27
6.3	26
6.2	25
6	24
5.8	23
5.6	22
5.5	21
5.3	20
5.1	19
4.9	18
4.7	17
4.6	16
4.4	15
4.2	14
4	13
3.8	12

Points	Sit-Ups
3.7	11
3.5	10
3.3	9
3.1	8
3	7
2.8	6
2.6	5
2.4	4
2.2	3
2.1	2
1.9	1

Fit Group: F40-44 Run Time

Points	Run Time
60	0:12:36
59.5	0:12:42
59	0:12:48
58.5	0:12:54
58.1	0:12:58
57.6	0:13:04
57.2	0:13:09
56.9	0:13:12
56.4	0:13:18
56	0:13:23
55.7	0:13:26
55.3	0:13:31
55	0:13:35
54.5	0:13:40
54.3	0:13:43
53.9	0:13:47
53.6	0:13:51
53.3	0:13:54
53	0:13:58
52.7	0:14:01
52.4	0:14:05
52.1	0:14:08
51.8	0:14:12
51.5	0:14:15
51.2	0:14:19
50.9	0:14:22
50.7	0:14:25
50.3	0:14:29
50.1	0:14:32
49.7	0:14:36
49.5	0:14:39
49.2	0:14:42
49	0:14:45
48.6	0:14:49
48.4	0:14:52
48.1	0:14:55

Points	Run Time
47.9	0:14:57
47.6	0:15:01
47.3	0:15:04
47.1	0:15:07
46.7	0:15:11
46.5	0:15:14
46.2	0:15:17
46	0:15:20
45.6	0:15:24
45.4	0:15:27
45.1	0:15:30
44.9	0:15:32
44.6	0:15:36
44.3	0:15:39
44	0:15:43
43.7	0:15:46
43.4	0:15:50
43.1	0:15:53
42.8	0:15:57
42.5	0:16:00
42.2	0:16:04
41.9	0:16:07
41.6	0:16:11
41.3	0:16:14
40.9	0:16:19
40.7	0:16:21
40.4	0:16:25
40	0:16:30
39.6	0:16:34
39.3	0:16:38
38.9	0:16:42
38.6	0:16:46
38.3	0:16:49
37.8	0:16:55
37.5	0:16:59
37.1	0:17:03

Points	Run Time
36.6	0:17:09
36.2	0:17:14
35.8	0:17:19
35.3	0:17:24
35	0:17:28
34.4	0:17:35
33.9	0:17:41
33.3	0:17:48
32.7	0:17:55
32.1	0:18:02
31.4	0:18:10
30.7	0:18:18
29.6	0:18:31
28.3	0:18:46
26.9	0:19:02
25	0:19:25
22.7	0:19:51
19.2	0:20:32
12.5	0:21:50
1	0:24:05

Fit Group: F40-44 Push-Ups and Sit-Ups

Points	Push-Ups
10	32
9.9	31
9.7	30
9.5	29
9.4	28
9.2	27
9	26
8.8	25
8.7	24
8.5	23
8.3	22
8.1	21
8	20
7.8	19
7.6	18
7.4	17
7.3	16
7.1	15
6.9	14
6.7	13
6.6	12
6.4	11
6.2	10
6	9
5.8	8
5.7	7
5.5	6
5.3	5
5.1	4
5	3
4.8	2
4.6	1

Points	Sit-Ups
10	47
9.8	46
9.7	45
9.5	44
9.3	43
9.1	42
8.9	41
8.8	40
8.6	39
8.4	38
8.2	37
8	36
7.9	35
7.7	34
7.5	33
7.3	32
7.2	31
7	30
6.8	29
6.6	28
6.4	27
6.3	26
6.1	25
5.9	24
5.7	23
5.5	22
5.4	21
5.2	20
5	19
4.8	18
4.7	17
4.5	16
4.3	15
4.1	14
3.9	13
3.8	12

Points	Sit-Ups
3.6	11
3.4	10
3.2	9
3	8
2.9	7
2.7	6
2.5	5
2.3	4
2.2	3
2	2
1.8	1

Fit Group: F45-49 Run Time

Points	Run Time
60	0:13:03
59.5	0:13:09
59.1	0:13:13
58.6	0:13:19
58.1	0:13:25
57.7	0:13:30
57.3	0:13:34
56.9	0:13:39
56.5	0:13:44
56.1	0:13:48
55.7	0:13:53
55.3	0:13:58
54.9	0:14:02
54.6	0:14:06
54.3	0:14:09
53.8	0:14:15
53.5	0:14:19
53.1	0:14:23
52.8	0:14:27
52.5	0:14:30
52.2	0:14:34
51.9	0:14:37
51.6	0:14:41
51.3	0:14:44
50.9	0:14:49
50.7	0:14:51
50.3	0:14:56
50.1	0:14:58
49.8	0:15:02
49.5	0:15:05
49.2	0:15:09
48.9	0:15:12
48.7	0:15:15
48.3	0:15:19
48.1	0:15:22
47.8	0:15:25

