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THESIS

REVIEW OF THE CURRENT BODY FAT TAPING METHOD AND ITS IMPORTANCE IN ASCERTAINING FITNESS LEVELS IN THE UNITED STATES MARINE CORPS

by

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June 2015

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The United States Marine Corps (USMC) prides itself on its high standards of physical fitness and appearance. The USMC method to determine body composition is two-fold: weight and body fat based. The Department of Defense (DOD) body fat estimate was developed based on data collected in 1984 from the Naval Health Research Center, San Diego. In this thesis, multiple linear regression is used to estimate body fat on the overweight sample from the 1984 data. This thesis applies the DOD body fat estimate on a sample of current USMC males and females. Models are also fit to estimate weight in the current active-duty USMC population using physical fitness attributes. We find that physical fitness does not predict weight well. Models fit to the overweight members of the 1984 data are biased, overpredicting body fat at the lower end of the spectrum and underpredicting at the higher end. When applied to the current male USMC sample, the DOD body fat estimate overpredicts body fat in 30% of overweight males. When applied to the female USMC sample, the DOD method overpredicts body fat in 82% of overweight females. The current DOD taping method is a poor model, and needs to be revised.

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REVIEW OF THE CURRENT BODY FAT TAPING METHOD AND ITS IMPORTANCE IN ASCERTAINING FITNESS LEVELS IN THE UNITED STATES MARINE CORPS

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ABSTRACT

The United States Marine Corps (USMC) prides itself on its high standards of physical fitness and appearance. The USMC method to determine body composition is two-fold: weight and body fat based. The Department of Defense (DOD) body fat estimate was developed based on data collected in 1984 from the Naval Health Research Center, San Diego. In this thesis, multiple linear regression is used to estimate body fat on the overweight sample from the 1984 data. This thesis applies the DOD body fat estimate on a sample of current USMC males and females. Models are also fit to estimate weight in the current active-duty USMC population using physical fitness attributes. We find that physical fitness does not predict weight well. Models fit to the overweight members of the 1984 data are biased, overpredicting body fat at the lower end of the spectrum and underpredicting at the higher end. When applied to the current male USMC sample, the DOD body fat estimate overpredicts body fat in 30% of overweight males. When applied to the female USMC sample, the DOD method overpredicts body fat in 82% of overweight females. The current DOD taping method is a poor model, and needs to be revised

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Abdominal Circumference
AIC	Akaike Information Criteria
ALMAR	All Marine Message
Ammo	Ammunition
APFT	Army Physical Fitness Test
BF	body fat
BMI	Body Mass Index
CFT	Combat Fitness Test
DGCDAR	Direct Ground Combat Definition and Assignment Rule
DOD	Department of Defense
DODI	Department of Defense Instruction
FAH	Flexed-Arm Hang
GAO	Government Accountability Office
GCEITF	Ground Combat Element Integrated Task Force
MANMED	Manual of the Medical Department
MAP	Military Appearance Program
MARADMIN	Marine Administrative Message
MCO	Marine Corps Order
MOS	Military Occupational Specialty
PFA	Physical Fitness Assessment
PFT	Physical Fitness Test
PRT	Physical Readiness Test
LBM	Lean Body Mass
R^2	Coefficient of Determination
RSE	Root Standard Error
USMC	United States Marine Corps
WAAC	Women's Army Auxiliary Corps
WAVES	Women Accepted for Volunteer Emergency Service

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EXECUTIVE SUMMARY

The Marine Corps holds its members to the highest standards of physical fitness and appearance. Since physical fitness tests were introduced in 1908, fitness has been a cornerstone of Marine Corps culture. To maintain fitness standards, the Marine Corps has standards for body composition that all Marines must meet semiannually. Body composition standards are met if weight (by height and gender) standards are met. If a Marine's weight exceeds the upper weight standard, then his or her body fat composition is estimated and compared to the body fat standard. As physical fitness requirements continue to evolve, new methods for assessing body composition should be considered. The current method for estimating body fat was developed in 1984 by Hodgdon and Beckett (1984a, 1984b). This thesis studies the applicability of current body composition standards to today's Marine Corps.

The Direct Ground Combat Definition and Assignment Rule (DGCDAR) law of 1994 states that only males will be assigned to ground combat arms specialties (Amos 2014). The Secretary of Defense repealed DGCDAR in January 2013, tasking all services to start integrating females into ground combat military occupational specialties (MOS's) by January 2016 (Amos 2014). The Marine Corps continues to introduce physically demanding requirements for both males and females, yet little research has been done to address the possibilities of an outdated body composition program that may place more emphasis on being thin versus being strong. This thesis addresses four questions:

- Is there a correlation between body weight and a Marine's physical fitness attributes, such as physical fitness test (PFT) or combat fitness test (CFT) score?
- Given a sample of overweight (by Marine Corps standards) males and females, does the Department of Defense (DOD) body fat estimate methodology accurately assess body composition?
- Is there a modification of the current method for determining body composition that performs better than the current DOD tape test?

- How well does the DOD methodology predict body composition when applied to a current sample of male and female Marines?

The DOD implemented the requirement for all military services to have a body composition standard in 1981 as a supplement to weight for height standards. In 2002, the current taping method for estimating body fat became the standard across the four services.

Unfortunately, we do not have access to a data set that would answer all of the above questions. Instead, we study three sets of data that contain the necessary information. We study the entire Marine Corps population to see if there is a correlation between physical performance and weight. The second data set we study contains the original sample used by Hodgdon and Beckett (1984a, 1984b). Since only overweight Marines are subjected to the DOD taping method, we examine the model's effectiveness in estimating the body fat percentage of those Marines. Finally, we apply the DOD tape test to a current male and female Marine sample.

Utilizing data attained from a 31 March 2015 snapshot of the entire active-duty Marine Corps, several multiple linear regression models are developed in an attempt to predict weight in three populations: males, females performing pull-ups on their PFT, and females performing flexed-arm hang (FAH) on their PFT. When we take into account height, age, and gender, we hypothesize that we will see Marines with high levels of physical fitness weigh less than low performing Marines. The best three models proved to be highly biased, overestimating weight at the lower end of the weight spectrum and underestimating weight in the heavier population. These poor models lead us to conclude that there are other factors that may impact weight outside of physical performance.

Multiple regression models are fit on the data from Hodgdon and Beckett's (1984a, 1984b) study. The data was provided by the Naval Health Research Center, San Diego. These are the data used to develop methods currently used to estimate body fat based on a cross-sectional sample of male and female Sailors on active-duty in the 1980s. Not only are these data outdated, but the

services only use this body fat estimation methodology on overweight service members. To better study this methodology as it is actually used, the service models developed in the 1980s are applied to the overweight portion of this data. In addition, we fit regression models to the overweight portion of this data to see if the service models can be modified. We find that all models tend to be biased at the low and high end of the body fat spectrum.

Data provided by the Ground Combat Element Integrated Task Force (GCEITF) contains body fat data obtained from a bod pod (similar to hydrostatic testing, but measures displaced air instead of water) as well as the current DOD body fat estimate for each Marine. The GCEITF consists of male and female volunteers who are trained in combat arms military occupational specialties and are currently integrated into a combat arms unit (Commandant of the Marine Corps 2014). When the DOD equation for estimating body fat is applied to the GCEITF sample, we see that the DOD equation overpredicts body fat on 30% of the overweight male sample and 28% of the entire male sample. When we analyze the females, the DOD equation overpredicts body fat for 83% of the overweight sample, and 72% of the entire female sample.

Though the DOD standard may have performed fairly well in the past, the evolution of physical fitness standards with emphasis on combat and functional fitness has had an effect on the Marine Corps population. The DOD body fat methodology is not a good model, especially with regard to its tendency to wildly overpredict body fat in the female sample. Serious thought must be put into the current weight and body composition standards.

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I. INTRODUCTION

A. BACKGROUND

The Marine Corps holds its Marines to the highest standards of physical fitness and appearance. Since physical fitness tests were introduced in 1908, fitness has been a cornerstone of Marine Corps culture. As physical fitness requirements continue to evolve, new methods for measuring body composition should be considered. The current method for measuring body fat was developed in 1984, and is outdated.

Marine Corps physical fitness standards are two-tiered: performance-based and weight-based. The physical fitness test (PFT) is conducted once a year, from January to June, requiring all Marines to perform crunches, a three-mile run, and pull-ups (since 2013, females have had the option of performing a flexed-arm hang and not pull-ups, at least until 2016). Based on the number of crunches, total time to complete the three miles, number of pull-ups executed, gender, and age, individuals attain a first-class PFT, a second-class PFT, or a third-class PFT. The combat fitness test (CFT) is conducted from July to December, requiring Marines to run 880-yards, lift ammunition (ammo) can, and maneuver under fire. Each of the three categories is given a maximum score of 100. The sum of the three scores is then associated with a first-, second-, or third-class CFT score.

Weigh-ins are conducted on a biannual basis and may coincide with the PFT or CFT, depending on the reporting period. If Marines do not meet height and weight standards, they are administered a tape test to determine if their body fat is within body composition standards for their age group. The focus of this thesis is to evaluate whether the current methods for determining body composition are relevant to modern Marine Corps fitness standards.

In 1981, the Department of Defense (DOD) implemented the requirement for all military services to have a body composition standard as a supplement to

the weight for height standards already in existence. In 2002, the current taping method for estimating body fat became the standard for all four services. Body fat is calculated by first measuring the circumference of the neck and subtracting it from the circumference of the waist (for males). For females, the measurements for the waist and the hips at the "greatest protrusion of the buttocks as viewed from the side" (Assistant Secretary of Defense (FMP) 2002) are added and then subtracted from the neck circumference. Body fat is then ascertained using these measurements and the individual's height. Table 1 shows the maximum allowable body composition standards, given in percent body fat (BF), for males and females by age group in the Marine Corps. According to Hodgdon and Beckett (1984a, 1984b), the standard error for the current method for estimating body composition is approximately 3–4 percent.

Table 1. Marine Corps Body Composition Standard
(from Commandant of the Marine Corps 2008a)

Age Group	Male BF %	Female BF %
17-26	18	26
27-39	19	27
40-45	20	28
46+	21	29

In addition to standardizing body composition measurements across all services, the DOD also placed restrictions on how stringent the services could be with regard to their weight for height standards. As a result, the Marine Corps restructured its weight for height tables to allow females approximately eight more pounds per inch. Table 2 shows the current Marine Corps weight for height tables for males and females.

Table 2. Marine Corps Height and Weight Standards
(from Commandant of the Marine Corps 2008a)

Height (Inches)	Minimum Standards (Pounds)	Males	Females
		Maximum Standards (Pounds)	
58	91	131	119
59	94	136	124
60	97	141	128
61	100	145	132
62	104	150	136
63	107	155	141
64	110	160	145
65	114	165	150
66	117	170	155
67	121	175	159
68	125	180	164
69	128	186	169
70	132	191	174
71	136	197	179
72	140	202	184
73	144	208	189
74	148	214	194
75	152	220	200
76	156	225	205
77	160	231	210
78	164	237	216
79	168	244	221
80	173	250	227

*Minimum Weight is the same for males and females

B. PURPOSE

The Direct Ground Combat Definition and Assignment Rule (DGCDAR) law of 1994 states that only males would be assigned to ground combat arms specialties (Amos 2014). The Secretary of Defense repealed DGCDAR in January 2013, tasking all services to start integrating females into ground combat military occupational specialties (MOS's) by January 2016 (Amos 2014). The Marine Corps continues to introduce physically demanding requirements for both males and females, yet little research has been done to address the possibility of an outdated body composition program that may place more emphasis on being thin versus being strong. This thesis addresses four questions:

- Is there a correlation between body weight and a Marine's physical fitness attributes, such as physical fitness test (PFT) or combat fitness test (CFT) score?
- Given a sample of overweight (by Marine Corps standards) males and females, does the Department of Defense (DOD) body fat estimate methodology accurately assess body composition?
- Is there a modification of the current method for determining body composition that performs better than the current DOD tape test?
- How well does the DOD methodology predict body composition when applied to a current sample of male and female Marines?

C. ORGANIZATION OF STUDY

Chapter II gives a detailed account of the historical context with regard to body composition across the services, as well as the evolution of weight standards in the Marine Corps. This chapter also provides a literature review, which forms the basis for the regression analysis in Chapter III. The literature review includes the current regression model in use by the DOD to determine body fat from height and taped measurements. Additionally, the four service's adaptations for body fat regression, used from 1981 through 2002, are also discussed. Finally, this chapter identifies the current body composition requirements, physical fitness standards, and weight for height standards for each service.

Chapter III explores the relation between weight, height, age group, and physical fitness levels in the current active-duty Marine Corps. Statistics are extracted from the 2015 active-duty Marine Corps population. Weight is predicted on three subsets of the population—males, females performing pull-ups on the PFT, and females performing the flexed-arm hang (FAH) on the PFT—and further divided by age group. We fit multiple linear regression models to predict weight using mainly physical fitness variables such as PFT and CFT (raw and aggregated data).

Chapter IV discusses the various regression models used to analyze body fat in an overweight sample. We apply regression equations developed by the United States Marine Corps (USMC), Navy, and Army during the 1980s on a sample of overweight (by USMC standards) male and female Sailors. We develop regression models to estimate body fat in the overweight sample using anthropometric measurements taken by Hogdgon and Beckett (1984a, 1984b). We also apply the current Air Force body composition method to the overweight sample.

Chapter V focuses on a current sample of male and female Marines. Body fat is predicted using the DOD body fat estimation on male and female Marines currently assigned to the Ground Combat Element Integrated Task Force (GCEITF). Body fat is measured using the bod pod (similar to the hydrostatic technique, but measures displaced air instead of water). We analyze the predicted versus actual body fat on the entire as well as overweight male and female GCEITF sample to determine the validity of the DOD estimation methodology.

The final chapter of this thesis consists of the summary, conclusions, and recommendations. This section can be utilized by the Marine Corps to help in analyzing future physical fitness requirements and possible revision of the body composition approach.

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II. HISTORICAL CONTEXT AND LITERATURE REVIEW

A. INTRODUCTION

This chapter is separated into three parts: the historical context and evolution of height/weight standards and physical fitness tests; the development of body composition and the current DOD body fat estimate standard; and a review of all four service's fitness and body composition standards. Though particular focus is paid to the Marine Corps in each section, it is important to understand the political and social culture of the time, which inevitably spurred change across the DOD. The scope of the information discussed in this chapter only applies to the U.S. military services.

B. EVOLUTION OF WEIGHT AND FITNESS STANDARDS: CIVIL WAR THROUGH 1980

Well into the 1960s, standards for weight were primarily focused on ensuring men were fit to fight. This, in turn, led to the development of minimum height for weight tables, with a suggested healthy standard weight as the goal rather than a requirement. Upper weight limits were not widely used in any of the services until post-World War II. From the 1960s to 2002, the Marine Corps height for weight standards would see three major revisions.

The introduction of a fitness test for the Marine Corps came via President Theodore Roosevelt's Executive Order No. 989, but was suspended due to war (Assistant Chief of Staff, G-3 1962). Physical fitness tests would not be resumed until after the Korean War. From the 1950s to 1975, the male fitness test would change five times. Between 1963 and 1975, the female fitness test would change three times.

In this section, we outline the history of weight and fitness standards from the Civil War through 1980. We discuss each of the changes and the reasons for those changes. An important part of understanding the evolution of weight and

fitness standards is understanding the history of how women were inducted into the services.

1. Weight Standards and Marine Corps Physical Fitness Standards: The Early Years

Height and weight standards for the military originated during the American Civil War, and were primarily focused on requiring soldiers to meet the minimum weight standards in order to be considered fit to fight. As discussed in Friedl (1990), "weight-for-height standards were relevant when a sizable proportion of draftees and volunteers were malnourished, had tuberculosis, or had parasitic diseases; underweight was a good marker of such individuals who were clearly unsuited to the physical demands of the military" (Friedl 1990, 31).

The first documented attempt to institute a Marine Corps fitness test originated in 1875 from a proposal submitted by First Lieutenant Henry Clay Cochrane (Assistant Chief of Staff, G-3 1962). Frustrated with the lack of promotion opportunities post-Civil War, his proposal was intended to help weed those senior officers deemed physically unfit from the Marine Corps, and allow for upward mobility through the ranks (Assistant Chief of Staff, G-3 1962). Unfortunately for First Lieutenant Cochrane, there was no attempt to implement a physical fitness test until President Roosevelt's Executive Order No. 989 of 1908 (Assistant Chief of Staff, G-3 1962).

On 9 December 1908, President Roosevelt's Executive Order No. 989 called for a biannual physical fitness test for all officers in the Marine Corps. Over the course of three days, line officers were required to march a distance of 50 miles, while field officers were to ride 90 miles on horseback. During one of the marching periods, line officers would be required to double-time for 200 yards, rest for 30 seconds, then double-time for 300 yards, with one minute's rest, and then double-time again for 200 yards. By February 1911, the physical fitness requirement had been reduced to a 25-mile march within two days, to be conducted quarterly. Another modification to the physical fitness order came in

October 1911. Required marching distance was decreased to 10 miles over the course of four hours, to be conducted on a monthly basis. This test remained in effect until April 1917, when the test was suspended due to World War I (Assistant Chief of Staff, G-3 1962). Physical fitness testing would not resume until after the end of the Korean War.

2. World War I

Is there any law that says a yeoman must be a man?

—Secretary of the Navy Josephus Daniels, 1916

The history of American women taking up arms against an enemy can be traced back as far as the Revolutionary War and the story of Molly Pitcher (Holm 1992). Until World War I, women who wished to serve in times of national crisis were able to serve only in a health care capacity. Other than this, women supported the war effort as civilians or resorted to disguising themselves as men (Holm 1992).

The decision to enlist women into the military was born of pragmatism. Seeing the need to have every able-bodied man available to fight, on 19 March 1917, the Navy Department enrolled women in the Navy Reserve with the following military specialties: yeoman, electrician (radio), and any other specialty deemed necessary to the war effort (Holm 1992, 10). The Marine Corps followed suit a year later with the enlistment of Private Opha Mae Johnson into the Marine Corps Reserve. However, once hostilities ended, with the exception of the Nurse Corps, women were demobilized in the Navy, Marine Corps, and the Coast Guard (Holm 1992).

3. World War II and Women in Service

Though World War I showed that women in the services had been a success, the introduction of the Women's Army Auxiliary Corps (WAAC) bill in May 1941 met with resistance from both the War Department and Congress

(Holm 1992). Members of Congress viewed the induction of women into the services negatively as reflected in the following quote:

> I think it is a reflection upon the courageous manhood of the country to pass a law inviting women to join the armed forces in order to win a battle. Take the women into the armed service, who then will do the cooking, the washing, the mending, the humble homey tasks to which every woman has devoted herself. Think of the humiliation! What has become of the manhood of America? (Holm 1992, 24)

Reservations against women in the services were put aside by the War Department post-Pearl Harbor. On 15 May 1942, the WAAC bill was signed into law. On 30 July 1942, the Navy bill authorized the Navy Women's Reserve—later known as the Women Accepted for Volunteer Emergency Service (WAVES)—as well as the Marine Corps Women's Reserve. Four months later, the Coast Guard Women's Reserve was established (Holm 1992).

At the end of World War II, the lack of a measured approach to disbanding females who had, during the war, been central to the ensuring the administrative portion of each service ran smoothly, would trigger a national discussion about fully integrating women into the active-duty military (Holm 1992). Additionally, Marine Corps fitness tests would be reinstated after an almost 40-year absence.

Initial efforts to introduce women into the regular services post-war met with the same resistance as did the WAAC bill prior to World War II. In April 1947, the Army-Navy Nurse Act established the Nurse Corps as a permanent staff corps of the two services (Holm 1992, 108). The Air Force followed suit in 1949 with the establishment of the Air Force Nurses Corps. On 2 June 1948, Congress passed the Women's Armed Services Act of 1948 and on 12 June, President Truman signed into law the permanent establishment of women into the armed services.

Official physical fitness testing did not resume until 1956. The updated Physical Readiness Test (PRT) applied to all Marines below the rank of Colonel, or under 40 years of age. The test included the following events: chin-ups,

pushups, sit ups, one minute of squat thrusts, broad jump, 50-yard duck waddle, 880-yard run (30-40 year olds) with no time limit, and 440 yard run (under 30 years old must complete within 75 seconds for a satisfactory score). The uniform for the event was shorts, shirt, and athletic shoes (Commandant of the Marine Corps 1956). There is no evidence that females had a physical fitness standard during this time.

4. Keeping Up Appearances: The Marine Corps during the 1960s and Early 1970s

The 1960s saw the first attempt by the Marine Corps to associate physical fitness with personal appearance with regard to female Marines. For the first time, females were given written instruction on suggested exercises that would help keep them within the ideal weight for height standard. A suggested fitness test also accompanied this instruction.

Meanwhile, as the conflict in Vietnam continued to escalate, the Marine Corps focused on two things: ensuring males were combat ready and filling the current manpower deficiency. In answer to the former challenge, the male fitness test was twice changed to a more combat-style assessment between 1960 and 1971. The Marine Corps answered the manpower issue by expanding previously MOS's.