Points	Run Time
47.6	0:15:28
47.3	0:15:31
47.1	0:15:33
46.7	0:15:38
46.5	0:15:40
46.1	0:15:45
45.9	0:15:47
45.6	0:15:51
45.3	0:15:54
45	0:15:58
44.7	0:16:01
44.4	0:16:05
44.1	0:16:08
43.8	0:16:12
43.5	0:16:15
43.2	0:16:19
42.9	0:16:22
42.7	0:16:25
42.3	0:16:29
42.1	0:16:32
41.7	0:16:36
41.4	0:16:40
41.1	0:16:43
40.7	0:16:48
40.5	0:16:50
40.1	0:16:55
39.7	0:17:00
39.5	0:17:02
39.1	0:17:07
38.7	0:17:11
38.4	0:17:15
38	0:17:20
37.5	0:17:25
37.2	0:17:29
36.9	0:17:32
36.5	0:17:37

Points	Run Time
36.1	0:17:42
35.6	0:17:48
35	0:17:55
34.7	0:17:58
34.3	0:18:03
33.8	0:18:09
33.4	0:18:13
32.8	0:18:20
32	0:18:30
31.1	0:18:40
30.1	0:18:52
29.1	0:19:03
27.7	0:19:20
26.3	0:19:36
24.7	0:19:55
22.7	0:20:18
19.5	0:20:55
14.7	0:21:51
12.5	0:22:17
1	0:24:31

Fit Group: F45-49 Push-Ups and Sit-Ups

Points	Push-Ups
10	31
9.9	30
9.7	29
9.6	28
9.4	27
9.2	26
9	25
8.9	24
8.7	23
8.5	22
8.3	21
8.2	20
8	19
7.8	18
7.6	17
7.5	16
7.3	15
7.1	14
6.9	13
6.7	12
6.6	11
6.4	10
6.2	9
6	8
5.9	7
5.7	6
5.5	5
5.3	4
5.2	3
5	2
4.8	1

Points	Sit-Ups
10	46
9.9	45
9.7	44
9.6	43
9.4	42
9.2	41
9	40
8.8	39
8.7	38
8.5	37
8.3	36
8.1	35
8	34
7.8	33
7.6	32
7.4	31
7.2	30
7.1	29
6.9	28
6.7	27
6.5	26
6.3	25
6.2	24
6	23
5.8	22
5.6	21
5.5	20
5.3	19
5.1	18
4.9	17
4.7	16
4.6	15
4.4	14
4.2	13
4	12
3.8	11

Points	Sit-Ups
3.7	10
3.5	9
3.3	8
3.1	7
3	6
2.8	5
2.6	4
2.4	3
2.2	2
2.1	1

Fit Group: F50 Run Time

Points	Run Time
60	0:14:00
59.7	0:14:04
59.2	0:14:10
58.7	0:14:16
58.2	0:14:22
57.8	0:14:27
57.3	0:14:32
56.9	0:14:37
56.5	0:14:42
56.1	0:14:46
55.7	0:14:51
55.3	0:14:56
54.9	0:15:00
54.5	0:15:05
54.1	0:15:10
53.7	0:15:14
53.4	0:15:18
53	0:15:23
52.6	0:15:27
52.3	0:15:31
51.9	0:15:35
51.6	0:15:39
51.3	0:15:42
51	0:15:46
50.7	0:15:49
50.3	0:15:54
50	0:15:58
49.7	0:16:01
49.4	0:16:05
49	0:16:09
48.7	0:16:13
48.4	0:16:16
48.1	0:16:20
47.8	0:16:23
47.5	0:16:27
47.2	0:16:30

Points	Run Time
46.9	0:16:34
46.5	0:16:38
46.3	0:16:41
45.9	0:16:45
45.6	0:16:49
45.3	0:16:52
45.1	0:16:55
44.7	0:16:59
44.4	0:17:03
44.1	0:17:06
43.7	0:17:11
43.4	0:17:15
43	0:17:19
42.8	0:17:22
42.4	0:17:26
42.1	0:17:30
41.8	0:17:33
41.5	0:17:37
41.1	0:17:41
40.8	0:17:45
40.5	0:17:48
40.1	0:17:53
39.8	0:17:57
39.4	0:18:01
39.2	0:18:04
38.8	0:18:08
38.5	0:18:12
38.1	0:18:16
37.8	0:18:20
37.4	0:18:25
36.9	0:18:30
36.6	0:18:34
36.2	0:18:39
35.8	0:18:43
35.3	0:18:49
35	0:18:53

Points	Run Time
34.5	0:18:58
33.9	0:19:05
33.4	0:19:11
32.9	0:19:17
32.3	0:19:24
31.8	0:19:30
31.2	0:19:37
30.7	0:19:43
29.7	0:19:54
28.9	0:20:04
27.7	0:20:18
26.7	0:20:29
25.5	0:20:43
23.9	0:21:02
22	0:21:24
19.7	0:21:51
1	0:25:29

Fit Group: F50 Push-Ups and Sit-Ups

Points	Push-Ups
10	28
9.8	27
9.5	26
9.3	25
9.1	24
9	23
8.8	22
8.6	21
8.4	20
8.3	19
8.1	18
7.9	17
7.7	16
7.6	15
7.4	14
7.2	13
7	12
6.9	11
6.7	10
6.5	9
6.3	8
6.2	7
6	6
5.8	5
5.6	4
5.5	3
5.3	2
5.1	1

Points	Sit-Ups
10	41
9.9	40
9.7	39
9.5	38
9.3	37
9.1	36
9	35
8.8	34
8.6	33
8.4	32
8.2	31
8.1	30
7.9	29
7.7	28
7.5	27
7.4	26
7.2	25
7	24
6.8	23
6.6	22
6.5	21
6.3	20
6.1	19
5.9	18
5.7	17
5.6	16
5.4	15
5.2	14
5	13
4.9	12
4.7	11
4.5	10
4.3	9
4.1	8
4	7
3.8	6

Points	Sit-Ups
3.6	5
3.4	4
3.2	3
3.1	2
2.9	1

Fit Group: F50-54 Run Time

Points	Run Time
60	0:13:51
59.6	0:13:56
59.1	0:14:02
58.6	0:14:07
58.2	0:14:12
57.7	0:14:18
57.3	0:14:23
56.8	0:14:28
56.5	0:14:32
56.1	0:14:37
55.6	0:14:42
55.3	0:14:46
54.9	0:14:51
54.5	0:14:55
54.1	0:15:00
53.8	0:15:03
53.5	0:15:07
53.1	0:15:12
52.7	0:15:16
52.4	0:15:20
52	0:15:24
51.7	0:15:28
51.3	0:15:33
51	0:15:36
50.7	0:15:40
50.3	0:15:44
50.1	0:15:47
49.7	0:15:51
49.4	0:15:55
49	0:15:59
48.8	0:16:02
48.5	0:16:05
48.2	0:16:09
47.8	0:16:13
47.5	0:16:17
47.2	0:16:20

Points	Run Time
47	0:16:23
46.6	0:16:27
46.4	0:16:30
46	0:16:34
45.7	0:16:38
45.4	0:16:41
45.1	0:16:45
44.7	0:16:50
44.5	0:16:52
44.2	0:16:55
43.8	0:17:00
43.5	0:17:04
43.1	0:17:08
42.8	0:17:12
42.5	0:17:15
42.1	0:17:20
41.8	0:17:23
41.5	0:17:27
41.2	0:17:30
40.9	0:17:34
40.5	0:17:39
40.3	0:17:41
39.9	0:17:46
39.5	0:17:50
39.1	0:17:55
38.7	0:18:00
38.5	0:18:02
38.1	0:18:07
37.8	0:18:10
37.5	0:18:14
37	0:18:19
36.7	0:18:23
36.3	0:18:28
35.8	0:18:33
35.4	0:18:38
35	0:18:43

Points	Run Time
34.4	0:18:50
33.9	0:18:56
33.4	0:19:01
32.8	0:19:08
32.2	0:19:15
31.6	0:19:22
30.9	0:19:31
30.3	0:19:38
29.7	0:19:45
28.6	0:19:57
27.6	0:20:09
26.3	0:20:24
25.1	0:20:38
23.2	0:21:00
21.3	0:21:23
18.9	0:21:51
1	0:25:19

Fit Group: F50-54 Push-Ups and Sit-Ups

Points	Push-Ups
10	29
9.9	28
9.7	27
9.6	26
9.4	25
9.2	24
9	23
8.9	22
8.7	21
8.5	20
8.3	19
8.2	18
8	17
7.8	16
7.6	15
7.5	14
7.3	13
7.1	12
6.9	11
6.8	10
6.6	9
6.4	8
6.2	7
6.1	6
5.9	5
5.7	4
5.5	3
5.4	2
5.2	1

Points	Sit-Ups
10	40
9.5	39
9.3	38
9.2	37
9	36
8.8	35
8.6	34
8.4	33
8.3	32
8.1	31
7.9	30
7.7	29
7.6	28
7.4	27
7.2	26
7	25
6.8	24
6.7	23
6.5	22
6.3	21
6.1	20
5.9	19
5.8	18
5.6	17
5.4	16
5.2	15
5.1	14
4.9	13
4.7	12
4.5	11
4.3	10
4.2	9
4	8
3.8	7
3.6	6
3.4	5

Points	Sit-Ups
3.3	4
3.1	3
2.9	2
2.7	1

Fit Group: F55-59 Run Time

Points	Run Time
60	0:14:35
59.6	0:14:39
59.1	0:14:45
58.6	0:14:51
58.1	0:14:57
57.5	0:15:04
57	0:15:09
56.4	0:15:16
56.1	0:15:20
55.7	0:15:25
55.3	0:15:29
55.1	0:15:31
54.7	0:15:36
54.5	0:15:38
54	0:15:44
53.7	0:15:48
53.2	0:15:54
52.9	0:15:57
52.6	0:16:00
52.3	0:16:04
51.9	0:16:09
51.5	0:16:13
51.2	0:16:17
50.9	0:16:20
50.6	0:16:24
50.3	0:16:27
50	0:16:31
49.6	0:16:35
49.2	0:16:40
48.9	0:16:43
48.7	0:16:46
48.4	0:16:49
48.1	0:16:53
47.8	0:16:56
47.5	0:17:00
47.2	0:17:03