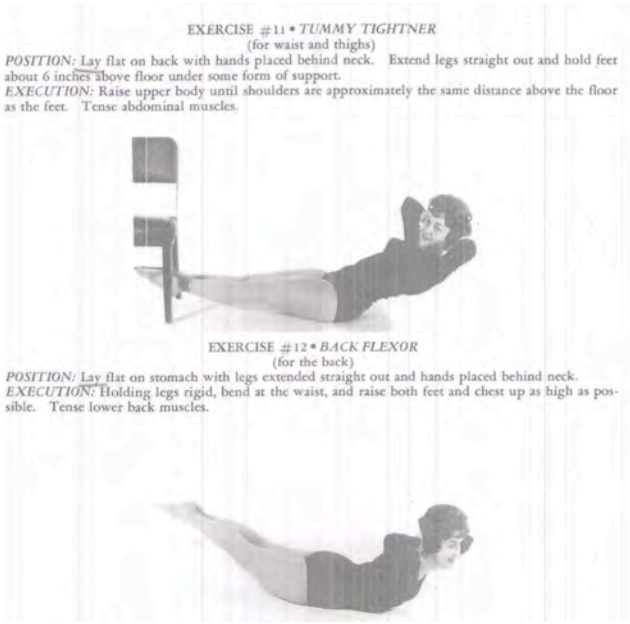
a. The Evolution of Female Physical Fitness

Throughout the end of World War II and into the 1960s, female Marines were required to maintain an appearance commensurate with that of a well-proportioned, slim female. The Marine Corps published a manual entitled *Slim and Trim: For Women Marines*, which included 12 exercises for women to do in order to maintain a trim and healthy appearance. The first five exercises included callisthenic movements such as the twist and overhead squat (Figure 1). The rest of the exercises include isometric movements such as the "tummy tightner" and the back flexor (Figure 2).

EXERCISE #1 • *TWIST*
(for waist, legs, and hips)
POSITION: Stand straight with feet spaced approximately 3 feet apart. Place a straight bar or broom handle across the shoulders and extend arms over and straight out along axis of bar.
EXECUTION: Bend forward and twist to the right. Attempt to touch *left* hand to *right* foot. Keep legs rigid. Return to starting position and repeat to the left side. Exhale as you bend forward, inhale as you come up.

EXERCISE #2 • *OVERHEAD SQUAT*
(for hips and legs)
POSITION: Stand erect with feet spaced 6 to 12 inches apart. Grasp bar with hands spaced 2 to 3 feet apart and extend arms directly overhead.
EXECUTION: Holding back erect, rise on toes and squat down until upper legs are parallel with the floor. Do *not* bend the back. If this is difficult at first place a two inch board or book under the heels. Inhale as you go down, exhale as you come up.

Figure 1. A Female Marine Demonstrates the Twist and Overhead Squat (from United States Marine Corps 1963)



EXERCISE #11 • *TUMMY TIGHTNER*
(for waist and thighs)
POSITION: Lay flat on back with hands placed behind neck. Extend legs straight out and hold feet about 6 inches above floor under some form of support.
EXECUTION: Raise upper body until shoulders are approximately the same distance above the floor as the feet. Tense abdominal muscles.

EXERCISE #12 • *BACK FLEXOR*
(for the back)
POSITION: Lay flat on stomach with legs extended straight out and hands placed behind neck.
EXECUTION: Holding legs rigid, bend at the waist, and raise both feet and chest up as high as possible. Tense lower back muscles.

Figure 2. A Female Marine Demonstrates the “Tummy Tightner” and the Back Flexor (from United States Marine Corps 1963)

The idea of an official female physical fitness requirement was still a relatively new concept for the Marine Corps during the early 1960s. However, as suggested in United States Marine Corps (1963), the times were changing. Table 3 shows the recommended physical fitness test for women Marines. The test was to be performed with no pause between repetitions, with no more than one-minute rest between exercises (United States Marine Corps 1963).

Table 3. Physical Fitness Test for Women Marines, circa 1963
(from United States Marine Corps 1963)

Age	Twist	Squat	Sit-Up	Leg Raise	Hip Roll
18-39	20-20	20	25	20	20-20
Over 40	10-10	10	15	10	10-10

b. Marine Corps Physical Fitness (Male) through the early 1970s

As a reflection of the times, the PRT was updated in 1960, and focused on combat-related tasks. The uniform for the test consisted of boots, utilities, weapon, and a light marching pack. The first of the five events was the Step Test. This test required a Marine to perform 60 step-ups in less than three minutes, and was to simulate marching up hill. The second event, a 20-foot rope climb, was to test an individual's strength. The third event required a Marine to run 50 yards in a zig-zag pattern followed by a fireman's carry back to the starting position (Rasch and Brown 1965, 3). The fourth event, fire and maneuver, incorporated a 25-yard low crawl as well as a zig-zag run. The last event was a forced three-mile march. All male Marines under the age of 40, regardless of rank, were required to take the PRT.

From 1969–1971, the Marine Corps experimented with a new PRT program. The uniform for Males remained boots and utilities; however, the age requirement now applied to those 46 years of age and under. Though Males were still tested in five events, there were now nine possible events by which a Marine could be tested. These nine tests were divided into five groups. On the day of the test, a Marine was to perform one event from each group, with no

advanced notice of which event he would be required to execute. Table 4 provides a breakdown of the nine events by group. The new physical fitness order also established the very first female physical fitness standards. Females under the age of 35 were now required to participate in the following events: shuttle run (timed), knee push-ups, bent knee sit ups, vertical jump, and 600 yard walk/run (timed). Each event was pass/fail, with no associated score.

Table 4. Male PRT, 1969–1971 (after Commandant of the Marine Corps 1968)

Group	Exercise (one per group)	Scoring Method
Group I	Pull Ups	No time limit. As many as possible until fatigued.
	Push Ups	
	20 Foot Rope Climb	Timed Event. As fast as possible
Group II	Sit Ups	As many as possible in two minutes
	Leg Lifts	
Group III	Bend and Thrust	As many as possible in one minute
Group IV	Broad Jump	Best distance/height. Three attempts.
	Vertical Leap	
Group V	3 Mile Run	Timed Event. As fast as possible.

The 1972 the modern Marine Corps physical fitness test (PFT) was introduced. Male Marines were required to conduct pull-ups, sit ups, and a three mile run. The uniform shifted from boots and utilities to shorts, shirt, and athletic shoes. The new order also updated the minimum requirements for each event by age group; 17–26, 27–39, and 40–45 (United States Marine Corps 1972). The reason for the change from the previous physical fitness test to the new one was addressed in a press release dated December 1972. It stated: “six of the events in the old test were abandoned because some individuals could not improve their conditioning to meet the requirements, no matter how hard they tried” (United

States Marine Corps 1972, 5). Table 5 reflects the minimum requirements for each PFT event, while Table 6 outlines the maximum allowable points per event regardless of age. Though the events were to remain the same over the years, the requirements would differ as policy changed.

Table 5. Required Minimum Acceptable Performance for Male Marines (from Commandant of the Marine Corps 1975)

Age	Pull-ups	Sit Ups	3-Mile Run (Min)	Subtotal Points	Required Additional Points	Passing Score
17-26	3	40	28	95	40	135
27-39	3	35	29	84	26	110
40-45	3	35	30	78	7	85

Table 6. Maximum Possible Points by PFT Event for Male Marines (after Commandant of the Marine Corps 1975)

Points	Pull-ups	Sit Ups	3-Mile Run (Min)
100	20	80	18:00

c. The Feminine Ideal, the Need for Useful Women, and the Introduction of Maximum Weight Standards for Both Sexes

In addition to the suggested exercises in United States Marine Corps (1963), the subject of weight control was also addressed. Citing statistics gained from life insurance companies regarding the shortened life expectancy of overweight individuals as the main reason to maintain a healthy weight, the following was emphasized: "we will limit ourselves here to the statement that weight control can only be achieved by pushing yourself away from the table—soon enough. Remember: the time to stop is when you'd still like to eat a little more" (United States Marine Corps 1963, 4). Table 7 shows the height for weight table for women, as published in the Manual of the Medical Department (MANMED), U.S. Navy. Note that there is a specific minimum standard, as well as an ideal weight standard, but no maximum weight requirement for women as of 1963 (United States Marine Corps 1963).

Table 7. Weight standards for all categories of Women
(from United States Marine Corps 1963)

Height (inches)	Weight according to age and height													
	18-19		20-25		26-30		31-35		36-40		41-45		46-49	
	Min	Std	Min	Std	Min	Std	Min	Std	Min	Std	Min	Std	Min	Std
58	97	105	100	108	100	111	100	114	103	117	105	120	107	122
59	100	108	103	111	103	114	103	117	105	120	108	123	110	125
60	102	111	105	114	105	117	105	120	108	123	111	126	113	128
61	102	114	105	117	105	120	108	123	111	126	114	129	116	131
62	102	117	105	120	108	123	111	126	114	129	117	132	119	134
63	105	120	108	123	111	126	114	129	117	132	120	135	122	137
64	109	124	112	127	115	130	118	133	121	136	124	139	126	141
65	113	128	116	131	119	134	122	137	125	140	128	143	130	145
66	117	132	120	135	123	138	126	141	129	144	132	147	134	149
67	121	136	124	139	127	142	130	145	133	148	136	151	138	153
68	125	140	128	143	131	146	134	149	137	152	140	155	142	157
69	129	144	132	147	135	150	138	153	141	156	144	159	146	161
70	132	148	136	151	139	154	142	157	145	160	148	163	150	165
71	137	152	140	155	143	158	146	161	149	164	152	167	154	169
72	141	156	144	159	147	162	150	165	153	168	156	171	158	173

When the Marine Corps was expanding in 1964 and considering opening previously closed MOSs, there was considerable concern about the caliber of female that would be recruited. The concern was so high that the Commandant of the Marine Corps commissioned a Woman Marine Program Study Group to establish the Marine Corps requirements for female Marines. The study group, headed by General Pepper—and later known as the Pepper Board—submitted 83 recommendations to the Commandant, 75 of which were approved. Focusing on quality over quantity, the report stated: "Women Marines must always be the smallest group of women in the military service. In accordance with the Commandant's desire, they must also be the most attractive and useful women in the four line services" (Holm 1992, 181).

The following year (1965), the revised MANMED set forth height for weight tables with maximum limits for both men and women. This new standard established minimum and maximum allowable weights for not only females, but also officers, aviators, and enlisted Marines, as seen in Tables 8–10 (U.S. Department of the Navy 1965).

Table 8. Weight for Height Minimum and Maximum Standards, All Officers Excluding Aviators and Enlisted Men (from U.S. Department of the Navy 1965)

Height	Minimum	Maximum					
		16-20	21-24	25-30	31-35	36-40	41+
60	100	163	173	173	173	168	164
61	102	171	176	175	175	171	166
62	103	174	178	178	177	173	169
63	104	178	182	181	180	176	171
64	105	183	184	185	185	180	175
65	106	187	190	191	190	185	180
66	107	191	196	197	196	190	185
67	111	196	201	202	201	195	190
68	115	202	207	208	207	201	195
69	119	208	213	214	212	206	200
70	123	214	219	219	218	211	205
71	127	219	224	225	223	216	210
72	131	225	231	232	230	224	216
73	135	231	239	238	237	230	223
74	139	237	246	246	243	236	229
75	143	243	253	253	251	243	235
76	147	248	260	260	257	250	241
77	151	254	267	267	264	256	248
78	153	260	275	273	271	263	254

Table 9. Weight for Height Minimum and Maximum Standards, Aviators (from U.S. Department of the Navy 1965)

Height		64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
Weight	Minimum	105	106	107	111	115	119	123	127	131	135	139	143	147	151	153
	Maximum	160	165	170	175	181	186	192	197	203	209	214	219	225	230	235

Table 10. Weight for Height Minimum and Maximum Standards, All Categories of Women (from U.S. Department of the Navy 1965)

Height	Minimum Weight	Maximum Weight					
		18-20	21-24	25-30	31-35	36-40	41+
58	90	121	123	126	124	135	135
59	92	123	125	129	126	139	138
60	94	125	127	132	128	142	141
61	96	127	129	135	131	145	141
62	98	129	132	139	132	148	147
63	100	135	136	141	136	151	150
64	102	136	140	144	140	155	154
65	104	140	144	148	145	159	158
66	106	144	149	151	150	164	163
67	109	147	151	156	154	168	167
68	112	152	158	159	159	172	171
69	115	158	160	164	162	176	175
70	118	162	166	168	167	181	180
71	122	168	171	171	171	185	184
72	125	171	176	176	175	189	188

5. Shape Up or Ship Out: The 1970s

The female PRT remained the same until 1975, when the physical fitness order was again revised to require females to conduct FAH, sit ups, and a 1.5 mile run as part of their physical fitness evaluation. This also heralded the changing of the PRT to the PFT. From 1975 to 1995, this remained the female PFT requirement for the Marine Corps. Table 11 shows the updated minimum requirements by event for females by age group. Table 12 reflects the maximum score females could achieve per event.

Table 11. Female Required Minimum Acceptable Performance (after Commandant of the Marine Corps 1975)

Age	FAH (Seconds)	Sit Ups (in 1 min)	1.5 Mile Run (Min)	Total Points
17-24	16	22	15	100
25-31	14	20	16	82
32-38	12	18	17	64
39-45	10	18	18	56

Table 12. Female Maximum Possible Points by PFT Event (from Commandant of the Marine Corps 1975)

Points	FAH (Seconds)	Sit Ups (in 1 min)	1.5 Mile Run (Min)
100	70	50	10:00

6. Tweaking Physical Fitness: Women Can Run and Men Cannot Kip, the 1990s

By 1996, the PFT was revised again. The female requirements remained the same with regard to the FAH. However, the maximum requirement for sit-ups increased from 50 to 80 (the same as men), and the required run went from 1.5 miles to 3 miles. The scoring matrix for the female run was to add three minutes to the male time in order to obtain the equivalent score. The matrix was developed from data collected during 1996 on female Marines, who ran approximately three-minutes slower than male Marines (Gebicke 1998).

In addition to increasing the female run length and sit up requirement, the Marine Corps also eliminated "kipping" from pull-ups. In order for pull-ups to count on the PFT, males were now required to conduct dead hang pull-ups (Fuentes 1997). In 1997, one additional modification to both the male and female PFT was made, which changed sit-ups to crunches. In order to acquire maximum points on the PFT, one would need to conduct 100 crunches instead of 80 sit-ups regardless of sex. Table 13 shows the minimum and maximum requirements per PFT event for males and females.

Table 13. Minimum and Maximum Requirements by PFT Event (after Commandant of the Marine Corps 2002)

Males			
	Pull-ups	Crunches (in 2 min)	3-Mile Run (Min)
Max Requirement	20	100	18:00
Min Requirement	3	40	33:00
Females			
	FAH (Seconds)	Crunches (in 2 min)	3-Mile Run (Min)
Max Requirement	70	100	21:00
Min Requirement	15	40	36:00

C. EVOLUTION OF BODY FAT ASSESSMENT: GROWING CONCERN OVER THE PERCEPTION OF A FAT MILITARY

The MANMED was used by the Marine Corps as the definitive height for weight determinant from 1965 to 1975. The updated Marine Corps Order (MCO) 6100.3G, *Physical Fitness, Weight Control and Military Appearance*, signed 23 September 1975 completely revamped the height for weight requirements. Major changes included the elimination of maximum weight increases per age group for both men and women, as well as a single height for weight table for males, regardless of MOS or rank. These new tables made universal the need to stay within the weight requirements previously reserved for the youngest population of women (ages 18–20) and aviation requirements for men. Tables 14–15 reflect

the weight standard from 1975, which was to remain in effect until 2002 (Commandant of the Marine Corps 1975).

Table 14. Weight for Height Minimum and Maximum Standards, Male Marines (Commandant of the Marine Corps 1975)

Height		64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Weight	Minimum	105	106	107	111	115	119	123	127	131	135	139	143	147	151	153	155	157
	Maximum	160	165	170	175	181	186	192	197	203	209	214	219	225	230	235	241	247

Table 15. Weight for Height Minimum and Maximum Standards, female Marines (from Commandant of the Marine Corps 1975)

Height		58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
Weight	Minimum	90	92	94	96	98	100	102	104	106	109	112	115	118	122	125
	Maximum	121	123	125	127	129	135	136	140	144	147	152	158	162	168	171

By the late 1970s, each of the four services had developed their own requirements for both upper/lower limits with regard to height and weight, as well as physical fitness standards. Growing public opinion regarding an overweight military prompted President Carter to commission a study in 1981 called the *Study of the Military Services Physical Fitness* (Institute of Medicine 1998, 33–34). The study group determined that the best measure of physical fitness in individuals was correlated to body fat. According to them, individuals with more body fat negatively impacted physical performance. As a result of this study, Department of Defense Instruction (DODI) 1308.1, *Physical Fitness and Body Fat Program* and accompanying DODI 1308.8, *Physical Fitness and Body Fat Programs and Procedures* were published in 1981 (Institute of Medicine 1998). In the instruction, each service was tasked with the responsibility to develop its own body fat assessment.

1. Estimating Body Fat: Services Develop Their Own Methodology

In addition to requiring each service to develop their own metric for assessing body fat, DODI 1308.1 set an upper limit on body fat of 20% for males

and 26% for females. Even though according to Institute of Medicine (1998, 34), “the study panel that was given responsibility to set upper body fat limits for the DOD recommended upper limits of 20 percent body fat for men and 29 to 30 percent for women, based on information in the textbook of McArdle et al. (1981) showing that the average body fat of physically fit young men was 20 percent and that of fit young women was approximately 30 percent.” The female upper limit was reduced to 26% in the belief that it was more desirable to have females with body fat closer to that of males, under the assumption that such women would have greater strength and stamina with regard to physical fitness (Institute of Medicine 1998, 34).

In 1987, DODI 1308.1 was amended to require each service to use a circumference-based approach for estimating body fat. Each service adopted its own methods. The Marine Corps was the first service to adopt a circumference-based model, developed by Wright, Dotson, and Davis (1980, 1981), and officially incorporated it into MCO 6100.10A, *Weight Control and Military Appearance,* on 29 Dec 1986. According to this new order, a Marine would be allowed an “alternative weight standard” if he/she fell within the upper limits of his/her respective body fat (18% for males and 26% for females). The attributes used in the Marine Corps equation to estimate body fat included measuring the abdomen and neck for males, and the biceps, forearm, neck, abdomen, and thigh for females (Commandant of the Marine Corps 1986). These estimates were to remain in effect until 2002. Table 16 lists the attributes used by each service to estimate body fat by the end of the 1980s.

The following sections discuss each service’s body fat estimate methodology. Each study identifies as correlation coefficient, which will be interpreted as a coefficient of determination (R^2). All circumference and height measurements are in centimeters.

Table 16. By the late 1980s, each service was using a different circumference-based estimate for body fat utilizing different body parts (after Hodgdon 1990).

Service	Study	Male Attributes	Female Attributes
Marine Corps	Wright, Dotson, and Davis (1980, 1981)	Abdomen, Neck	Biceps, Forearm, Neck, Abdomen, Thigh
Navy	Hodgdon and Beckett (1984a, 1984b)	Abdomen, Neck, Height	Abdomen, Hip, Neck, Height
Army	Vogel, Kirkpatrick, Fitzgerald, and Hodgdon (1988)	Abdomen, Neck, Height	Weight, Wrist, Neck, Forearm, Hip, Height
Air Force	Fuchs, Theis, and Lancaster (1978); Brennan (1974)	Flexed Bicep, Height, Weight	Forearm, Height, Weight

a. Army Metrics

In 1988, the Army developed methods for estimating body fat meeting the following criteria: skinfold measurements were not used; circumference measurement sites must be easily identifiable/located; uses four or fewer attributes (excluding height and weight); required minimal equipment; attained a correlation coefficient of at least 0.8 with a standard error no greater than 4.0%; and that equations should give comparable results in the three major race/ethnic groups (Vogel et al. 1988, 7). The methods were based on multiple regression fit separately for males and females where for both, the response variable was actual body fat percentage measured using a hydrostatic weighing technique (Vogel et al. 1988). The fitted regression equations are given in Table 17.

Though the regression equation for males was developed based on a sample of all racial and age groups, the female regression equation proved problematic when estimating body fat for black women. “Consistently, correlation coefficients were lower and standard error of the estimate larger in this group than in White or Hispanic women” (Vogel et al. 1988, 12). As a result, the female regression was fit using the all-white population sample in order to attain the required 0.80 correlation coefficient.

Table 17. U.S. Army Body Fat Equations (after Vogel et al. 1988)

Population	Equation	Correlation Coefficient	Standard Error
Males	$76.5 * Log_{10}(AbdomenII - Neck) - 68.7 * Log_{10}(Height) + 46.9$	0.82	4.02%
Females	$105.3 * Log_{10}(Weight) - 0.2 * Wrist - 0.533 * Neck - 1.574 * Forearm + 0.173 * Hip - 0.515 * Height - 35.6$	0.82	3.60%

Note: AbdomenII is defined by the waist circumference at the level of the umbilicus (belly button)

Upon cross-validation, the regression over predicted body fat by 3.2 percent or more for 46% of the male sample, leading Vogel et al. (1988) to conclude that the regression tended to over-predict body fat percentage in lean males.

b. Navy Metrics

In October 1981, the Chief of Naval Operations Instruction 6100.1B, *Health and Physical Readiness,* instructed the Navy to use body fat percentage as a basis for weight control decisions. It further directed the interim use of the Marine Corps methods developed by Wright et al. (1980, 1981) until the Navy could develop their own.

Data was culled from male and female Navy Personnel in 1984. As with the Army data, actual body fat was determined through use of the hydrostatic weighing technique. Further, one of the main criteria in developing a circumference-based method would be the ease by which an untrained individual could make an evaluation “in the field” (Hodgdon and Beckett 1984a). Multiple regression models were fit with the best model producing a correlation coefficient of 0.9 in males with a standard error of 3.52 (see Table 18). The best female multiple regression model produced a correlation coefficient of 0.85 with a standard error of 3.72 (Hodgdon and Beckett 1984b).

Table 18. U.S. Navy Body Fat Equations
(after Hodgdon and Beckett 1984a, 1984b)

Population	Equation	Correlation Coefficient	Standard Error
Males	$-0.919 * Log_{10}(AbdomenII - Neck) + 0.155 * Log_{10}(Height) + 1.032$	0.90	3.52%
Females	$-0.35 * Log_{10}(AbdomenI + Hip - Neck) + 0.221 * Log_{10}(Height) + 1.296$	0.85	3.72%

Note: AbdomenI is defined as the circumference of the natural waistline.

c. Marine Corps

In 1973, data was collected on male Marines to develop an accurate, simple technique for estimating body fat from 37 anthropometric measurements, including skin fold and circumference measurements (Wright et al. 1981, 23). Stepwise variable selection techniques applied to the 37 anthropometric measurements yielded a regression model with a correlation coefficient of 0.87 and a standard error of 3.08. However, this model included skin fold measurements, which were not ideal for a field environment (Wright et al. 1981). A second regression model only included circumference-based measurements, height, and weight for variable selection. This regression fit produced a correlation coefficient of 0.81 with a standard error 3.67 for males.

In 1980, anthropometric data was collected on female Marines in order to develop a simple method of estimating body fat. "Unfortunately, either because the military has been so accustomed to using height/weight tables or since all effort has been directed toward preparing men for combat, very little research has been done on the body composition of females in military organizations" (Wright et al. 1980, 19). The best predictors of percent body fat in females were the skinfold measurements of the abdomen and thigh. Adjusting the model to only include circumference-based measurements, height, and weight, the best regression had a correlation coefficient of 0.73 and a standard error of 4.11 (see Table 19). Actual body fat was obtained using hydrostatic weighing, for both the males and females.

Table 19. U.S. Marine Corps Body Fat Equations
(after Wright et al. 1980, 1981)

Population	Equation	Correlation Coefficient	Standard Error
Males	$0.740 * AbdomenII - 1.249 * Neck + 40.985$	0.81	3.67%
Females	$1.051 * Biceps - 1.522 * Forearm - 0.879 * Neck + 0.326 * AbdomenII + 0.597 * Thigh + 0.707$	0.73	4.11%

d. Air Force

The Air Force took a different view of body fat composition. Instead of developing equations to estimate body fat, they chose to focus on estimated Lean Body Mass (LBM) to determine if an Airman was within standards.

Data obtained from 198 aircrewmen was used to determine the best anthropometric measurements to estimate LBM. Using conclusions from previous studies, special focus was given to two measurements: biceps circumference and height. Unlike the three previous methods, which measured actual body fat through the use of hydrostatic weighing, blood samples were analyzed to obtain LBM and percent body fat from a standard formula (Fuchs et al. 1978).

A multiple regression model was developed to estimate LBM, which produced a correlation coefficient of 0.84 with a standard error of 2.95 kg. After estimating LBM, body fat percentage was calculated by computing fat mass (weight-LBM) divided by current weight, multiplied by 100. It was noted LBM tended to be overestimated in obese men and underestimated in very lean men (Fuchs et al. 1978, 676).

In 1974, Ellen Brennan developed an estimation equation for LBM using data obtained from the hydrostatic weighing technique and circumference measurements in young women (Brennan 1974). A multiple regression model was developed to estimate LBM in females using non-service and service women (Hodgdon 1990). See Table 20 for the U.S. Air Force Body Fat Equations.

Table 20. U.S. Air Force Body Fat Equations
(after Fuchs et al. 1978, Brennan 1974)

Population	Equation	Correlation Coefficient	Standard Error
Males	$LBM = 0.018 * Flex - Biceps^2 + 0.514 * Height - 49.67$ $BodyFat = 100 * \frac{(Weight - LBM)}{Weight}$	0.84	2.95 kg
Females	$LBM = 1.619 * Forearm + 0.311 * Height - 47.76$ $BodyFat = 100 * \frac{(Weight - LBM)}{Weight}$	0.84	2.29 kg

2. Standardizing Body Composition, the 1990s and 2000s

By 1995, the DOD had updated the acceptable body fat limits to their current requirement as reflected in DODI 1308.1. Services were authorized to dictate the upper limits of body fat for their service, as long as it was no more stringent than that decreed by the DODI. Hence, upper limits for males were given a range of 18–26 percent and 26–36 percent for females. With this updated directive, each of the services, with the exception of the Marine Corps, relaxed their upper limit on body fat standards.

A Government Accountability Office (GAO) report (submitted to the Subcommittee on Readiness, Committee on Armed Services, U.S. Senate) in 1998 discussed the variability in body fat estimates across the services. Though the methods proved fairly robust with regard to estimating male body fat, it was not the case for females. "One such example was the Army's equation estimated one woman's body fat at 42 percent, whereas the estimated percentage of body fat for the same woman was 29 percent using the Navy and Air Force equations and 27 percent using the Marine Corps equation" (Gebicke 1998, 6). This discrepancy across the services led to the GAO recommendation that one DOD body fat estimate be used.

By 2002, the DOD acquiesced to the recommendation and standardized the body fat estimation method for all services. The latest and most current DODI

1308.3 directive states that the equations used by the Navy and developed by Hodgdon and Beckett (1984a, 1984b) would replace all other body fat equations. It further specified that no other means of body fat estimation was to be used, to include hydrostatic testing or estimates based on skin fold measurements. In addition to standardizing the body fat estimation methods across the services, the DODI 1308.3 also placed a lower limit on how stringent the services could be with regard to their height for weight charts. These new standards were based on what was considered the range of healthy weight for height, according to the Quetelet index, otherwise known as the body mass index (BMI) equation (Assistant Secretary of Defense (FMP) 2002). A new minimum weight standard was associated with a BMI of 19, while the new minimum upper weight limit was placed at a BMI of 25 (Assistant Secretary of Defense (FMP) 2002). Table 21 shows the current weight for height standards as published by DODI 1308.3.

Table 21. Maximum and Minimum Screening Weights Based on Selected BMI Standards (from Assistant Secretary of Defense (FMP) 2002)

Maximum Allowable Weights for BMI of 27.5 (regardless of age)																								
Height	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Weight	131	136	141	145	150	155	160	165	170	175	280	186	191	197	202	208	214	220	225	231	237	244	250
Maximum Allowable Weights for BMI of 25.0 (regardless of age)																								
Height	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Weight	119	124	128	132	136	141	145	150	155	159	164	169	174	179	184	189	194	200	205	210	216	221	227
Minimum Weights for BMI of 19.0																								
Height	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Weight	91	94	97	100	104	107	110	114	117	121	125	128	132	136	140	144	148	152	156	160	164	168	173

D. THE WAY AHEAD: CURRENT STANDARDS IN THE MILITARY SERVICES

1. Air Force

In 2009, the Air Force completely revamped their physical fitness and body composition program. Though height and weight are still recorded per DODI 1308.1, they are no longer used in initially assessing whether an Airman is fit for duty. For the Air Force, the initial body composition assessment and physical fitness standards have become intertwined. Special permission was granted to the Air Force to waive the DOD body fat measurement methodology.

The memorandum from the Under Secretary of Defense (Personnel and Readiness) to the Assistant Secretary of the Air Force (Manpower and Reserve Affairs) which granted the waiver also stated: "DODI 1308.3 is currently being updated and the abdominal circumference methodology is being reviewed by DOD and the Joint Services Physical Fitness and Body Fat Working Group for inclusion in this instruction" (Secretary of the Air Force 2013, 80).

Body composition assessment in the Air Force is now three-pronged. The initial assessment is incorporated into the Air Force Fitness Assessment test, and associates abdominal circumference (AC) to a point scale. The Fitness Assessment is broken down into four categories: aerobic (1.5 mile run); Body Composition (as demonstrated by AC); push-ups (as many as possible in one minute); and sit-ups (as many as possible in one minute). An Alternative Aerobic Test (2 kilometer walk) is available for Airmen who are not medically cleared to complete the 1.5-mile run. As long as an Airman falls within the acceptable AC for their gender, then there is no need for further body composition evaluations. Table 22 shows the Air Force Fitness Assessment composite scoring technique. In order to pass the Fitness Assessment, Airmen must earn a composite score of 75 or greater. Table 23 breaks down the maximum and minimum requirements of the Fitness Assessment by gender, age, and assessment category. Complete Air Force Fitness Assessment Scoring tables can be found in Appendix A.

a. Fitness Assessment Scoring and Testing Frequency

The Air Force further categorizes the composite score into four fitness levels—Excellent, Satisfactory, Unsatisfactory, and Exempt. Airmen who obtain a composite score of 90 or above and meet all minimum requirements are categorized as Excellent. Airmen who obtain an Excellent score are required to complete the Fitness Assessment within 12 months of attaining that level. Satisfactory Airmen must conduct a Fitness Assessment at least twice a year, while Unsatisfactory Airmen must retest within 90 days (Secretary of the Air Force 2013).

Table 22. Air Force Fitness Assessment Composite Score
(after Secretary of the Air Force 2013)

Composite Score			Total Component Points Achieved*100 Total Possible Points	
Component:	Aerobic	Body Composition	Push-Ups	Sit-Ups
Possible Points:	60	20	10	10

Table 23. Air Force Fitness Assessment Test
(after Secretary of the Air Force 2013)

Gender	Age Groups	Max/Min Requirements	Run Time (min:secs)	Points	AC	Points	Push-Ups	Points	Sit-Ups	Points
Male	< 30	Max	<9:13	60	<32.6	20	>66	10	>57	10
		Min	13:36	42.3	39.0	5	33	5	42	6
	30-39	Max	<9:35	60	<32.6	20	>56	10	>53	10
		Min	14:00	39.3	39.0	12.6	27	5	39	6
	40-49	Max	<9:44	60	<32.6	20	>43	10	>49	10
		Min	14:52	42.3	39.0	12.6	21	5	34	6
	50-59	Max	<10:38	60	<32.6	20	>43	10	>45	10
		Min	16:22	42.4	39.0	12.6	15	5	28	6
	60+	Max	<11:23	60	<32.6	20	>29	10	>41	10
		Min	18:14	42.4	39.0	12.6	14	5	22	6
Female	< 30	Max	<10:24	60	<29.1	20	>46	10	>53	10
		Min	16:22	44.1	35.5	12.8	18	5	38	6
	30-39	Max	<10:52	60	<29.1	20	>45	10	>44	10
		Min	16:57	40.8	35.5	12.8	14	5	19	6
	40-49	Max	<11:23	60	<29.1	20	>37	10	>40	10
		Min	18:14	45.9	35.5	12.8	11	5	24	6
	50-59	Max	<12:54	60	<29.1	20	>34	10	>31	10
		Min	19:43	45.5	35.5	12.8	9	5	20	6
	60+	Max	<14:01	60	<29.1	20	>20	10	>30	10
		Min	22:28	40.8	35.5	12.8	7	5	11	6

If an Airman fails the AC portion of the Fitness Assessment, yet passes the other components of the Fitness Assessment, then a BMI screening is conducted. Airmen with an associated BMI of 25 or less, as published in DODI 1308.3, and reproduced in Table 21, pass the Fitness Assessment. However, individuals who fail the BMI screen will then be assessed for body fat as per DODI 1308.3. In order to pass the body fat assessment, males must not exceed 18% body fat while females shall not exceed 26%, the lowest allowable maximum limit as set forth by the DOD. If an Airman passes the BMI or body fat assessment, then they are marked “exempt” for the Body Composition portion of the Fitness Assessment.

2. Army

The Army Physical Fitness Test (APFT) is performed twice a year and contains three events—push-ups, sit-ups, and a two mile run—done in that order, with a minimum of 10 minutes and a maximum of 20 minutes rest in between sets (Secretary of the Army 2012). The lowest passing score for each event is 60 to attain an overall score of 180. The highest score available is 300. Table 24 shows the minimum and maximum breakdown of points by gender and PFT category. The complete APFT Scoring tables can be found in Appendix B.

Table 24. U.S. Army PRT Minimum and Maximum Standards by Gender, Age, and Event (after Secretary of the Army 2012)

Males							
Age Group	Min/Max Requirements	Push-Ups	Points	Sit-Ups	Points	Run Time	Points
17-21	Max	71	100	78	100	13:00	100
	Min	42	60	53	60	15:54	60
22-26	Max	75	100	80	100	13:00	100
	Min	40	60	50	60	16:36	60
27-31	Max	77	100	82	100	13:18	100
	Min	39	60	45	60	17:00	60
32-36	Max	75	100	76	100	13:18	100
	Min	36	60	42	60	17:42	60
37-41	Max	73	100	76	100	13:36	100
	Min	34	60	38	60	18:18	60
42-46	Max	66	100	72	100	14:06	100
	Min	30	60	32	60	18:42	60
47-51	Max	59	100	66	100	14:24	100
	Min	25	60	30	60	19:30	60
52-56	Max	56	100	66	100	14:42	100
	Min	49	60	28	60	19:48	60
57-61	Max	53	100	64	100	15:18	100
	Min	18	60	27	60	19:54	60
62+	Max	50	100	63	100	15:42	100
	Min	16	60	26	60	20:00	60

Females							
Age Group	Min/Max Requirements	Push-Ups	Points	Sit-Ups	Points	Run Time	Points
17-21	Max	42	100	78	100	15:36	100
	Min	19	60	53	60	18:54	60
22-26	Max	46	100	80	100	15:36	100
	Min	17	60	50	60	19:36	60
27-31	Max	50	100	82	100	15:48	100
	Min	17	60	45	60	20:30	60
32-36	Max	45	100	76	100	15:54	100
	Min	15	60	42	60	21:42	60
37-41	Max	40	100	76	100	17:00	100
	Min	13	60	38	60	22:42	60
42-46	Max	37	100	72	100	17:24	100
	Min	12	60	32	60	23:42	60
47-51	Max	34	100	66	100	17:36	100
	Min	10	60	30	60	24:00	60
52-56	Max	31	100	66	100	19:00	100
	Min	9	60	28	60	24:24	60
57-61	Max	28	100	64	100	19:42	100
	Min	8	60	27	60	24:48	60
62+	Max	25	100	63	100	20:00	100
	Min	7	60	26	60	25:00	60

Alternate aerobic events are allowed for Soldiers who cannot perform the 2-mile run due to permanent or long-term temporary profiles (Secretary of the Army 2012). See Table 25 for the minimum required time per event by age group and gender

Table 25. Minimum Required Times to Pass Alternate Aerobic Events for Soldiers with Permanent or Long Term Temporary Profiles (from Secretary of the Army 2012)

Event	Gender	Age									
		17-21	22-26	27-32	32-36	37-41	42-46	47-51	52-56	57-61	62+
800-Yard Swim	Male	20:00	20:30	21:00	21:30	22:00	22:30	23:00	24:00	24:30	25:00
	Female	21:00	21:30	22:00	22:30	23:00	23:30	24:00	25:00	25:30	26:00
6.2 Mile Cycle Ergometer and Bicycle Test	Male	24:00	24:30	25:00	25:30	26:00	27:00	28:00	30:00	31:00	32:00
	Female	25:00	25:30	26:00	26:30	27:00	28:00	30:00	32:00	33:00	34:00
2.5-Mile Walk	Male	34:00	34:30	35:00	35:30	36:00	36:30	37:00	37:30	38:00	38:30
	Female	37:00	37:30	38:00	38:30	39:00	39:30	40:00	40:30	41:00	41:30

a. Army Body Composition Program

As with the APFT, body composition standards are broken down by gender and age category. Height for weight tables maintain the DOD minimum weight standard across the age groups, regardless of gender, but gives leniency with regard to the maximum standard as males and females age. Table 26 reflects the current height for weight tables. Soldiers over their maximum standards have their body fat estimated per DODI 1308.3. As with the height for weight standards, acceptable maximum body fat is broken down by age group, see Table 27 for the Army body fat standards.

Table 26. Current Army Height for Weight Standards
(after Secretary of the Army 2013)

Height (Inches)	Minimum Weight Standard	Age Group (Maximum Weight Standard)							
		17-20		21-27		28-39		40+	
		Male	Female	Male	Female	Male	Female	Male	Female
58	91	-	119	-	121	-	122	-	124
59	94	-	124	-	125	-	126	-	128
60	97	132	128	136	129	139	131	141	133
61	100	136	132	140	134	144	135	146	137
62	104	141	136	144	138	148	140	150	142
63	107	145	141	149	143	153	144	155	146
64	110	150	145	154	147	158	149	160	151
65	114	155	150	159	152	163	154	165	156
66	117	160	155	163	156	168	158	170	161
67	121	165	159	169	161	174	163	176	166
68	125	170	164	174	166	179	168	181	171
69	128	175	169	179	171	184	173	186	176
70	132	180	174	185	176	189	178	192	181
71	136	185	179	189	181	194	183	197	186
72	140	190	184	195	186	200	188	203	191
73	144	195	189	200	191	205	194	208	197
74	148	201	194	206	197	211	199	214	202
75	152	206	200	212	202	217	204	220	208
76	156	212	205	217	207	223	210	226	213
77	160	218	210	223	213	229	215	232	219
78	164	223	216	229	218	235	221	238	225
79	168	229	221	235	224	241	227	244	230
80	173	234	227	240	230	247	233	250	236

Table 27. Current Army Body Fat Standards
(from Secretary of the Army 2013)

Gender	Age Group			
	17-20	21-27	28-39	40+
Male	20%	22%	24%	26%
Female	30%	32%	34%	36%

3. Navy

The Navy Physical Fitness Assessment (PFA) consists of three events—a medical screening, a body composition assessment (BCA), and the PRT (Chief of Naval Operations 2011, Enclosure (1)). As part of the medical screening, Sailors are required to have a current Periodic Health Assessment and answer

pre-physical activity questions prior to participating in the PRT. The BCA portion of the PFA consists of ensuring Sailors fall within the prescribed height for weight standards, see Table 28 for the Navy's height for weight standards. If a Sailor fails to meet the weight standards, he or she is then measured for body fat. As long as the Sailor is within established body fat standards for their age and gender, then they pass the BCA portion of the PFA, see Table 29 for the Navy's body fat standards by age and gender. The BCA portion of the PFA must be completed within 10 days, and no less than 24 hours prior to the PRT. The Navy PRT consists of three events—cardio (1.5-mile run, swim, elliptical, or bike), curl-ups (as many as possible in two minutes), and push-ups (as many as possible in two minutes).

Table 28. Current Navy Height for Weight Standards by Gender (from Chief of Naval Operations 2011)

Height (Inches)	Maximun Weight Standards by Gender	
	Male	Female
57	127	127
58	131	131
59	136	136
60	141	141
61	145	145
62	150	149
63	155	152
64	160	156
65	165	160
66	170	163
67	175	167
68	181	170
69	186	174
70	191	177
71	196	181
72	201	185
73	206	189
74	211	194
75	216	200
76	221	205
77	226	211
78	231	216
79	236	222
80	241	227

Table 29. Current Navy Body Fat Standards by Gender and Age (from Chief of Naval Operations 2011)

Gender	Age Group	
	17-39	40+
Males	22%	23%
Females	33%	34%

a. PRT Scoring

Each PRT event is graded on a 100-point scale. A Sailor is then assigned an overall level of performance based on the average of the three scored events. The run and swim cardio option is scored based off total time to either run 1.5 miles, or swim 500 yards. For the elliptical and bike cardio option, the object is to burn as many calories as possible in 12 minutes. Sailors are required to get permission from the Commanding Officer or Officer in Charge to perform the elliptical or bike options in lieu of the swim or run options. Table 30 provides the PRT performance levels and associated score. Table 31 provides the maximum and minimum requirements per PRT event by gender. The complete PRT Scoring tables can be found in Appendix C.