Points	Run Time
46.7	0:17:09
46.4	0:17:12
46.2	0:17:15
45.9	0:17:18
45.7	0:17:21
45.3	0:17:25
45.1	0:17:27
44.7	0:17:32
44.4	0:17:36
44	0:17:40
43.7	0:17:44
43.5	0:17:46
43.2	0:17:50
42.9	0:17:53
42.6	0:17:56
42.3	0:18:00
42	0:18:03
41.8	0:18:06
41.4	0:18:10
41.1	0:18:14
40.8	0:18:17
40.5	0:18:21
40.2	0:18:24
39.9	0:18:28
39.6	0:18:31
39.3	0:18:35
38.8	0:18:41
38.6	0:18:43
38.2	0:18:48
38	0:18:50
37.7	0:18:53
37.4	0:18:57
37	0:19:01
36.6	0:19:06
36.2	0:19:11
35.8	0:19:15

Points	Run Time
35.4	0:19:20
35	0:19:25
34.5	0:19:30
34.2	0:19:34
33.8	0:19:39
33.4	0:19:43
32.8	0:19:50
32	0:19:59
31.5	0:20:05
30.6	0:20:16
29.9	0:20:24
28.9	0:20:35
28	0:20:46
26.8	0:21:00
25.7	0:21:13
24.5	0:21:26
22.5	0:21:50
25.5	0:21:15
24.2	0:21:30
22.2	0:21:53
1	0:25:59

Fit Group: F55-59 Push-Ups and Sit-Ups

Points	Push-Ups
10	27
9.8	26
9.7	25
9.5	24
9.3	23
9.1	22
9	21
8.8	20
8.6	19
8.4	18
8.3	17
8.1	16
7.9	15
7.7	14
7.6	13
7.4	12
7.2	11
7	10
6.9	9
6.7	8
6.5	7
6.3	6
6.2	5
6	4
5.8	3
5.6	2
5.5	1

Points	Sit-Ups
10	39
9.8	38
9.7	37
9.5	36
9.3	35
9.1	34
8.9	33
8.7	32
8.5	31
8.4	30
8.2	29
8	28
7.8	27
7.6	26
7.4	25
7.2	24
7.1	23
6.9	22
6.7	21
6.5	20
6.3	19
6.1	18
5.9	17
5.8	16
5.6	15
5.4	14
5.2	13
5	12
4.8	11
4.7	10
4.5	9
4.3	8
4.1	7
3.9	6
3.7	5
3.5	4

Points	Sit-Ups
3.4	3
3.2	2
3	1

Fit Group: F60 Run Time

Points	Run Time
60	0:15:43
59.8	0:15:45
59.6	0:15:47
59.5	0:15:48
58.6	0:15:57
57.9	0:16:04
57.6	0:16:07
56.5	0:16:18
55.8	0:16:25
55.2	0:16:31
54.9	0:16:34
54.3	0:16:40
53.4	0:16:49
52.9	0:16:54
52.8	0:16:55
52.5	0:16:57
52.2	0:17:00
51.5	0:17:07
51.1	0:17:11
50.9	0:17:13
50.4	0:17:18
50.2	0:17:20
50	0:17:22
49.9	0:17:23
49.8	0:17:24
49.7	0:17:25
49.2	0:17:30
48.9	0:17:33
48.6	0:17:36
48.4	0:17:38
48	0:17:42
47.8	0:17:44
47.4	0:17:48
47.1	0:17:51
46.6	0:17:56
46.3	0:17:59

Points	Run Time
46.1	0:18:01
45.8	0:18:04
45.3	0:18:09
45.2	0:18:10
44.8	0:18:14
44.4	0:18:18
44.2	0:18:20
43.5	0:18:27
43.3	0:18:29
42.6	0:18:36
42.3	0:18:39
41.9	0:18:43
41.8	0:18:44
41.7	0:18:45
41.2	0:18:50
40.8	0:18:54
40.1	0:19:01
39.5	0:19:07
39	0:19:12
38.5	0:19:17
37.9	0:19:23
37.7	0:19:25
37.5	0:19:27
37.4	0:19:28
37.1	0:19:31
36.2	0:19:40
35.8	0:19:44
35.7	0:19:45
35.4	0:19:48
35	0:19:52
34.7	0:19:55
34.2	0:20:00
33.8	0:20:04
33.2	0:20:10
33.1	0:20:11
32.7	0:20:15

Points	Run Time
32.2	0:20:19
31.8	0:20:23
31.5	0:20:26
31.1	0:20:30
30.6	0:20:35
29.8	0:20:43
29.3	0:20:48
29	0:20:51
28.6	0:20:55
26.9	0:21:12
26	0:21:21
24.9	0:21:32
24.1	0:21:40
1	0:25:30

Fit Group: F60 Push-Ups and Sit-Ups

Points	Push-Ups
10	25
9.7	24
9.5	23
9.3	22
9.1	21
8.9	20
8.7	19
8.5	18
8.3	17
8.1	16
7.9	15
7.7	14
7.5	13
7.2	12
7	11
6.8	10
6.6	9
6.4	8
6.2	7
6	6
5.8	5
5.6	4
5.4	3
5.2	2
5	1

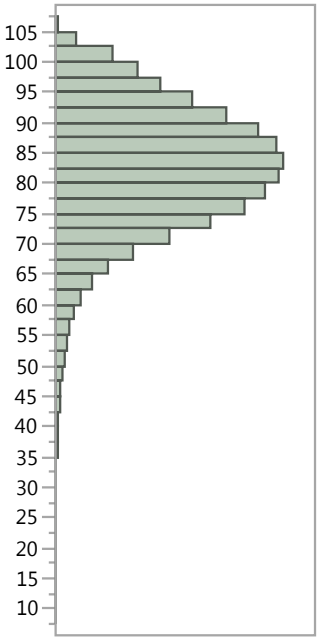
Points	Sit-Ups
10	39
9.8	38
9.6	37
9.4	36
9.2	35
9	34
8.9	33
8.7	32
8.5	31
8.3	30
8.1	29
7.9	28
7.7	27
7.6	26
7.4	25
7.2	24
7	23
6.8	22
6.6	21
6.4	20
6.3	19
6.1	18
5.9	17
5.7	16
5.5	15
5.3	14
5.2	13
5	12
4.8	11
4.6	10
4.4	9
4.2	8
4	7
3.9	6
3.7	5
3.5	4

Points	Sit-Ups
3.3	3
3.1	2
2.9	1

Appendix G: Total Score for All Airmen Divided into Percentiles

Summary statistics and distributions of the created rubric score and the current standard score (called "True Score" in the Figure) are shown below:

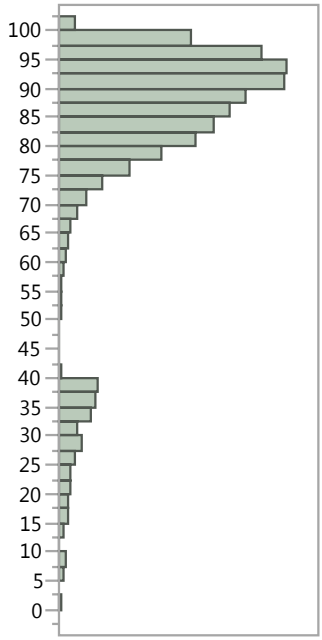
Rubric Total Points



Summary Statistics

Mean	82.217455
Std Dev	10.819549
Std Err Mean	0.005345
Upper 95% Mean	82.227931
Lower 95% Mean	82.206979
N	4097491

True Score



Summary Statistics

Mean	80.867448
Std Dev	20.451905
Std Err Mean	0.0089958
Upper 95% Mean	80.885079
Lower 95% Mean	80.849816
N	5168802

The data table for the quantiles of these distributions are shown below:

Rubric Score	
Quantile	Score
100%	106
99%	102.4154
98%	101.1655
97%	100.2444
96%	99.46128
95%	98.71644
94%	98.02205
93%	97.3421
92%	96.71186
91%	96.12286
90%	95.57395
89%	95.06098
88%	94.57267
87%	94.11277
86%	93.66696
85%	93.2468
84%	92.84228
83%	92.45369
82%	92.0728
81%	91.70479
80%	91.34999
79%	91.00182
78%	90.66209
77%	90.33353
76%	90.01811
75%	89.70383
74%	89.3976
73%	89.09656
72%	88.80082
71%	88.50766
70%	88.22161
69%	87.93819
68%	87.65739
67%	87.38047

Current Standard Score	
Quantile	Score
100%	100
99%	99.8
98%	99.3
97%	98.9
96%	98.6
95%	98.2
94%	97.9
93%	97.6
92%	97.3
91%	97.1
90%	96.8
89%	96.6
88%	96.3
87%	96.1
86%	95.8
85%	95.6
84%	95.4
83%	95.2
82%	94.9
81%	94.7
80%	94.5
79%	94.3
78%	94
77%	93.8
76%	93.7
75%	93.4
74%	93.2
73%	93
72%	92.7
71%	92.5
70%	92.4
69%	92.1
68%	91.9
67%	91.7

Rubric Score	
Quantile	Score
66%	87.10573
65%	86.83283
64%	86.56104
63%	86.29446
62%	86.0268
61%	85.75852
60%	85.49119
59%	85.22629
58%	84.96165
57%	84.69792
56%	84.43411
55%	84.17253
54%	83.90852
53%	83.64576
52%	83.385
51%	83.12434
50%	82.86203
49%	82.60187
48%	82.33684
47%	82.07271
46%	81.8085
45%	81.54547
44%	81.27914
43%	81.01185
42%	80.74543
41%	80.47738
40%	80.2079
39%	79.9313
38%	79.65601
37%	79.37973
36%	79.09708
35%	78.81732
34%	78.53458
33%	78.24884

Current Standard Score	
Quantile	Score
66%	91.4
65%	91.2
64%	91
63%	90.8
62%	90.6
61%	90.3
60%	90.1
59%	89.8
58%	89.6
57%	89.3
56%	89.1
55%	88.8
54%	88.6
53%	88.3
52%	88
51%	87.7
50%	87.4
49%	87.2
48%	86.9
47%	86.6
46%	86.3
45%	86.1
44%	85.7
43%	85.4
42%	85.1
41%	84.9
40%	84.5
39%	84.2
38%	83.9
37%	83.6
36%	83.2
35%	82.9
34%	82.6
33%	82.3