Table 30. Navy PRT Performance Levels and Associated Scores (from Chief of Naval Operations 2011)

Performance Levels	Points
Outstanding	90-100
Excellent	75-89
Good	60-74
Satisfactory	45-59
Failure	<45

Table 31. Current Maximum and Minimum Requirements to Pass the PRT by Gender and Age (after Chief of Naval Operations 2011)

Males						
Age Group	Performance Level	Curl-Ups	Push-Ups	1.5-Mile Run	500-yd Swim	450-m Swim
17-19	Outstanding	102	86	9:00	7:15	7:05
	Satisfactory	50	42	12:30	12:45	12:35
20-24	Outstanding	98	81	9:15	7:30	7:20
	Satisfactory	46	37	13:30	13:00	12:50
25-29	Outstanding	95	77	9:38	7:38	7:20
	Satisfactory	43	34	14:00	13:08	12:58
30-34	Outstanding	92	74	10:00	7:45	7:35
	Satisfactory	40	31	14:30	13:15	13:05
35-39	Outstanding	88	70	10:08	7:53	7:34
	Satisfactory	37	27	15:00	13:23	13:13
40-44	Outstanding	85	67	10:15	8:00	7:50
	Satisfactory	35	24	15:30	13:30	13:20
45-49	Outstanding	81	52	12:08	9:23	9:13
	Satisfactory	31	21	16:08	13:38	13:28
50-54	Outstanding	78	59	10:45	8:15	8:05
	Satisfactory	29	19	16:45	13:45	13:35
55-59	Outstanding	74	56	11:25	8:17	8:07
	Satisfactory	26	10	17:09	13:55	13:45
60-64	Outstanding	70	52	12:04	8:20	8:10
	Satisfactory	20	8	18:52	14:05	13:55
65+	Outstanding	60	44	12:43	8:25	8:15
	Satisfactory	10	4	20:35	14:15	14:05
Females						
Age Group	Performance Level	Curl-Ups	Push-Ups	1.5-Mile Run	500-yd Swim	450-m Swim
17-19	Outstanding	102	47	11:30	8:30	8:20
	Satisfactory	50	19	15:00	14:15	14:05
20-24	Outstanding	98	44	11:30	8:45	8:20
	Satisfactory	46	16	15:30	14:30	14:20
25-29	Outstanding	95	43	11:45	9:00	8:50
	Satisfactory	43	13	16:08	14:45	14:35
30-34	Outstanding	92	41	12:00	9:15	9:05
	Satisfactory	40	11	16:45	15:00	14:50
35-39	Outstanding	88	39	12:08	9:30	9:20
	Satisfactory	37	9	17:00	15:15	15:05
40-44	Outstanding	85	37	12:15	9:45	9:35
	Satisfactory	35	7	17:15	15:30	15:20
45-49	Outstanding	81	35	12:30	9:35	9:43
	Satisfactory	31	5	17:23	15:38	15:28
50-54	Outstanding	78	33	12:45	10:00	9:50
	Satisfactory	29	2	17:30	15:45	15:35
55-59	Outstanding	74	26	13:57	10:07	9:57
	Satisfactory	26	2	18:34	16:00	15:50
60-64	Outstanding	70	22	15:08	10:15	10:05
	Satisfactory	20	2	19:43	16:15	16:05
65+	Outstanding	60	18	16:19	10:23	10:13
	Satisfactory	10	1	20:52	16:30	16:20

*Adjusted tables are available for Sailors conducting the PRT at elevations of 5,000 feet or higher.

4. Marine Corps

As discussed previously, DODI 1308.3 had set the standard for how stringent the services could be with regard to weight for height tables as well as body fat. The Marine Corps, having the most restrictive standards prior to the updated 2002 DODI publication, was required to revise their weight standards.

In 2008, the Marine Corps once again updated their body composition standards. Previous leniency with regard to upper limits of body fat, which allowed a male to have up to 22% body fat and a female up to 30% body fat if they attained a 1st Class PFT. Within the same month, the physical fitness order was also updated, and included the CFT. Four years later, the female PFT changed again—pull-ups would replace the FAH by 2013, at least in theory.

a. Forced to Change: The Marine Corps in the 2000s

DODI 1308.3 required the Marine Corps to update their height for weight tables. Adopting the DOD requirements, new maximum weight standards were set at a BMI of 25 for females and 27.5 for males. For the female population, this new order gave them an extra eight pounds across all heights. The male maximum remained fairly unchanged with the exception of a pound difference for some of the heights. The alternative weight standard associated with the Marine Corps Body Fat assessment was abandoned.

Instead, the Marine Corps developed the Physical Performance Evaluation, which took into account the “total” Marine and acknowledged the 3 to 4% margin of error in body fat estimation. In order to meet the criteria for a Physical Performance Evaluation, a Marine would have to obtain a first class PFT score taken a maximum of 90 days before or 30 days after the body composition evaluation. Additionally, the body fat estimation should not exceed the standard by more than 4%, 22% for males, and 30% for females (Commandant of the Marine Corps 2002). This remained the standard until 2008.

b. Military Appearance and the CFT—the End of Skinny Fat

By 2008, the Marine Corps shifted focus to combat fitness. In addition to the PFT, the Marine Corps now required Marines to perform the CFT. The new test was to take place annually, between the months of July and December. The CFT consists of three events to be performed in the following order—Movement to Contact, Ammo Can Lift, and Maneuver Under Fire. The uniform for each event would be boots and utilities. Movement to Contact involves a 880 yard sprint. The Ammo Can Lift is a timed two-minute event in which one performs as many push presses as possible using a 30 pound ammo can. The Maneuver Under Fire event of the CFT is a 300 yard shuttle run that includes a variety of combat-related tasks (Commandant of the Marine Corps 2008b, 3–4). Figure 3 illustrates all the required tasks for the Maneuver Under Fire event. Table 32 reflects the minimum and maximum CFT scores by event, age group, and gender. Complete scoring tables for the PFT and CFT are in Appendices D and E.

Table 32. Minimum and Maximum Requirements by Event, Age Group, and Gender; CFT Scores
(after Commandant of the Marine Corps 2008b)

Males				
Age	Min/Max Requirement	Movement to Contact (Min)	Ammo Can Lift (2 min)	Maneuver Under Fire (Min)
17-26	Max	2:45	91	2:14
	Min	4:13	33	3:58
27-39	Max	2:51	97	3:26
	Min	4:31	28	4:42
40-45	Max	3:03	89	2:34
	Min	5:07	17	5:59
46+	Max	3:05	86	2:52
	Min	5:09	16	6:07
Females				
17-26	Max	3:23	17	3:01
	Min	5:27	60	5:59
27-39	Max	3:30	13	3:07
	Min	5:28	63	6:04
40-45	Max	3:49	7	3:21
	Min	5:35	45	6:25
46+	Max	3:55	6	3:44
	Min	5:50	41	6:30
CFT Classification				
1st Class		270-300		
2nd Class		225-269		
3d Class		190-224		
Fail		<190		

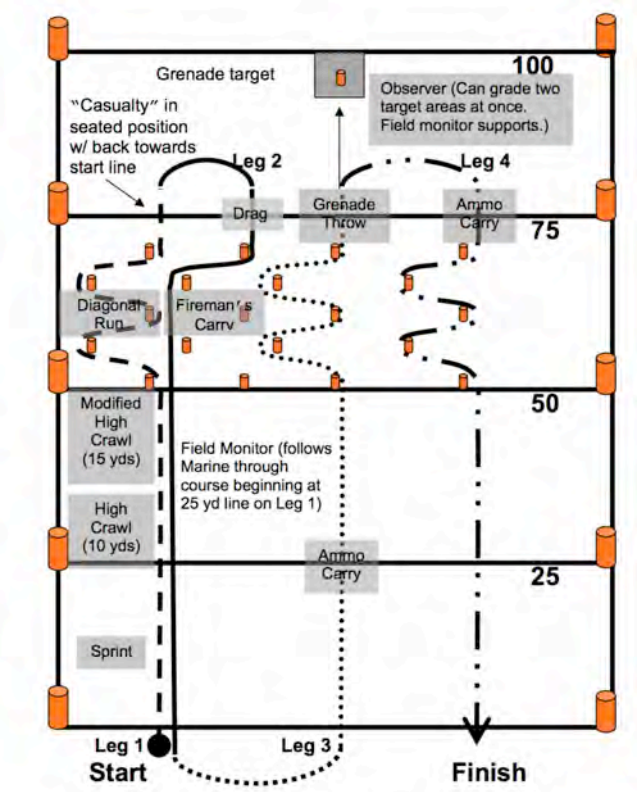


Figure 3. Maneuver Under Fire Layout
(from Commandant of the Marine Corps 2008b)

The Marine Corps also updated their body composition order in 2008. Major changes included the revocation of the Physical Performance Evaluation, an age-delimited body fat standard, and the introduction of the Military Appearance Program (MAP). See Table 33 for the updated body fat standards by age and gender. As part of the informal MAP program, commanders have been tasked with establishing redistribution/weight reduction procedures for Marines who are within their respective weight standards, but have improper distribution/excessive accumulation of body fat as per the commander's discretion (Commandant of the Marine Corps 2008a, 5). Under the informal program, Marines have a total of 120 days to attain a suitable military appearance. Formal MAP assignment requires commanders with Special Courts-Martial Convening Authority to conduct a MAP assessment. "Assessments will include a review of all relevant MAP documentation and a Commander/Officer-in-

Charge Summer Service 'C' uniform inspection" (Commandant of the Marine Corps 2008a, 11). Figure 4 provides an overview of the Marine Corps Body Composition/MAP Program.

Table 33. Current Marine Corps Body Composition Standards by Age and Gender (from Commandant of the Marine Corps 2008a)

Age Group	Male BF %	Female BF %
17-26	18	26
27-39	19	27
40-45	20	28
46+	21	29

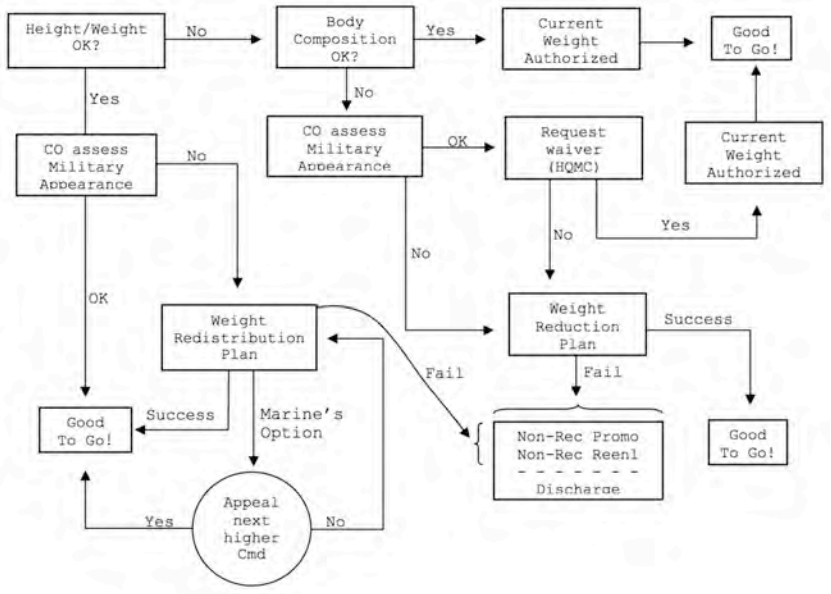


Figure 4. Marine Corps Body Composition/MAP Program Decision Tree (from Commandant of the Marine Corps 2008a)

c. One Step Closer to Gender-Norming: Female Do Pull-ups

All Marine Message (ALMAR) 046/12, dated 27 November 2012, announced that the Marine Corps would be transitioning from the FAH to pull-ups, effective 1 January 2014. Females were given the option to conduct pull-ups in lieu of the FAH on the PFT beginning 1 January 2013. The minimum

requirements for pull-ups would be the same as the male requirement, three pull-ups. Eight pull-ups would be the maximum requirement with an associated score of 100 points. Table 34 shows the points associated with total pull-ups executed.

Table 34. Female Pull-Up Score Table
(after Commandant of the Marine Corps 2012)

Pull-Ups Executed	Points
8	100
7	95
6	85
5	75
4	65
3	45

(1) A Rocky Road: The Trouble with Deadlines

By 24 January 2014, the Marine Corps modified the transition timeline through 30 June 2014, again giving females the option to perform the FAH in that reporting period (Commandant of the Marine Corps 2014c). Implementing pull-ups was further delayed through calendar year 2015 due to ongoing data collection (Commandant of the Marine Corps 2014b). "Attempts to replace the times flexed-arm hang option with a 3 pull-up requirement had to be suspended until December 2015, since 55% of female Marine recruits were unable to perform the minimum test" (Center for Military Readiness 2014, 9). As it stands now, females should continue to assume pull-ups will be the Marine Corps standard come 2016.

E. SUMMARY OF CHAPTER

The majority of this chapter is aimed at providing a historical context and a foundation for the data analysis in Chapter III. The literature reviewed in this thesis focused on the development of physical fitness, body composition, and weight standards throughout the services, with particular focus on the Marine Corps. Analysis of each service equation is done on the original data set utilized by Hodgdon and Beckett (1984a, 1984b). Analysis will also be done on the entire

Marine Corps population to determine if there is a correlation between weight and physical fitness assessments. Further, the DOD equation is tested on a current sample of Marines to see whether the taping method is a good indicator for predicting body fat in today's Marine Corps.

III. MARINE CORPS PHYSICAL FITNESS DATA, METHODOLOGY, AND ANALYSIS

A. INTRODUCTION

This chapter focuses on the relationship between physical fitness standards and weight with regard to the entire Marine Corps. The data contains height, weight, age, race, ethnic group, rank, marital status, number of dependents, estimated body fat percentage (overweight population only), PFT scores (including raw data), and CFT scores (including raw data). This data is a snapshot of all active-duty Marines on 31 March 2015. The data set contains a total of 177,834 Marines. In this chapter, we analyze the relationship between physical fitness and weight standards for both the male and female population of the Marine Corps.

B. DATA STATISTICS

In order to analyze whether there is a correlation between height and weight standards and physical fitness, we divide the Marine Corps population data set into a male and female subset. We further divide females by who currently execute pull-ups on the PFT, those doing FAH, and females with no current record of having done pull-ups or the FAH, but still have a PFT score.

Because this part of the thesis seeks to find a correlation between physical fitness and weight standards, we delete records with no record of height (0.4% of the female population, and 0.3% of the male population). In addition, we delete records that contain neither CFT nor PFT scores (6.5% of the female population, and 3% of the male population). Upon inspecting the data with missing height information we find that the distribution of weight, age, CFT, and PFT scores mirror that of the remaining male and female population. The same holds true for the population missing PFT and CFT scores with regard to weight, age, and height distribution.

1. Male Population

Since the Marine Corps has weight for height tables, the male population is subdivided by height, and categorized by four weight zones: under standards (below the minimum weight requirements), within standards (includes the range from the minimum allowable weight requirements for height up to five pounds from the maximum allowable standard), the danger zone (within five pounds or less of the maximum allowable weight for height), and over standards (over the maximum allowable weight requirements). Figure 5 and Table 35 give a breakdown of the entire male population. Due to the low numbers of Marines below 61 and above 79 inches (0.06% of the total population), the population of males under 61 inches are combined into a group with heights $\leq$ 61 inches while the male population over 79 inches are combined into a group with heights $\geq$ 79 inches.

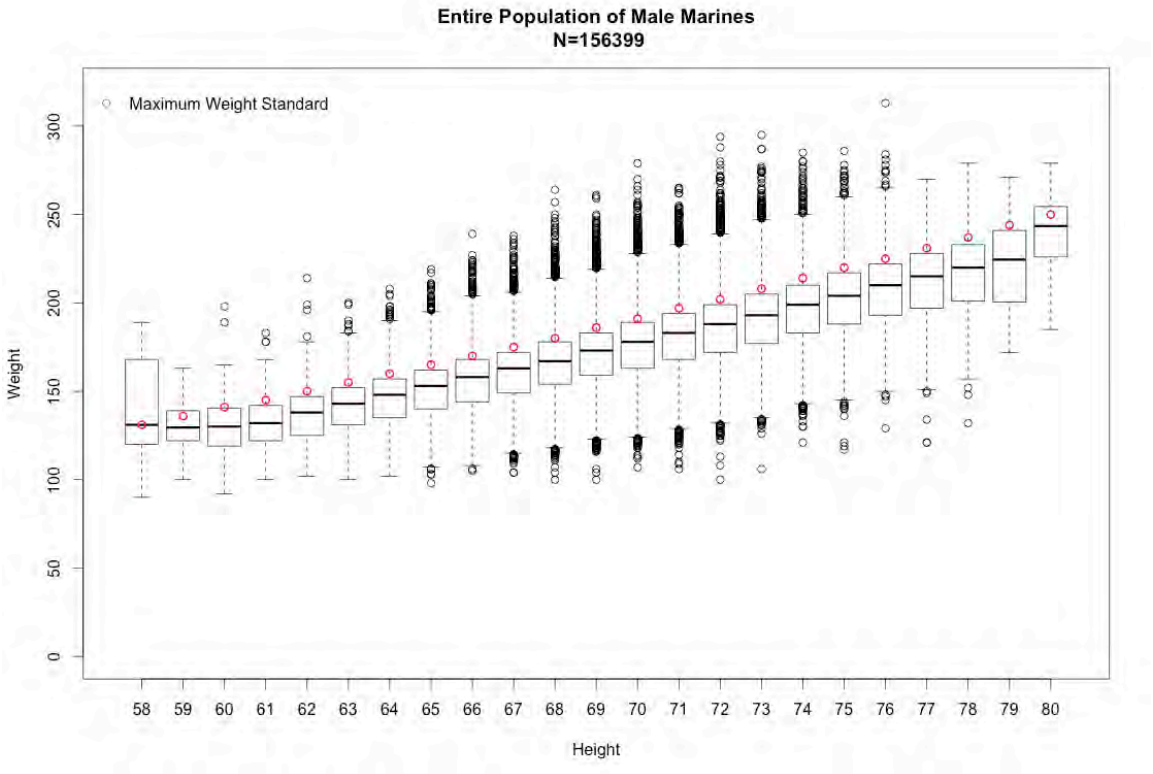


Figure 5. Entire Population of Male Marines by Height (inches) and Weight (pounds)

Table 35. Descriptive Statistics on Entire Population of Male Marines

Entire Male Population (156399 Marines)							
Height (inches)	Min Weight (pounds)	Max Weight (pounds)	Median Weight (pounds)	Min Age	Max Age	Median Age	Total Population
≤ 58	90	189	131	20	46	23	17
59	100	163	129.5	18	41	22.5	14
60	92	198	130	18	35	22	32
61	100	183	132	18	45	22	133
62	102	214	138	18	45	22	372
63	100	200	143	18	48	22	1110
64	102	208	148	18	52	22	2682
65	98	219	153	18	53	22	5260
66	105	239	158	17	54	22	9393
67	104	238	163	17	55	22	14566
68	100	264	167	17	57	23	19297
69	100	261	173	17	63	23	23013
70	107	279	178	17	61	23	21874
71	106	265	183	17	59	23	19914
72	100	294	188	17	62	24	16223
73	106	295	193	17	59	24	10246
74	121	285	199	17	60	24	6325
75	117	286	204	18	54	25	3396
76	129	313	210	18	52	25	1496
77	121	270	215	18	51	25	649
78	132	279	220	18	56	25	251
79	172	271	224.5	18	46	25	104
≥ 80	185	279	243.5	19	45	26.5	32

Figure 6 provides an overview of the entire male population by height and weight zones. We see that there is little relationship between the percent in each weight zone and height. On average, 18% of males are over standards, 15% are in the danger zone, 66% are within standards, and very few, 1%, are under standards.

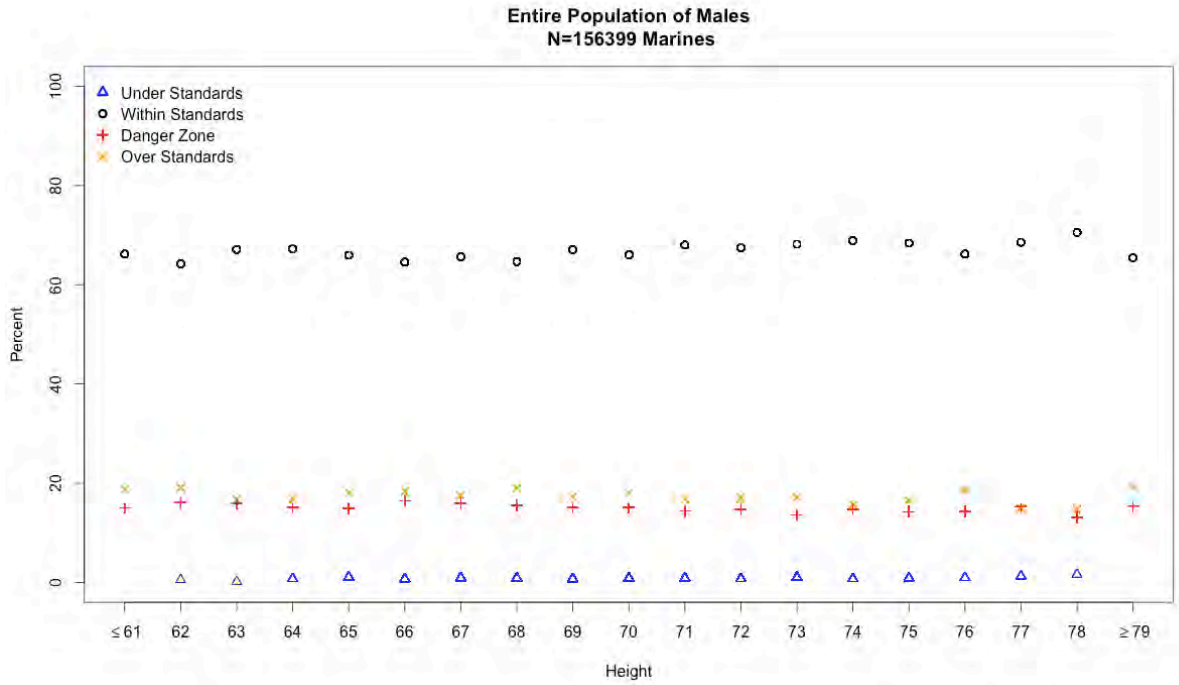


Figure 6. Entire Population of Males by Height (inches) and Percent Under Standards, In Standards, in the Danger Zone, and Over Standards

For the purpose of this analysis, data is further partitioned into three performance zones for PFT and CFT score respectively. Table 36 provides a breakdown of the three PFT and CFT zones. As discussed in the previous chapter, the Marine Corps PFT has a different class threshold for each age group. We see from Figure 7 that males attaining a 1st class PFT score remain fairly consistent across all heights, with a slight decrease as height increases. Similarly, we see a downward trend with regard to males attaining a high 1st class PFT as height increases. We also see a steady increase in the low PFT performers as height increases.