Rubric Score	
Quantile	Score
32%	77.96047
31%	77.66795
30%	77.37183
29%	77.072
28%	76.7677
27%	76.4573
26%	76.13818
25%	75.81954
24%	75.49316
23%	75.15785
22%	74.81311
21%	74.45892
20%	74.09281
19%	73.71287
18%	73.31833
17%	72.90842
16%	72.4784
15%	72.02155
14%	71.53365
13%	71.00648
12%	70.43832
11%	69.80909
10%	69.10477
9%	68.33114
8%	67.44436
7%	66.40236
6%	65.15306
5%	63.6496
4%	61.74031
3%	59.17718
2%	55.48256
1%	49.55876
0%	9.957164

Current Standard Score	
Quantile	Score
32%	81.9
31%	81.5
30%	81.2
29%	80.8
28%	80.4
27%	80
26%	79.6
25%	79.2
24%	78.7
23%	78.2
22%	77.7
21%	77.1
20%	76.4
19%	75.7
18%	74.9
17%	73.9
16%	72.6
15%	71
14%	68.8
13%	65.2
12%	59.2
11%	39.1
10%	38.2
9%	37
8%	35.6
7%	34.3
6%	32.6
5%	30.1
4%	27.9
3%	24.7
2%	20
1%	14.8
0%	0

Bibliography

Andreasson, J., & Johansson, T. (2014). The Fitness Revolution. Historical Transformations in the Global Gym and Fitness Culture. *Sport science review*, *23*(3-4), 91-111.

Ashwell, M., Gunn, P., & Gibson, S. (2012). Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. *Obesity reviews*, *13*(3), 275-286.

Bennington, Raymond O., Lieutenant Colonel, USAF. Report of TDY Travel for the Purpose of Participating in the AF Physical Fitness Study Group. Air Force Military Personnel Center, Randolph AFB TX, 5 October 1978.

Berryman, J. W. (1996). Thomas K. Cureton, Jr.: Pioneer researcher, proselytizer, and proponent for physical fitness. *Research quarterly for exercise and sport*, *67*(1), 1-12.

Borish, L. (1997). Catherine Beecher and Thomas W. Higginson on the Need for Physical Fitness. Major Problems in American Sport History. Boston: Houghton Mifflin.

Browning, L. M., Hsieh, S. D., & Ashwell, M. (2010). A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. Nutrition research reviews, 23(02), 247-269.

Callendar, Bruce D. "Jumper to Airmen: Get in Shape," Air Force Magazine, p70 (January 2004).

Castelli, D. M., Hillman, C. H., Buck, S. M., & Erwin, H. E. (2007). Physical fitness and academic achievement in third-and fifth-grade students. *Journal of Sport and Exercise Psychology*, *29*(2), 239.

Cooper, Kenneth H. Aerobics. New York: Bantam Books, 1968.

Cooper, Kenneth H. The proposed United States Air Force Physical Fitness Program. Aerospace Medical Laboratory, Wilford Hall USAF Hospital, Lackland AFB TX, May 1967

Chief of Naval Operations. *Physical Readiness Program.* Department of the Navy. OPNAVINST 6110.1J. 11 Jul 2011.

Commandant of the Marine Corps. Marine Corps Physical Fitness Program. Department of the Navy. MCO 6100.13. 1 Aug 2008.

Dalleck, L. C., & Kravitz, L. (2002). The history of fitness. IDEA Health and Fitness Source, 20(2), 26-33

Department of the Air Force. Training-Physical Conditioning. AFR 50-5. Washington: GPO, 13 November 1947.

Department of the Air Force. Training-Physical Conditioning. AFR 50-5. Washington: GPO, 27 April 1959.

Department of the Air Force. Physical Conditioning. AFM 160-26. Washington: GPO, 8 June 1961.

Department of the Air Force. USAF Aerobics Physical Fitness Program (Male). AFP 50-56. Washington: GPO, 1 November 1969.

Department of the Air Force. Physical Fitness. AFM 50-15, Change 3. Washington: GPO, February 1971.

Department of the Air Force. USAF Physical Fitness and Weight Control Program. AFR 50-49. Washington: GPO, 21 July 1972.

Department of the Air Force. Air Force Physical Fitness Program. AFR 35-11, Immediate Message Change 79-1. Washington: GPO, 23 September 1977.

Department of the Air Force. The Weight and Body Fat Management Program. AFI 40 502. Washington: HQ AFMOA/SGOP, 1994

Department of the Air Force. The Air Force Physical Fitness Program. AFI 40-501. Washington: HQ AFMOA/SGOP, 1998

Department of the Air Force. The Air Force Fitness Program. AFI 10-248. Washington: HQ USAF/SGO, 1 January 2004.

Department of the Air Force. Fitness Program. AFI 36-2905. Washington: HQ USAF/SGO, 1 July 2010.

Department of the Air Force. Fitness Program. AFI 36-2905. Washington: HQ USAF/SGO, 21 October 2013.

Department of the Air Force. Air Force Guidance Memorandum for AFI 36-2905, Fitness Program. AFI 36-2905_AFGM2.1. Washington: HQ USAF/SGO, 1 July 2011.