Table 36. Breakdown of PFT and CFT Zones

	High	1st Class	Low
PFT	≥ 285	<285 but still attain a 1st Class for age	<1st Class PFT
CFT	≥ 285	270≥ CFT Score< 285	<270

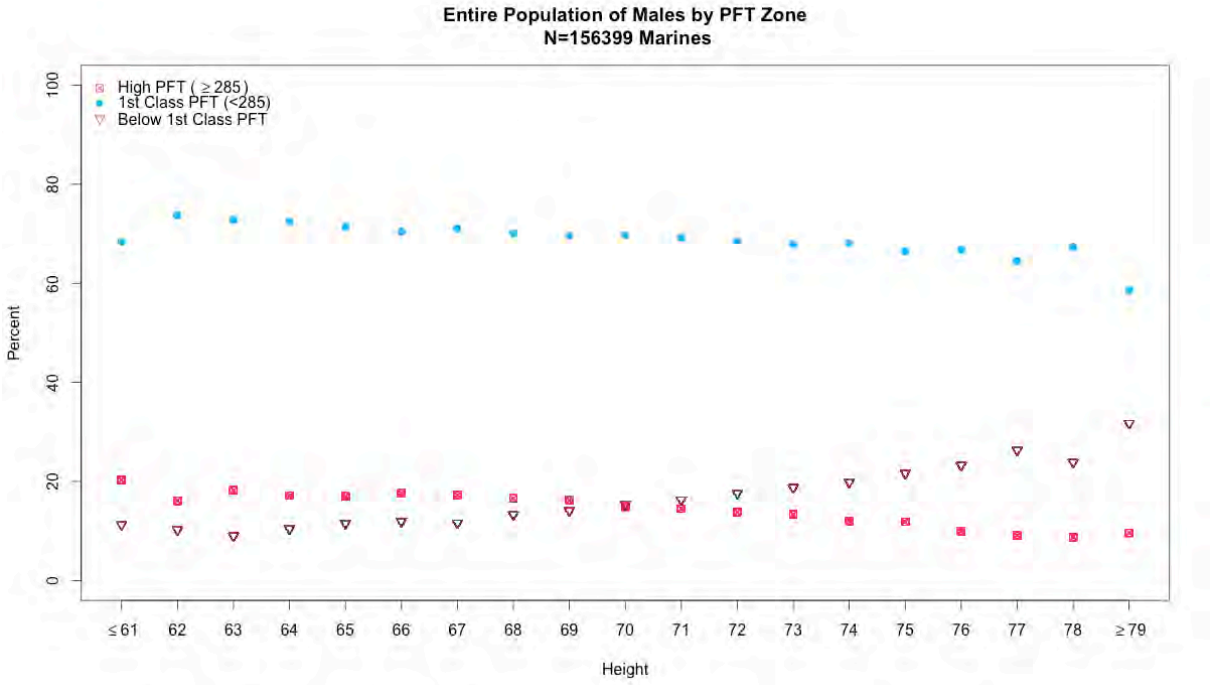


Figure 7. Percentage of the Entire Male Population by Height (inches) and PFT Zone

We see in Figure 8 a relationship between height and high CFT score for male Marine less than 68 inches. Scores below a 1st class CFT also seem to decrease, eventually leveling off at 68 inches as well. For the entire male population of the Marine Corps, approximately 73% score a high CFT, 20% score a 1st class CFT, and 7% score a low class CFT.

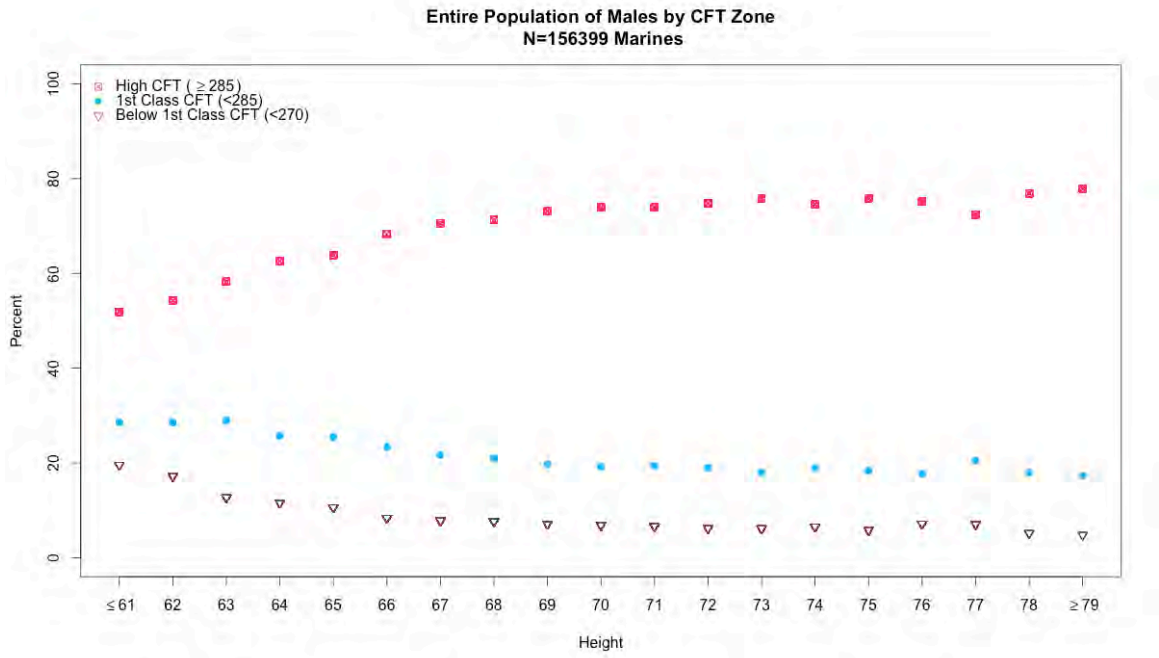


Figure 8. Percentage of the Entire Male Population by Height (inches) and CFT Zone

Table 37 cross-classifies the male population of the Marine Corps by PFT and CFT zone. Interestingly, the highest concentration of the male population falls in the high 1st class CFT and 1st class PFT category (51%).

Table 37. Percentage Male Population by PFT zone and CFT zone

		CFT		
		High	1st Class	Low
PFT	High	14.7%	0.5%	0.1%
	1st Class	51%	14.6%	3.9%
	Low	6.6%	5.2%	3.3%

The PFT requirements for a 1st class PFT decreases as age increases. Accordingly, the data is further divided into four age categories: 17–26; 27–39; 40–45; and 46+. Figure 9 provides an overview of male Marines by age group and percent weight zone. As in Figure 8, there is little relationship between weight and height, except perhaps for a small increase in the proportion of males in the danger zone or over standards for the 27–39 age group when compared to the 17–26 age group. From Figure 9 we see that the proportion within weight standards decreases with age and conversely that the proportion in the danger zone and overweight standards increase with age.

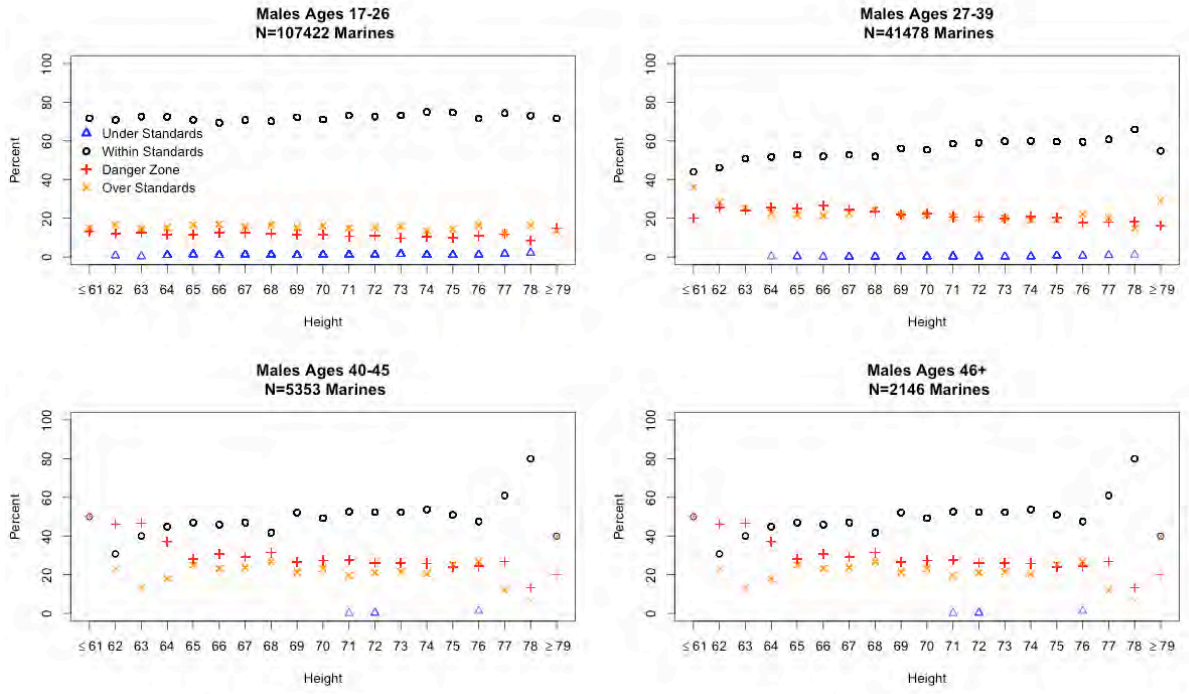


Figure 9. Male Marines by Age Group, Height (inches), and Percent Weight Zone

Physical performance with regard to the PFT seems to peak between 27–39, with a higher percentage of Marines scoring a high or low 1st class PFT. CFT scores appear to slightly increase from 17–39, then level off after 40. As we see in Figure 10, the only age group for which there appears to be a relationship between PFT and height is with the 17–26 age group. After 27 PFT scores appear to stay constant for all age groups.

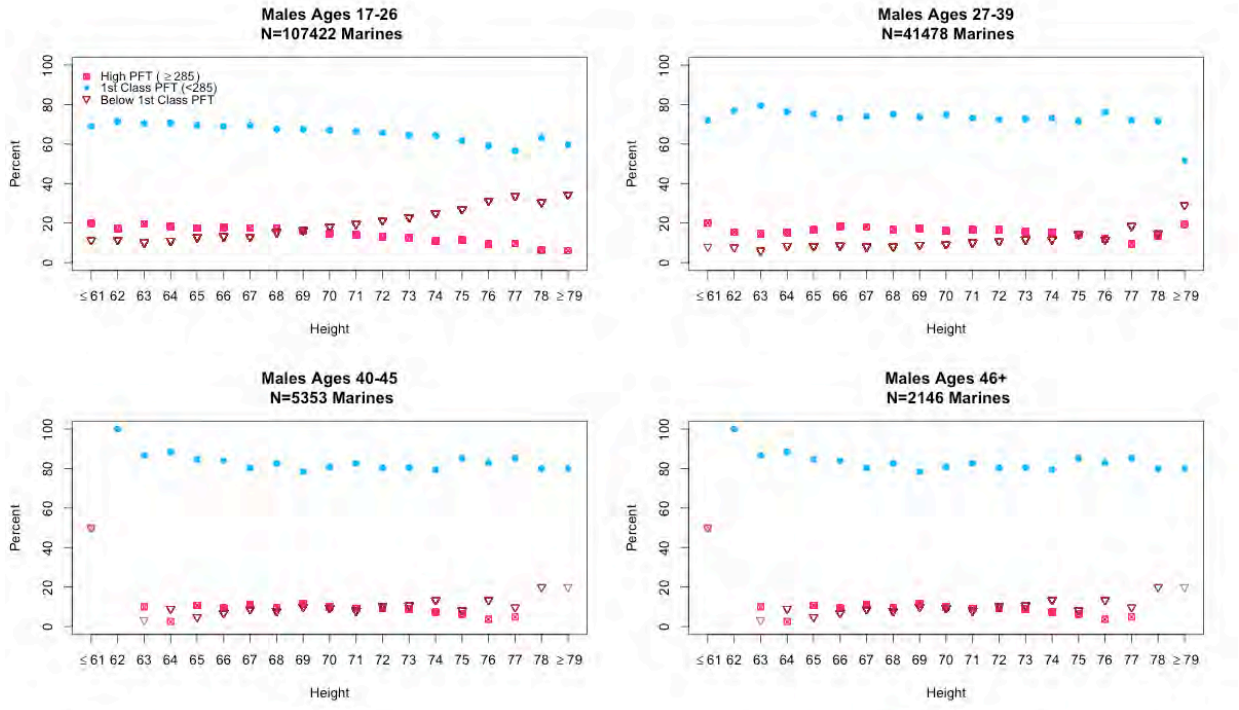


Figure 10. Male Marines by Age Group and Percent PFT Zone

We see in Figure 11 that there appears to be a slight increase in high CFT scores as height increases in ages 17–39. However, scores appear to level off after 40.

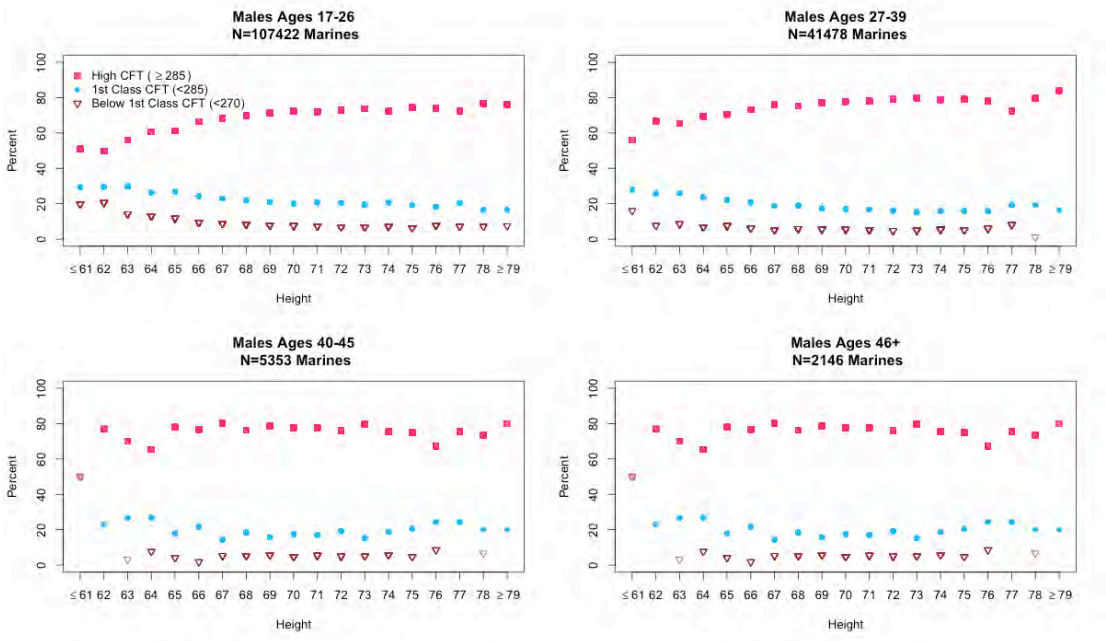


Figure 11. Male Marines by Age Group, Height (inches), and CFT Zone

2. Female Population

The female population of the Marine Corps ranges in height from 56 to 75 inches. Due to the small number of females below 59 and above 71 inches (1% of the total population), the population of females under 59 inches are combined into a group with heights ≤59 while the female population over 71 inches are combined into a group with heights ≥71 inches. Figure 12 and Table 38 reflect the descriptive statistics for the entire female Marine population.

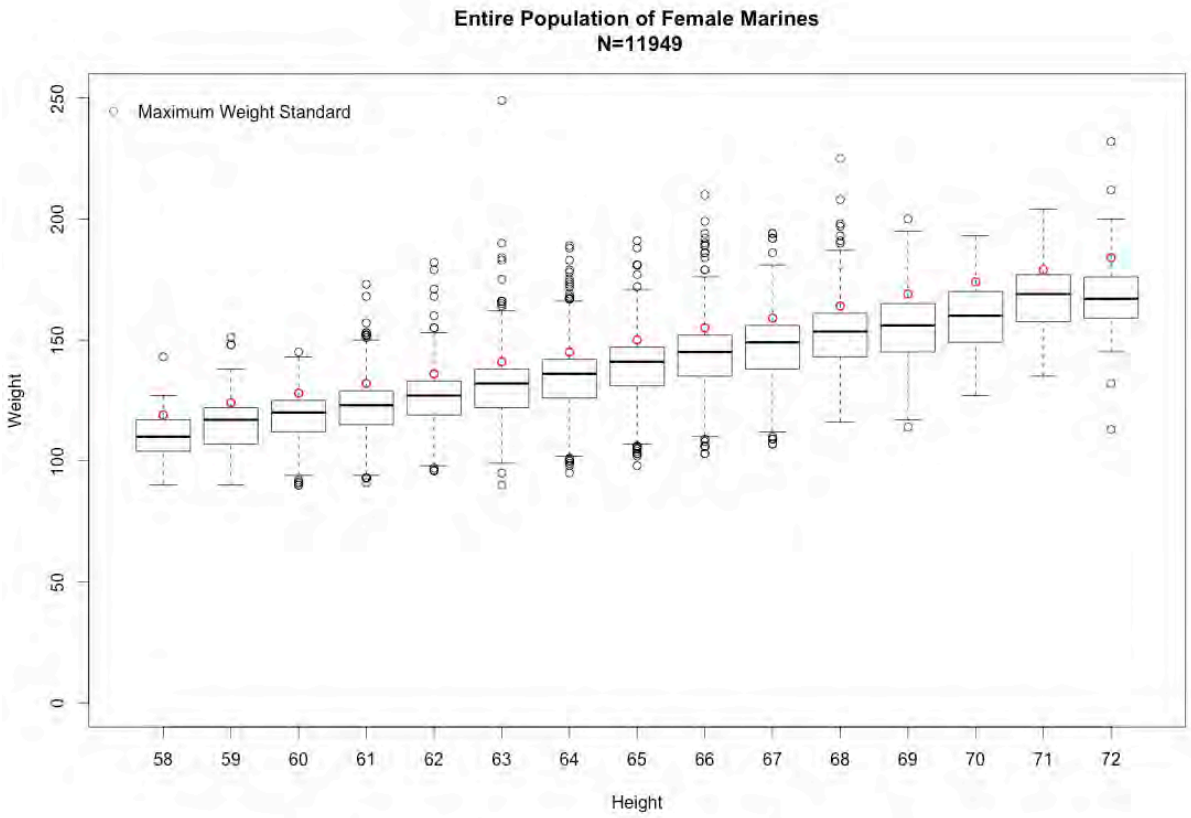


Figure 12. Entire Population of Females by Height (inches) and Weight (pounds)

Table 38. Descriptive Statistics on Entire Population of Female Marines

Entire Female Population (11949 Marines)							
Height (inches)	Min Weight (pounds)	Max Weight (pounds)	Median Weight (pounds)	Min Age	Max Age	Median Age	Total Population
≤ 58	90	143	110	18	37	22	86
59	90	151	117	17	46	22	214
60	90	145	120	18	49	21.5	466
61	91	173	123	18	47	22	871
62	96	182	127	18	49	22	1225
63	90	249	132	17	56	22	1642
64	95	189	136	18	50	22	1862
65	98	191	141	17	50	22	1760
66	103	210	145	17	54	23	1465
67	107	194	149	18	49	23	1078
68	116	225	153	18	46	23	614
69	114	200	156	18	47	23	368
70	127	193	160	18	43	23	169
71	135	204	169	18	44	24	80
≥ 72	113	232	167	19	52	24	49

We see from Figure 13 that the percentage in each weight zone is not related to height, with the exception of the under 59 inch population. There are approximately 14% of females over weight standards, 23% in the danger zone, 61% within standards, and 2% under standards.