Dwyer, T., Sallis, J. F., Blizzard, L., Lazarus, R., & Dean, K. (2001). Relation of academic performance to physical activity and fitness in children. *Pediatric Exercise Science*, *13*(3), 225-237.

Fortier, M. D., Katzmarzyk, P. T., Malina, R. M., & Bouchard, C. L. A. U. D. E. (2001). Seven-year stability of physical activity and musculoskeletal fitness in the Canadian population. *Medicine and Science in Sports and Exercise*, *33*(11), 1905-1911.

Garnett, S. P., Baur, L. A., Srinivasan, S., Lee, J. W., & Cowell, C. T. (2007). Body mass index and waist circumference in midchildhood and adverse cardiovascular disease risk clustering in adolescence. *The American journal of clinical nutrition*, *86*(3), 549-555.

Genovesi, S., Antolini, L., Giussani, M., Pieruzzi, F., Galbiati, S., Valsecchi, M. G., Brambilla, P., & Stella, A. (2008). Usefulness of waist circumference for the identification of childhood hypertension. *Journal of hypertension*, *26*(8), 1563-1570.

Han, T. S., Seidell, J. C., Currall, J. E. P., Morrison, C. E., Deurenberg, P., & Lean, M. E. J. (1997). The influences of height and age on waist circumference as an index of adiposity in adults. *International journal of obesity*, *21*(1), 83-90.

Han, T. S., Van Leer, E. M., Seidell, J. C., & Lean, M. E. J. (1995). Waist circumference action levels in the identification of cardiovascular risk factors: prevalence study in a random sample. *Bmj*, *311*(7017), 1401-1405.

Harman, E. A., & Frykman, P. N. (1992). The relationship of body size and composition to the performance of physically demanding military tasks. *Body composition and physical performance: Applications for the military services*, 105-118.

Hermansmen, Lars and Bengt, Saltin. "Oxygen uptake during maximal treadmill and bicycle exercise," Journal of Applied Physiology, 26: 31-37 (1969).

Hsieh, S. D., & Muto, T. (2005). The superiority of waist-to-height ratio as an anthropometric index to evaluate clustering of coronary risk factors among non-obese men and women. *Preventive medicine*, *40*(2), 216-220.

Hunn, Heather M. Factors Influencing the Air Force Cycle Ergometry Fitness Assessment. MS thesis, AFIT/GLM/ENV/01M-02. School of Engineering and Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 2001.

Jackson, Andrew S. and Robert M. Ross. "Methods and limitations of assessing functional work capacity objectively," Journal of Back and Musculoskeletal Rehabilitation, 6: 265-276 (1996).

Janssen, I., Katzmarzyk, P. T., & Ross, R. (2004). Waist circumference and not body mass index explains obesity-related health risk. *The American journal of clinical nutrition*, *79*(3), 379-384.

Jefferson, T., and Johnston, R. H. (1903). The Writings of Thomas Jefferson (Vol. 20). Issued under the auspices of the Thomas Jefferson memorial association of the United States.

Karolides, N. J., & Karolides, M. 1993. *Focus on Fitness.* Santa Barbara, CA: ABC-CLIO

Katzmarzyk, P. T., & Craig, C. L. (2002). Musculoskeletal fitness and risk of mortality. *Medicine and science in sports and exercise*, *34*(5), 740-744.

Keller, A. (1972). Colonial America: a compact history. American Printing House for the Blind.

Kennedy, John F. "The Soft American," Sports Illustrated, 16-17 (December 1960).

Kennedy, John F. "The Vigor we Need," Sports Illustrated, 17: 12-15 (1962).

Keys, A., Fidanza, F., Karvonen, M. J., Kimura, N., & Taylor, H. L. (1972). Indices of relative weight and obesity. *Journal of chronic diseases*, *25*(6), 329-343.

Knapik, J., Ang, P., Reynolds, K., & Jones, B. (1993). Physical fitness, age, and injury incidence in infantry soldiers. *Journal of Occupational and Environmental Medicine*, *35*(6), 598-603.

Knapik, J. J., Sharp, M. A., Canham-Chervak, M., Hauret, K., Patton, J. F., & Jones, B. H. (2001). Risk factors for training-related injuries among men and women in basic combat training. *Medicine and science in sports and exercise*, *33*(6), 946-954.

Kraus, H. and Hirschland, R. "Minimum muscular fitness tests in school children," Research Quarterly. 25:178, (1954).

Lean, M. E. J., Han, T. S., & Morrison, C. E. (1995). Waist circumference as a measure for indicating need for weight management. *BMJ*, *311*(6998), 158-161.

McIlvaine, Rob. "PT Test Gets Overhaul." AR News, 2 Mar. 2011.

Meeuwsen, S., Horgan, G. W., & Elia, M. (2010). The relationship between BMI and percent body fat, measured by bioelectrical impedance, in a large adult sample is curvilinear and influenced by age and sex. *Clinical nutrition*, *29*(5), 560-566.

Mello, R. P., Murphy, M. M., & Vogel, J. A. (1988). Relationship Between a Two Mile run For Time and Maximal Oxygen Uptake. The Journal of Strength & Conditioning Research, 2(1), 9-12.