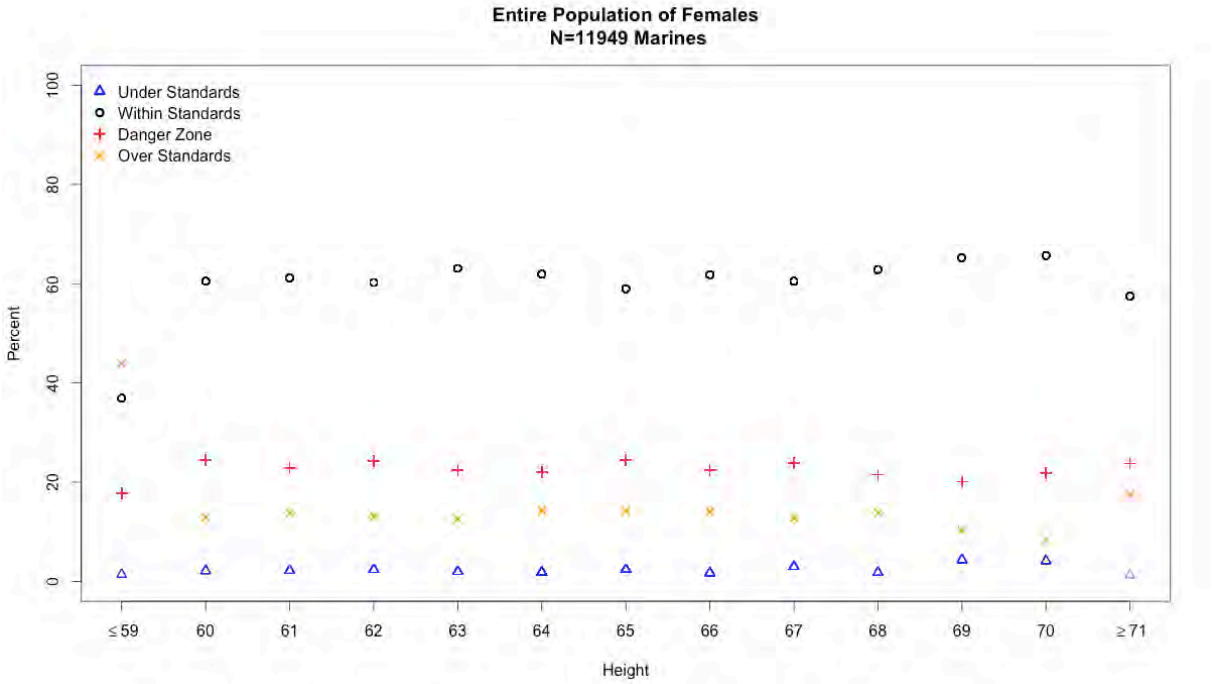


Figure 13. Entire Population of Females by Height (inches) and Percent Under Standards, In Standards, in the Danger Zone, and Over Standards

Height does not appear to affect PFT scores. Figure 14 shows the percentage of the population by height and PFT zone. Approximately 18% of females score a high PFT, 67% score a low 1st class PFT, and 15% score a low PFT.

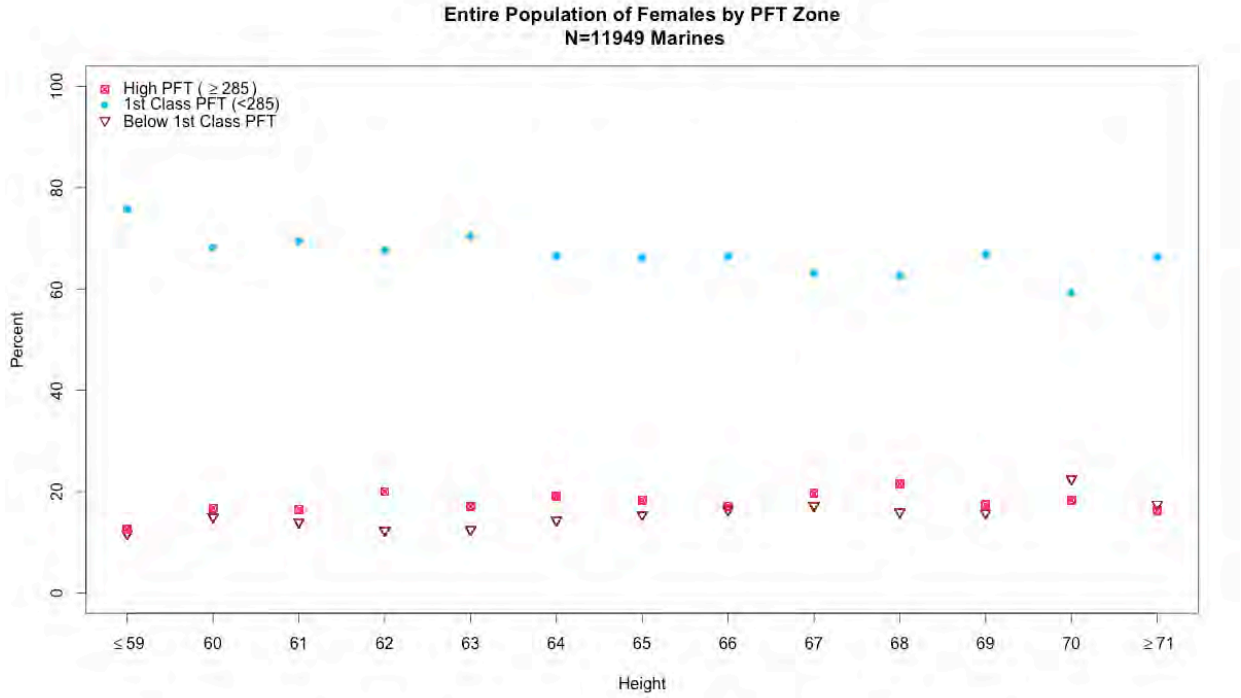


Figure 14. Percentage of the Entire Female Population by Height (inches) and PFT Zone

As with the male population we see a gradual increase in high CFT scores as height increases. Interestingly, we see decrease in both low 1st class and low CFT score as height increases. Figure 15 provides the breakdown of percentage of the population by height and CFT zone.

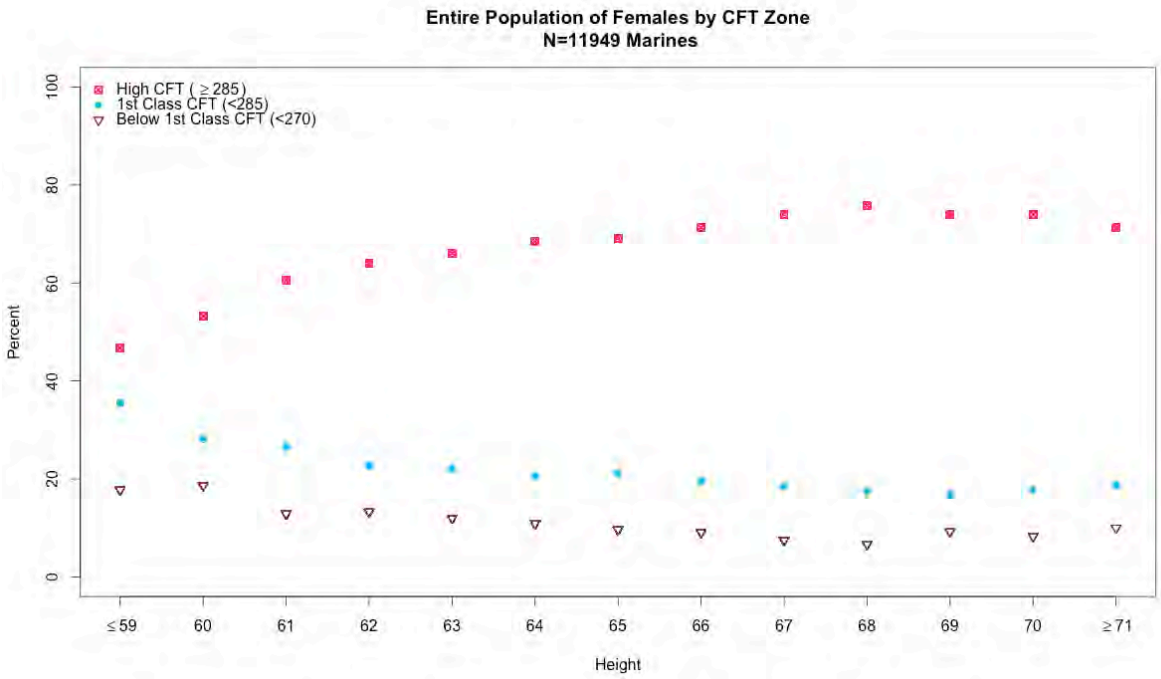


Figure 15. Percentage of the Entire Female Population by Height (inches) and CFT Zone

Table 39 cross-classifies the female population of the Marine Corps by PFT and CFT zone. As with the male population, the highest concentration of females fall in the high 1st class CFT and 1st class PFT category (44%).

Table 39. Percentage Female Population by PFT zone and CFT zone

		CFT		
		High	1st Class	Low
PFT	High	17%	0.8%	0.2%
	1st Class	44%	16%	7%
	Low	6%	5%	4%

From Figure 16, we see that height has no relation to females performing pull-ups or FAH on the PFT. Approximately 14% of females are performing pull-ups on their PFT, 83% are performing the FAH, and 3% of the population have PFT scores but no record of them performing either the FAH or pull-up.

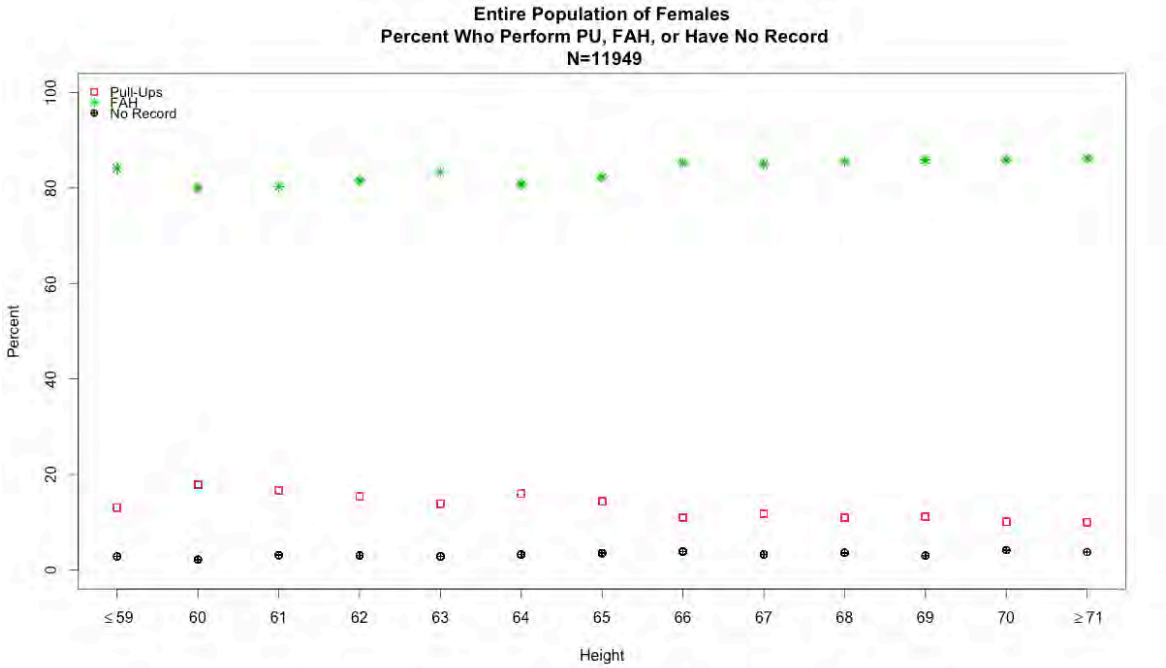


Figure 16. Percentage of the Entire Female Population Conducting Pull-Ups, FAH, or have no record by Height (inches)

Like the male population, the female population is separated into four age groups. Figure 17 represents the age groups by percent weight zone. We see that weight increases as female Marines age, with a slight increase in the danger and over standard zones within each age range.

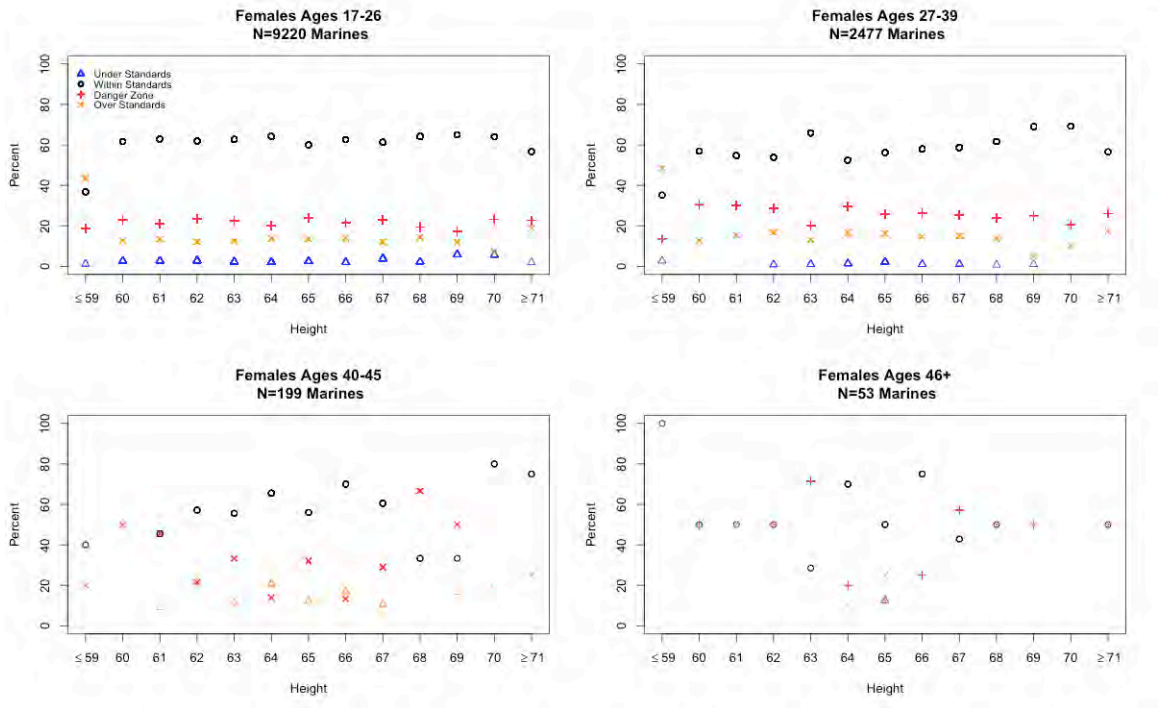


Figure 17. Female Marines by Age Group, Height (inches), and Percent Weight Zone

The proportion of females attaining a high, low 1st class, or low PFT is not affected by age, with the exception of the over 46 age group. The breakdown of female Marines by age group and PFT zone can be found in Appendix F. Figure 18 shows the breakdown of females by age group and CFT score. Interestingly, we see that CFT scores are most affected by height in the 17–26 age group. The female population between the ages of 27–45 maintains a relatively constant rate for CFT scores across heights.

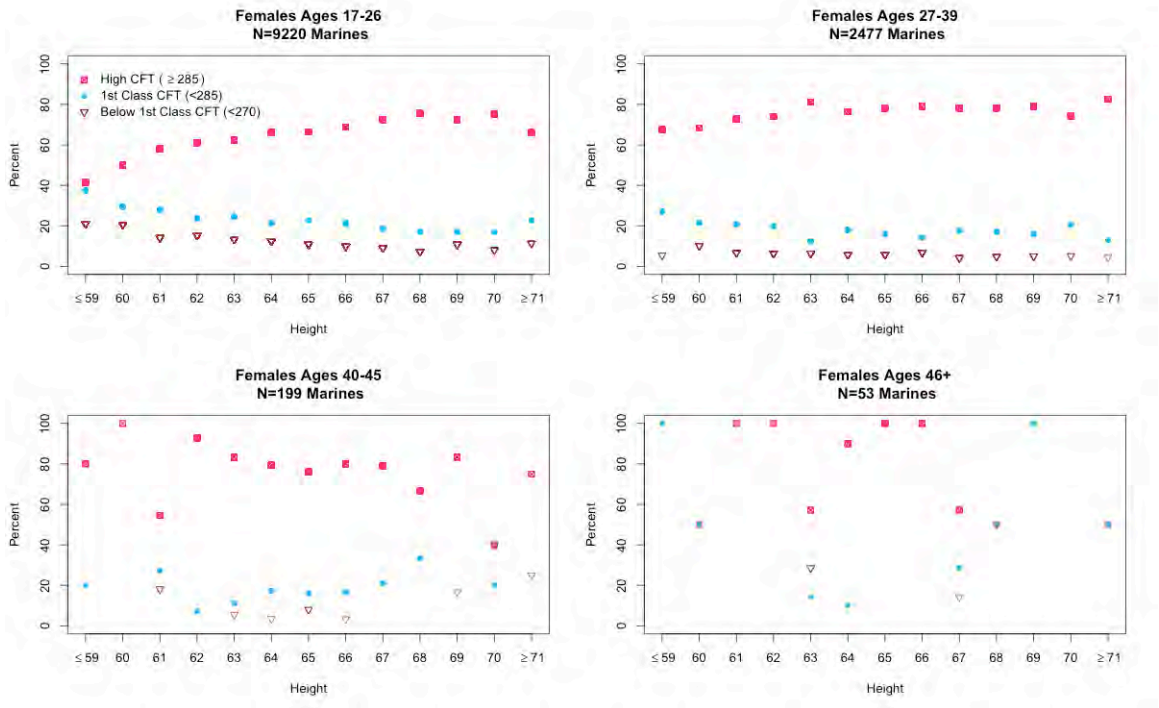


Figure 18. Female Marines by Age Group, Height (inches) and Percent CFT Zone

In Figure 19 we see a slight increase in the representation of pull-ups in the 27–39 population. We also see a relation between height and the pull-up population in the 40–45 age group.

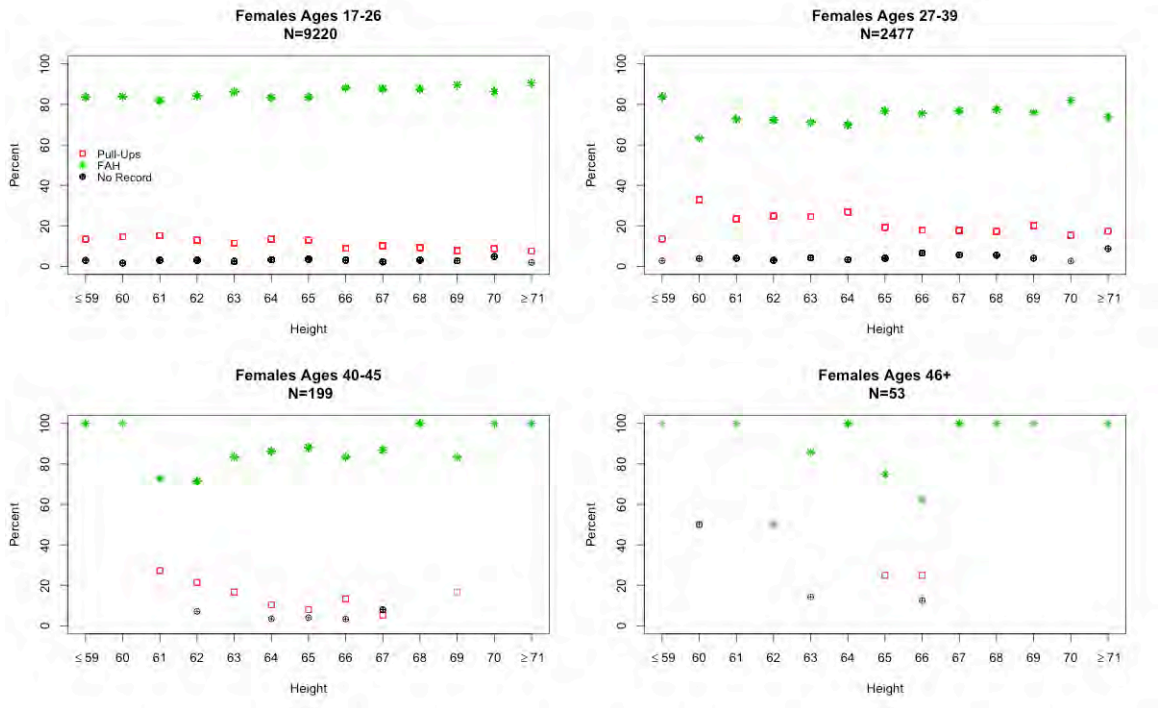


Figure 19. Female Marines by Age Group and Percent Conducting Pull-ups, FAH, or have no record by Height (inches)

C. MARINE CORPS DEPENDENT VARIABLE DESCRIPTION

The Marine Corps data contains 16 variables. We create three additional categorical variables to account for the different age groups and PFT or CFT zones, respectively. For the female population only, another categorical variable is created to annotate whether a female conducted pull-ups, FAH, or had no record for the PFT. The following identifies the continuous and categorical variables.

Continuous Variables: NDEPNS, PFT_SCORE, PFT_CRUNCHES, PFT_PULLUPS, RUN, AGE, CFT_SCORE, AMMO_LIFT, MANU_TIME, SPRINT, HEIGHT

Categorical Variables: STATUS, PGRD, SEX, PUtype, AgeR, PFTtype, CFTtype, RGROUP

Table 40 provides a brief description of each variable. Dependent variables with asterisks are described in detail in this section.

Table 40. Marine Corps Dependent Variables.

Variable	Description
NDEPNS	Number of dependents
PFT_SCORE	The total combined score of the three PFT events.
CRUNCHES	The number of crunches one can achieve on the PFT in two minutes.
PULLUPS	Indicates how many pull-ups executed or seconds on the FAH.
RUN	Time to run three miles. Run time was converted into seconds for analysis purposes.
AGE	Age of the Marine, ranging from 17-63.
CFTScore	The total combined score of the three CFT events.
AMMO_LIFT*	The number of ammo can lifts one can achieve in two minutes.
MANRUN	The total time to complete the Maneuver Under Fire section of the CFT. Times were converted to seconds for analysis purposes.
SPRINT	The total time to complete the 880 yard run portion of the CFT. Times were then converted to seconds.
HEIGHT	Height of an individual Marine.
MARST*	Marital status (Single of Married)
PGRD*	Officer, Warrant Officer, or Enlisted
SEX	Male or Female
PUtype	For female Marines only. This annotates whether a Marine conducted pull-ups, FAH, or had no record of data on their PFT.
AgeR	Categorical: 1—Ages 17-26; 2—Ages 27-39; 3—Ages 40-45; 4—Ages 46+
CFTtype	Categorical: 1—high 1st class CFT; 2—low 1st class CFT; 3—below 1st class CFT
RGROUP*	Race: Other, Black, Hispanic, White

1. Ammo Can Lifts

This variable contains outliers for both sexes. For the female data set, 21 Marines executed over 108 repetitions, ranging from 108 to 820, with a median of 118. All Marines scored a high 1st class CFT. All AMMO_LIFT>118 are reassigned the score of 118 in the female population. There are 121 male Marines who had ammo can repetitions ranging from 151 to 997 with a median of 160. With the exception of 17 Marines, all scored a high 1st class CFT. AMMO_LIFT is adjusted to reflect a maximum of 160 repetitions in the male population.

2. Marital Status

The Marine Corps currently recognizes six categories for marital status. For analysis purposes, status is updated to reflect two categories: Single and Married. Tables 41 and 42 provide a breakdown of the six original marital status

categories by percent of the male and female population as well as the final combined marital status.

Table 41. Marital Status in the Female Population of the Marine Corps

MARST	Definition	% Population		Updated MARST	% Population
A	Annulled	0.06		Single	62.9
D	Divorced	7.3			
L	Legally Separated	0.2			
W	Widowed	0.1			
S	Single	55.2			
M	Married	37.1		Married	37.1

Table 42. Marital Status in the Male Population of the Marine Corps

MARST	Definition	% Population		Updated MARST	% Population
A	Annulled	0.03		Single	54.1
D	Divorced	2.8			
L	Legally Separated	0.09			
W	Widowed	0.03			
S	Single	51.1			
M	Married	45.9		Married	45.9

3. Pay Grade

The Marine Corps data set contains 28 categorical levels ranging from E1-O10. For this analysis, the data is subdivided into three categories: Officer, Warrant Officer, and Enlisted. Table 43 reflects the total percentage of the male and female population by the updated pay grade.

Table 43. Percentage of the Marine Population by Pay Grade

Pay Grade	% Female Population	% Male Population
Officer	8.6	9.7
Warrant Officer	0.7	1.2
Enlisted	90.7	89.1

4. Race Group

The data contains race codes and ethnic group codes. Race codes contain six categorical variables while the ethnic group codes contain 25 categorical variables. Race is combined into four categories based on the six race codes, then further subdivided to identify the Hispanic population. The final grouping for race contain four categorical levels: White, Black, Hispanic, and Other. Table 44 provides the final percentage of the male and female population by race group.

Table 44. Entire Marine Corps Population by Race Group

Race Group	% Female Population	% Male Population
OTHER	8	6
BLACK	15	10
HISPANIC	25	17
WHITE	52	67

D. LINEAR REGRESSION

Separate multiple linear regression models are fit to male and female populations to estimate weight based on the dependent variables discussed in Section C. The equation for multiple linear regression with dependent variable y and m independent variables, $x_1, x_2, \ldots, x_m$, is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_m x_m + \varepsilon \ ,$$

where ε is the error between the actual and expected value of the dependent variables and where $\beta_0, \beta_1, ..., \beta_m$ are coefficients to be estimated. The distributional assumptions for multiple linear regression models are that the errors are independent and identically normally distributed with mean zero and constant variance.

The model assumptions for multiple linear regression are checked by inspecting a variety of residual plots (see e.g. Faraway 2002). For each regression model fit to the male and female Marine Corps population the residual plots show no evidence of heteroscedasticity in either the plots of residual versus fitted values or in the normal probability plot of residuals. In addition, partial residual plots show no evidence of non-linear relationships between weight and any of the independent variables.

Complex linear regression models tend to have a higher R^2 and lower root standard error (RSE) than simpler models, yet tend to do poorly when new data is introduced. This is called overfitting. RSE and R^2 are found by the following equations, where *N* is the number of observations in a data set, $\hat{y}_i$ is the predicted or fitted value for the i^{th} observation and $\bar{y}$ is the average of the y_i 's:

$$R^2 = 1 - \frac{\sum_{i=1}^{N} (y_i - \hat{y}_i)^2}{\sum_{i=1}^{N} (y_i - \bar{y})^2}$$

$$RSE = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \hat{y}_i)^2}{N - (m+1)}}$$

To limit model complexity, stepwise variable selection is used to reduce the number of independent variables. The selection criteria is Akaike Information Criteria (AIC) which is a function of RSE with a penalty for the number of

parameters. Furthermore, cross-validation is the best way to determine how well a model performs, with the more robust models having a small difference between the original RSE and the cross-validated RSE (Faraway 2002). In order to determine if the models selected in this chapter and the next two chapters are overfit, we perform ten-fold cross-validation. We find that for all linear models fit, the cross-validated RSE is roughly the same as the original RSE, and that our models are robust, showing no evidence of overfitting.

1. Male Marine Corps Data

We perform multiple linear regression is performed on the male population of the Marine Corps. We use physical fitness attributes to estimate weight; only observations whose independent variables have values greater than zero are used in the analysis. This brings the total analyzable population from the original 156399 to 112800 males. We subdivide the population by PFT class (high, first, and low class) and fit a regression model to these. Table 45 provides the three best regression models for each group where $\hat{y}$ represents the predicted value of weight based on the multiple regression model and each independent variable is subscripted by its name given in Table 40. Models with more than one equation in Table 45 include a categorical independent variable. Separate regression equations are given for each level of the categorical variables identified by the subscript of $\hat{y}$ where appropriate

Table 45. Best Weight Regression Model for USMC Male Population

Model Name	Regression Model	R^2	RSE (lbs)
Whole Male Population (N= 112800)			
1	$\hat{y}_{PFTClass=High} = -242.33 + 0.125x_{CRUNCHES} - 0.389x_{PULLUPS} + 0.027x_{RUN} + 0.713x_{AGE} + 0.364x_{AMMO\_LIFT} - 0.083x_{MANRUN} + 0.064x_{SPRINT} + 4.628x_{HEIGHT}$ $\hat{y}_{PFTClass=First} = -242.613 + 0.125x_{CRUNCHES} - 0.389x_{PULLUPS} + 0.027x_{RUN} + 0.713x_{AGE} + 0.364x_{AMMO\_LIFT} - 0.083x_{MANRUN} + 0.064x_{SPRINT} + 4.628x_{HEIGHT}$ $\hat{y}_{PFTClass=Low} = -239.891 + 0.125x_{CRUNCHES} - 0.389x_{PULLUPS} + 0.027x_{RUN} + 0.713x_{AGE} + 0.364x_{AMMO\_LIFT} - 0.083x_{MANRUN} + 0.064x_{SPRINT} + 4.628x_{HEIGHT}$	0.344	16.85
High 1st Class PFT Score (N= 18154)			
2	$\hat{y}_{MARST=Single} = -200.391 - 0.324x_{NDENPS} - 0.422x_{PULLUPS} + 0.035x_{RUN} + 0.738x_{AGE} + 0.208x_{AMMO\_LIFT} + 0.139x_{MANRUN} + 4.45x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -198.382 - 0.324x_{NDENPS} - 0.422x_{PULLUPS} + 0.035x_{RUN} + 0.738x_{AGE} + 0.208x_{AMMO\_LIFT} + 0.139x_{MANRUN} + 4.45x_{HEIGHT}$	0.347	14.93
1st Class PFT Score (N= 82411)			
3	$\hat{y}_{AgeR=1} = -205.355 + 0.267x_{NDEPNS} - 0.368x_{PULLUPS} + 0.989x_{AGE} - 0.073x_{MANRUN} + 0.06_{SPRINT} + 4.675x_{HEIGHT} + 0.0002x_{RUN}x_{AMMO\_LIFT}$ $\hat{y}_{AgeR=2} = -207.721 + 0.267x_{NDEPNS} - 0.368x_{PULLUPS} + 0.989x_{AGE} - 0.073x_{MANRUN} + 0.06_{SPRINT} + 4.675x_{HEIGHT} + 0.0002x_{RUN}x_{AMMO\_LIFT}$ $\hat{y}_{AgeR=3} = -214.767 + 0.267x_{NDEPNS} - 0.368x_{PULLUPS} + 0.989x_{AGE} - 0.073x_{MANRUN} + 0.06_{SPRINT} + 4.675x_{HEIGHT} + 0.0002x_{RUN}x_{AMMO\_LIFT}$ $\hat{y}_{AgeR=4} = -220.721 + 0.267x_{NDEPNS} - 0.368x_{PULLUPS} + 0.989x_{AGE} - 0.073x_{MANRUN} + 0.06_{SPRINT} + 4.675x_{HEIGHT} + 0.0002x_{RUN}x_{AMMO\_LIFT}$	0.34	16.9
Low PFT Score (N= 12235)			
4	$\hat{y}_{MARST=Single} = -182.986 - 0.561x_{PFT\_SCORE} + 0.236x_{CRUNCHES} + 0.418x_{AGE} + 0.446x_{AMMO\_LIFT} - 0.029x_{MANRUN} + 0.122x_{SPRINT} + 4.405x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -179.562 - 0.561x_{PFT\_SCORE} + 0.236x_{CRUNCHES} + 0.418x_{AGE} + 0.446x_{AMMO\_LIFT} - 0.029x_{MANRUN} + 0.122x_{SPRINT} + 4.405x_{HEIGHT}$	0.287	18.38

2. Female Marine Corps Data

The female population is divided into two data sets—pull-ups and FAH. As with the male Marine population, a linear regression model is fit to estimate weight for both female populations. The data sets are also subcategorized by PFT classification, to see if a better regression model could be used for these subsets. We use physical fitness attributes to estimate weight; only observations whose variables have values greater than zero are used in the analysis. This brings the total analyzable population from 11949 to 11472. Tables 46 and 47 provide the best linear regression models produced for the female Marine population. Of note, a linear regression model is not fit to the low PFT class group of females who do pull-ups, as their population consists of 15 Marines.

Table 46. Best Weight Regression Model for USMC Female Pull-up Population

Model Name	Regression Model	R^2	RSE (lbs)
Female Pull-up Population (N= 1645)			
1	$\hat{y}_{MARST=Single} = -140.733 - 0.381x_{PULLUPS} + 0.018x_{RUN} + 0.214x_{AGE} + 0.16x_{AMMO\_LIFT} - 0.057x_{MANRUN} + 3.859x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -142.677 - 0.381x_{PULLUPS} + 0.018x_{RUN} + 0.214x_{AGE} + 0.16x_{AMMO\_LIFT} - 0.057x_{MANRUN} + 3.859x_{HEIGHT}$	0.495	10.17
High 1st Class PFT Score (N= 687)			
2	$\hat{y}_{MARST=Single} = -153.063 - 0.513x_{PULLUPS} + 0.02x_{RUN} + 0.219x_{AGE} + 0.164x_{AMMO\_LIFT} + 3.835x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -156.794 - 0.513x_{PULLUPS} + 0.02x_{RUN} + 0.219x_{AGE} + 0.164x_{AMMO\_LIFT} + 3.835x_{HEIGHT}$	0.535	9.296
1st Class PFT Score (N= 943)			
3	$\hat{y} = -149.564 + 0.019x_{RUN} + 0.195x_{AGE} + 0.214x_{AMMO\_LIFT} - 3.8x_{HEIGHT} - 0.007x_{AMMO\_LIFT}x_{PULLUPS}$	0.474	10.73

Table 47. Best Weight Regression Model for USMC Female FAH Population

Model Name	Regression Model	R^2	RSE (lbs)
Female FAH Population (N= 9827)			
1	$\hat{y}_{MARST=Single} = -127.209 - 0.179x_{PFT\_SCORE} + 0.209x_{CRUNCHES} - 0.004x_{RUN} + 0.177x_{AGE} + 0.077x_{CFTScore} + 0.191x_{AMMO\_LIFT} + 3.94x_{HEIGHT} + .0001x_{MANRUN}x_{SPRINT}$ $\hat{y}_{MARST=Married} = -126.566 - 0.179x_{PFT\_SCORE} + 0.209x_{CRUNCHES} - 0.004x_{RUN} + 0.177x_{AGE} + 0.077x_{CFTScore} + 0.191x_{AMMO\_LIFT} + 3.94x_{HEIGHT} + .0001x_{MANRUN}x_{SPRINT}$	0.53	11.06
High 1st Class PFT Score (N= 1399)			
2	$\hat{y}_{MARST=Single} = -220.063 + 0.023x_{RUN} + 0.139x_{CFTScore} + 0.213x_{AMMO\_LIFT} + 0.059x_{SPRINT} + 3.97x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -218.773 + 0.023x_{RUN} + 0.139x_{CFTScore} + 0.213x_{AMMO\_LIFT} + 0.059x_{SPRINT} + 3.97x_{HEIGHT}$	0.487	10.73
1st Class PFT Score (N= 6998)			
3	$\hat{y} = -148.795 + 0.371x_{NDEPNS} - 0.100x_{PFT\_SCORE} + 0.128x_{CRUNCHES} - 0.223x_{PULLUPS} + 0.123x_{AGE} + 0.112x_{CFTScore} + 0.167x_{AMMO\_LIFT} + 0.078x_{SPRINT} + 3.888x_{HEIGHT}$	0.51	11.12
Low PFT Score (N= 1430)			
4	$\hat{y}_{MARST=Single} = -130.781 - 0.065x_{PFT\_SCORE} + 0.097x_{CRUNCHES} - 0.146x_{PULLUPS} + 0.296x_{AGE} + 0.211x_{AMMO\_LIFT} + 4.13x_{HEIGHT}$ $\hat{y}_{MARST=Married} = -132 - 0.065x_{PFT\_SCORE} + 0.097x_{CRUNCHES} - 0.146x_{PULLUPS} + 0.296x_{AGE} + 0.211x_{AMMO\_LIFT} + 4.13x_{HEIGHT}$	0.598	10.49

E. ANALYSIS OF CURRENT MARINE CORPS POPULATION

1. Male Marine Corps Data

Figure 20 shows the predicted versus actual weight by model. We can see that these models do not predict weight well. In all four models, the models overpredict at the lower end of the weight spectrum and underpredict at the higher end of the spectrum.

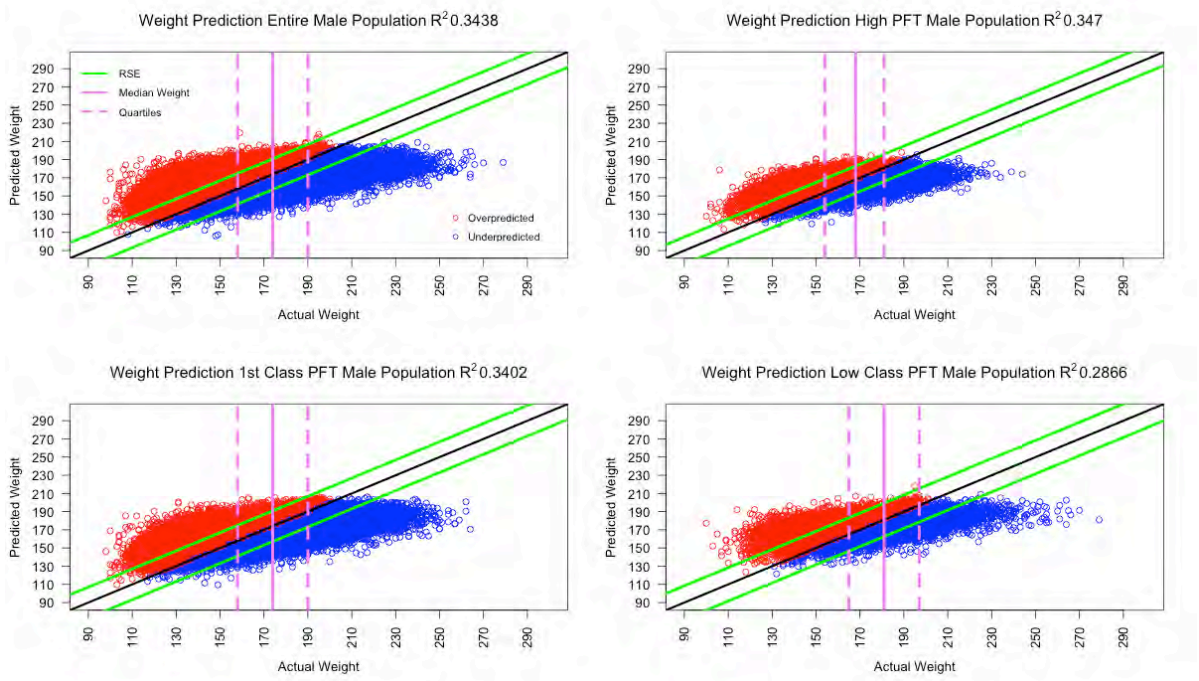


Figure 20. Male Population Regression Models by Predicted and Actual Weight Based on Regression Models in Table 45

2. Female Marine Corps Data

In Figures 21 and 22, we see that although the relationship between predicted and actual weight is stronger than for males, these models do no predict well. The models tend to overpredict weight at the lower end of the spectrum and underpredict the higher the weight.