Mitchell, Jere H. and Gunnar Blomquist. "Maximal oxygen uptake," New England Journal of Medicine, 284: 1018-1022 (1971)

Nieman, D.C. Fitness and Sports Medicine: An Introduction. Palo Alto CA: Bull Publishing Co., 1990.

Obama, F. L. M. (2012). Let's Move! Raising a healthier generation of kids. *Childhood obesity*, *8*(1), 1.

Pi-Sunyer, F. Xavier. "Statement on first federal obesity clinical guidelines," National Institute of Health, NHLBI Communications Office, (June 1998).

Pollock, Michael L. and others. The cross-validation of the United States Air Force submaximal cycle ergometry test to estimate aerobic capacity. Crew Systems Directorate, Crew Technology Division, Brooks AFB TX, June 1994 (ADA284005).

Pouliot, M. C., Després, J. P., Lemieux, S., Moorjani, S., Bouchard, C., Tremblay, A., Nadeau, A., & Lupien, P. J. (1994). Waist circumference and abdominal sagittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. *The American journal of cardiology*, *73*(7), 460-468.

Prista, A., Marques, A. T., & Maia, J. A. R. (1997). Relationship between physical activity, socioeconomic status, and physical fitness of 8–15-year-old youth from Mozambique. *American Journal of Human Biology*, *9*(4), 449-457.

Rader, B. G. (1991). The Quest for Self-Sufficiency and the New Strenuosity: Reflections on the Strenuous Life of the 1970s and the 1980s. *Journal of sport history*, *18*(2), 255-266.

Rice, E. A., Hutchinson, J. L., & Lee, M. 1958. *A Brief History of Physical Education.* New York: The Ronald Press Co.

Royal Canadian Air Force. *5BX Plan for Physical Fitness.* RCAF Pamphlet 30/1.

Sallis, J. F., McKenzie, T. L., Alcaraz, J. E., Kolody, B., Faucette, N., & Hovell, M. F. (1997). The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. Sports, Play and Active Recreation for Kids. *American journal of public health*, *87*(8), 1328-1334.

Savva, S. C., Tornaritis, M., Savva, M. E., Kourides, Y., Panagi, A., Silikiotou, N., Georgiou, C., & Kafatos, A. (2000). Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International journal of obesity*, *24*(11), 1453-1458.

Smith, T. G. and F. P. Flatten. Air Force Fitness Program Talking Paper. HSC/YAM (1997).

Swiderski, S. J. (2005). *Fit-To-Fight: Waist vs Waist/Height Measurements to Determine an Individual's Fitness Level-A Study in Statistical Regression and Analysis* (No. AFIT/GCA/ENC/05-03). AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF ENGINEERING AND MANAGEMENT.

Susi, Ronald A., Major, USAF. Aerobics: Fact or Fiction? Unpublished research report, No. 2654-74, Air Command and Staff College, Maxwell AFB AL, May 1974.

Taylor, R. W., Jones, I. E., Williams, S. M., & Goulding, A. (2000). Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3–19 y. *The American journal of clinical nutrition*, *72*(2), 490-495.

U.S. Army. *Army Physical Readiness Training.* Department of the Army. FM 7-22. Washington, D.C.: Government Printing Office, 2012.

U.S. Army. *APFT Card.* Department of the Army. DA Form 705. Washington, D.C.: Government Printing Office, 2010.

Vickers Jr, R. R. (2007). *Physical readiness training: A meta-analysis* (No. NHRC-07-20). NAVAL HEALTH RESEARCH CENTER SAN DIEGO CA.

Welch, P. D. 1996. *History of American Physical Education and Sport* (2nd ed.). Springfield, IL: Charles C. Thomas.

Worden, T., & White III, E. D. (2012). Modifying the US Air Force Fitness Test to reflect physical combat fitness: one study's perspective. *Military medicine*, *177*(9), 1090-1094.

Whorton, J. C. (1982). Crusaders for Fitness. *The History of American Health Reformers*.

Wuest, D. A., & Bucher, C. A. 1995. *Foundations of Physical Education and Sport.* St. Louis, MO: Mosby

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Air Force currently uses AFI 36-2905 for fitness standards and evaluation, but no study to our knowledge has evaluated these standards using large databases. Using a 5.38 million record database from the Air Force Fitness Management System, we evaluated how the abdominal circumference, body mass index (BMI), waist to height ratio (WtHR), and height to weight ratio correlated to fitness as assessed by the 1.5 mile aerobic run in the Air Force Fitness Test. Whether individually or adjusting for age group and gender, WtHR performed better that the rest with an average rank score of 1.1 with a relative improvement of 105% percent to the current metric of abdominal circumference. Additionally, we assessed how the current Fitness test adjusts for age and gender. We determined that the current test poorly adjusts for these variables at an alpha of 0.001. Because of this, we present a new scoring metric for the Air Force to consider with respect to incorporating WtHR in lieu of abdominal circumference as well adjusting for gender and age more appropriately.

15. SUBJECT TERMS

Air Force Fitness Test, Abdominal Circumference, Fitness Score, Waist-to-Height Ratio, Linear Regression

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