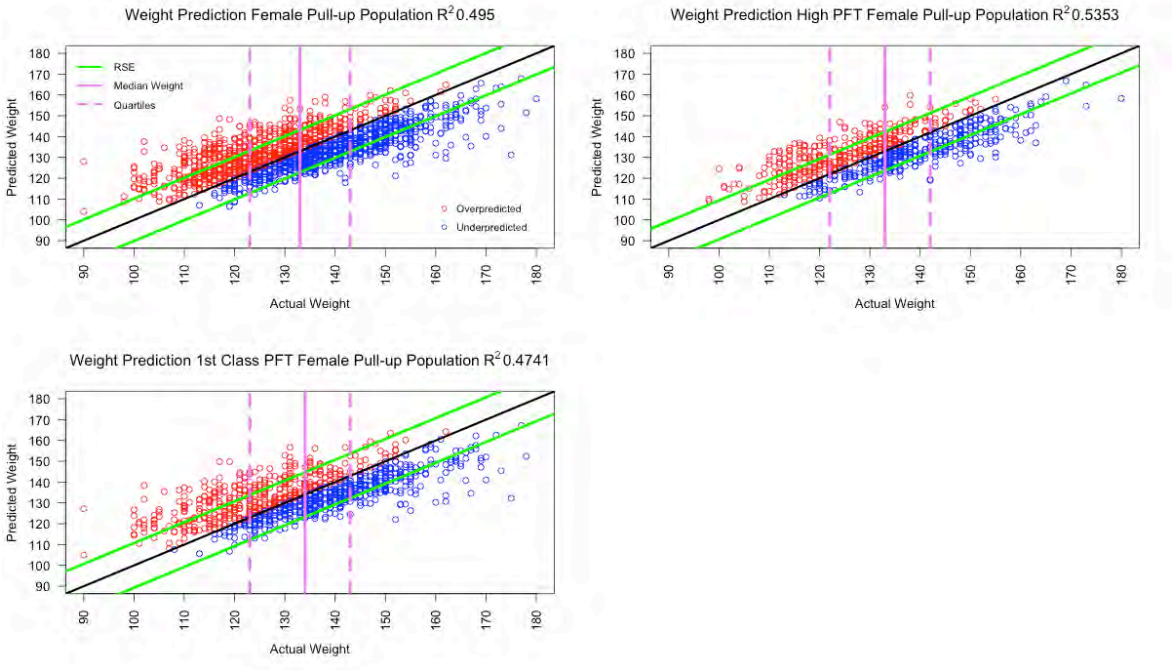


Figure 21. Female Pull-up Population Regression Models by Predicted and Actual Weight Based on Regression Models in Table 46

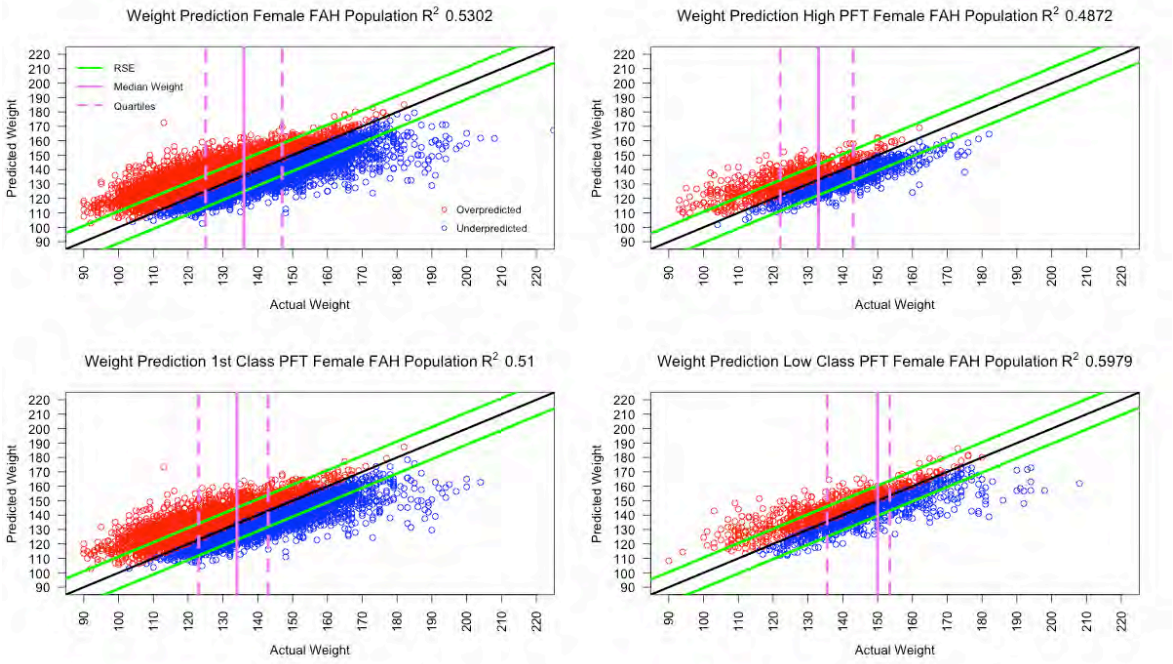


Figure 22. Female FAH Population Regression Models by Predicted and Actual Weight Based on Regression Models in Table 47

F. SUMMARY OF CHAPTER

In this chapter, we explored the relationship between weight and physical fitness attributes. On average, 18% of males are over standards, 15% are in the danger zone, 66% are within standards, and 1% are under standards. In the female population, approximately 14% are over weight standards, 23% are in the danger zone, 61% are within standards, and are 2% under standards. We see that even adjusting for height, age, and other independent variables, the relationship between physical fitness attributes and weight (for both males and females) is quite weak.

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IV. BODY FAT DATA, METHODOLOGY, AND ANALYSIS

A. INTRODUCTION

The data we analyze in this chapter (which we call the body fat data) contains the original sample of Sailors from Hodgdon and Beckett's (1984a, 1984b) study on estimating body fat. This sample was used to develop the current DOD methodology to estimate body fat. The data set contains 30 anthropometric measurements (height, weight, girth measurements, and skinfold measurements) on 1026 males and 341 females. The data set also contains body fat data derived from the hydrostatic weighing technique.

B. DATA STATISTICS

The body fat data set is subdivided into two sets: male and female. Anthropometric measurements are given for 1026 males and 341 females. The data is subdivided by height, and categorized by weight zone per Marine Corps weight for height standards.

1. Descriptive Statistics (Male)

Male height ranges from 61–78 inches in the body fat data set. Height is rounded to the nearest inch in accordance with DODI 1308.3 in order to establish descriptive statistics and maximum weight thresholds. Figure 23 provides the distribution of weight by height for the male body fat sample. The annotated maximum weight requirements reflect the Marine Corps maximum weight for height standards. We find that the heights of the male body fat sample is comparable to the male Marine Corps population. However, we see in Figure 23 a greater proportion of overweight males in the body fat sample than the Marine Corps population (43% and 14% respectively). Table 48 provides additional descriptive statistics for the male body fat sample.

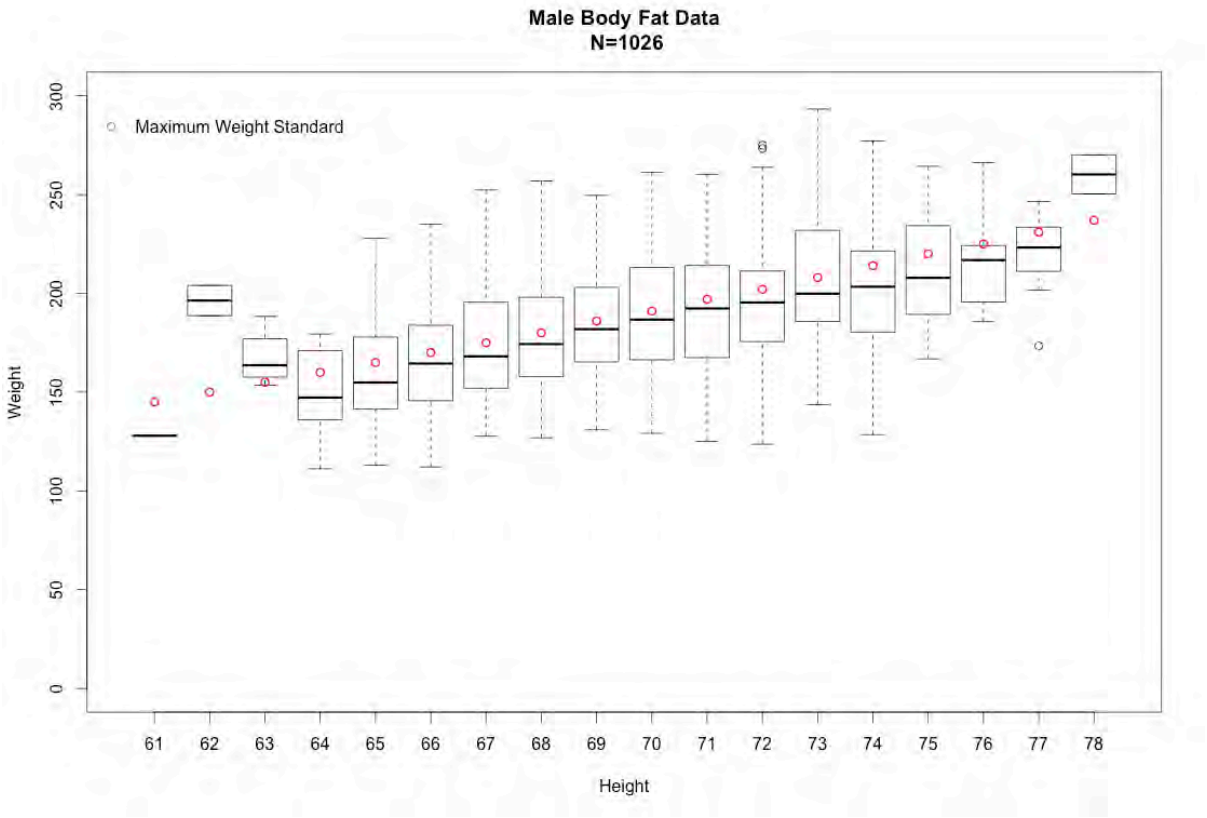

Figure 23. Male Body Fat Sample by Weight (pounds) and Height (inches)

Table 48. Descriptive Statistics for Male Body Fat Data Set

Entire Male Body Fat Population (N=1026)							
Height (Rounded to the nearest Inch)	Min Weight (pounds)	Max Weight (pounds)	Median Weight (pounds)	Min Age	Max Age	Median Age	Total Population
61	127.9	127.9	127.9	39	39	39	1
62	188.7	204	196.3	32	40	36	2
63	153.6	188.4	163.6	25	38	31	4
64	111.2	179.5	147.3	26	44	33	12
65	113	227.8	154.9	21	44	31	33
66	112.2	234.9	164.5	19	50	32	51
67	127.7	252.3	168.1	18	48	32	90
68	126.9	256.8	174.4	18	50	30	95
69	130.9	249.6	181.9	18	48	33	151
70	129.1	261.3	186.7	17	53	33	134
71	125.2	260.3	192.4	19	51	33	138
72	123.7	275	195.3	18	56	31	129
73	143.6	293.3	199.8	18	46	30	79
74	128.5	277	203	20	42	30	57

2. Descriptive Statistics (Female)

The height for the female body fat sample ranges from 58 inches to 74 inches. Height is rounded to the nearest inch in accordance with DODI 1308.3 in order to establish descriptive statistics and maximum weight thresholds. Figure 24 and Table 49 depict the female body fat sample. We annotate maximum weight as per Marine Corps standards in Figure 24. We see that the proportion of overweight females in the body fat sample is approximately 23% as compared to 14% in the Marine Corps population.

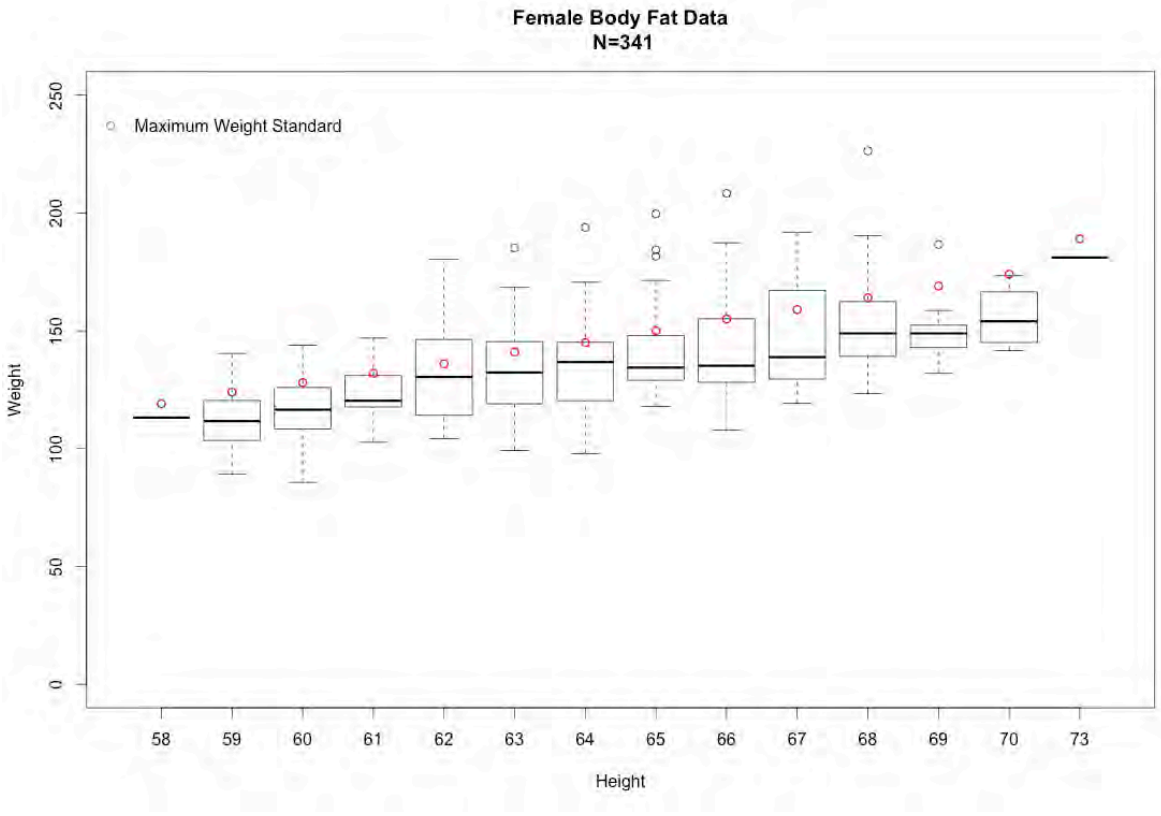

Figure 24. Female Body Fat Population by Weight (pound) and Height (inches)

Table 49. Descriptive Statistics for Female Body Fat Data Set

Entire Female Body Fat Population (N=341)							
Height (Rounded to the nearest Inch)	Min Weight (pounds)	Max Weight (pounds)	Median Weight (pounds)	Min Age	Max Age	Median Age	Total Population
58	113.2	113.2	113.2	21	21	21	1
59	89.18	140.4	111.7	20	24	20	5
60	85.68	143.90	116.5	19	34	22.5	12
61	102.7	146.9	120.3	19	35	24.5	20
62	104.2	180.4	130.4	20	44	28	27
63	99.17	168.4	134.3	19	44	24	46
64	104.4	185.1	129.6	18	48	28	40
65	97.92	193.8	136.7	14	36	27	45
66	117.9	199.6	134.4	18	37	26	55
67	107.9	208.3	135.1	19	42	27	37
68	119.2	191.9	138.8	21	39	28	21
69	123.4	226.3	148.8	21	37	24.5	18
70	131.9	186.6	148.9	19	30	25	9
71	141.6	173.4	154	21	36	31.5	4
74	181.1	181.1	181.1	31	31	31	1

C. BODY FAT DATA DEPENDENT VARIABLE DESCRIPTION

The body fat data set contains a total of 30 anthropometric measurements, to include nine skinfold measurements and four diameters. The skinfold and diameter measurements are excluded from this analysis because the focus of this thesis are those measurements easily obtained in a field environment. Two additional circumference measurements are deleted due to limited observations. All circumference measurements initially in centimeters are converted into inches. Table 50 provides a brief description of the anthropometric measurements used in the regression analysis. Dependent variables with asterisks are described in detail in this section.

Table 50. Body Fat Variable Description

Variable	Description
AGE	Age of the individual
RGROUP*	Race Group: Other, Black, White
HEIGHT	Height (inches)
WEIGHT	Weight (lbs)
NECK	Neck Circumference (inches)
SHOULDER	Shoulder Circumference (inches)
CHEST	Chest Circumference (inches)
AB1NATWAIST	Waist Circumference measured at the smallest part of the waist (inches)
AB2UMB	Waist Circumference measured at the umbilicus (inches)
HIP	Hip Circumference (inches)
THIGH	Thigh Circumference (inches)
CALF	Calf Circumference (inches)
RELARM	Relaxed Arm Circumference (inches)
FOREARM	Forearm Circumference (inches)
WRIST	Wrist Circumference (inches)

1. Race Group

The body fat data set has five race categories. The vast majority of the sample for both males and females are categorized as white. The second highest sample is categorized as black. Due to the small number represented in the additional three race categories, we combine them into an “Other” category. Table 51 provides a breakdown of the male and female sample by race group.

Table 51. Entire Body Fat Data Sample by Race Group

Race Group	% Female Population N=341	% Male Population N=1026
OTHER	2	7
BLACK	8	7
WHITE	90	86

D. LINEAR REGRESSION

Hodgdon and Beckett (1984a, 1984b) constructed linear regression models in order to predict body fat percentages from anthropometric measurements using all records in this dataset. However, the Marine Corps only

uses this model to predict the body fat percentage of those Marines who exceed the maximum weight for their height. Therefore, we restrict attention in this data set to only those males and females whose weight is over the maximum weight limit by the Marine Corps standards. Multiple linear regression is used to estimate body fat from the anthropometric measurements described.

Of the 1026 males in the body fat data set, 442 of them fall into the overweight category according to Marine Corps standards. Of the 341 females from the original data set, 77 are considered overweight by Marine Corps standards. We conduct regression analysis on both overweight samples. We consider two-way interactions and log transformations as possible variables. Table 52 provides the top three male body fat estimation models, along with their associated R^2 and RSE. Table 53 provides the top three female body fat estimation models.

Table 52. The Three Best Body Fat Regression Models for Overweight Male Body Fat Sample

Model Name	Regression Model	R^2	RSE (BF)
1	$\hat{y}_{RGROUP=White} = 34.26 + 0.643 - 52.516 * \log_{10} x_{HEIGHT} - 22.753 * \log_{10} x_{NECK} - 15.42 * \log_{10} x_{CHEST} + 125.691 * \log_{10}(avg(x_{AB1/NATWAIST} + x_{AB2/MB})) - 48.956 * \log_{10} x_{FOREARM}$ $\hat{y}_{RGROUP=Black} = 31.465 + 0.643 - 52.516 * \log_{10} x_{HEIGHT} - 22.753 * \log_{10} x_{NECK} - 15.42 * \log_{10} x_{CHEST} + 125.691 * \log_{10}(avg(x_{AB1/NATWAIST} + x_{AB2/MB})) - 48.956 * \log_{10} x_{FOREARM}$ $\hat{y}_{RGROUP=Other} = 33.901 + 0.643 - 52.516 * \log_{10} x_{HEIGHT} - 22.753 * \log_{10} x_{NECK} - 15.42 * \log_{10} x_{CHEST} + 125.691 * \log_{10}(avg(x_{AB1/NATWAIST} + x_{AB2/MB})) - 48.956 * \log_{10} x_{FOREARM}$	0.629	3.31
2	$\hat{y}_{RGROUP=White} = -182.076 - 0.352 x_{HEIGHT} - 0.276 x_{CHEST} + 111.19 * \log_{10} x_{AB2UMB} + 53.712 \log_{10} x_{HIP} - 1.714 x_{FOREARM}$ $\hat{y}_{RGROUP=Black} = -179.291 - 0.352 x_{HEIGHT} - 0.276 x_{CHEST} + 111.19 * \log_{10} x_{AB2UMB} + 53.712 \log_{10} x_{HIP} - 1.714 x_{FOREARM}$ $\hat{y}_{RGROUP=Other} = -181.683 - 0.352 x_{HEIGHT} - 0.276 x_{CHEST} + 111.19 * \log_{10} x_{AB2UMB} + 53.712 \log_{10} x_{HIP} - 1.714 x_{FOREARM}$	0.622	3.34
3	$\hat{y} = -111.523 - 0.618 x_{HEIGHT} + 142.047 \log_{10} x_{AB2UMB} - 53.395 \log_{10} x_{FOREARM} + 0.007 x_{HEIGHT} x_{HIP} - 0.006 x_{CHEST} x_{AB2UMB}$	0.605	3.4

Table 53. The Three Best Body Fat Regression Models for Overweight Female Body Fat Sample

Model Name	Regression Model	R^2	RSE (BF)
1	$\bar{y}_{RGROUP=White} = 2.493 - 0.164x_{AGE} - 2.265x_{NECK} + 1.177x_{AB1NATWAIST} + 1.158x_{HIP} - 1.235x_{CALF}$ $\bar{y}_{RGROUP=Black} = 0.272 - 0.164x_{AGE} - 2.265x_{NECK} + 1.177x_{AB1NATWAIST} + 1.158x_{HIP} - 1.235x_{CALF}$ $\bar{y}_{RGROUP=Other} = 3.734 - 0.164x_{AGE} - 2.265x_{NECK} + 1.177x_{AB1NATWAIST} + 1.158x_{HIP} - 1.235x_{CALF}$	0.707	2.7
2	$\bar{y}_{RGROUP=White} = -88.725 - 1.555x_{NECK} + 1.33x_{AB1NATWAIST} + 80.069 * \log_{10} x_{THIGH} - 0.044x_{CALF}^2$ $\bar{y}_{RGROUP=Black} = -90.982 - 1.555x_{NECK} + 1.33x_{AB1NATWAIST} + 80.069 * \log_{10} x_{THIGH} - 0.044x_{CALF}^2$ $\bar{y}_{RGROUP=Other} = -90.232 - 1.555x_{NECK} + 1.33x_{AB1NATWAIST} + 80.069 * \log_{10} x_{THIGH} - 0.044x_{CALF}^2$	0.679	2.8
3	$\bar{y} = 34.868 - 0.149x_{AGE} - 2.367x_{NECK} + 1.254x_{AB1NATWAIST} + 1.028x_{THIGH} - 40.236 * \log_{10} x_{CALF}$	0.679	2.79

E. ANALYSIS OF BODY FAT DATA

As in practice, we apply the service equations discussed in Chapter II to the overweight (by Marine Corps standards) males and females in the data set. The old Air Force model is not included in the analysis due to the limited number of Sailors who had their flexed-bicep measured during the body fat data collection. Additionally, the regression models of Tables 52 and 53 are also applied to determine if fitting a model to only overweight individuals improves the ability to estimate body fat for overweight individuals. Finally, the current Air Force body composition method is applied to the entire data set.

1. Male Body Fat Data

As discussed previously, 442 males are considered overweight by Marine Corps standards. Since the service equations would only be applied after a weight failure, this sample is of particular interest. RSE is calculated for each service equation, with results similar to the original RSE. However, the overweight R^2 is significantly lower than the original. In Figure 25 we see that the Navy and Army equations are very biased, and the Navy plot seems to have a nonlinear curvature.

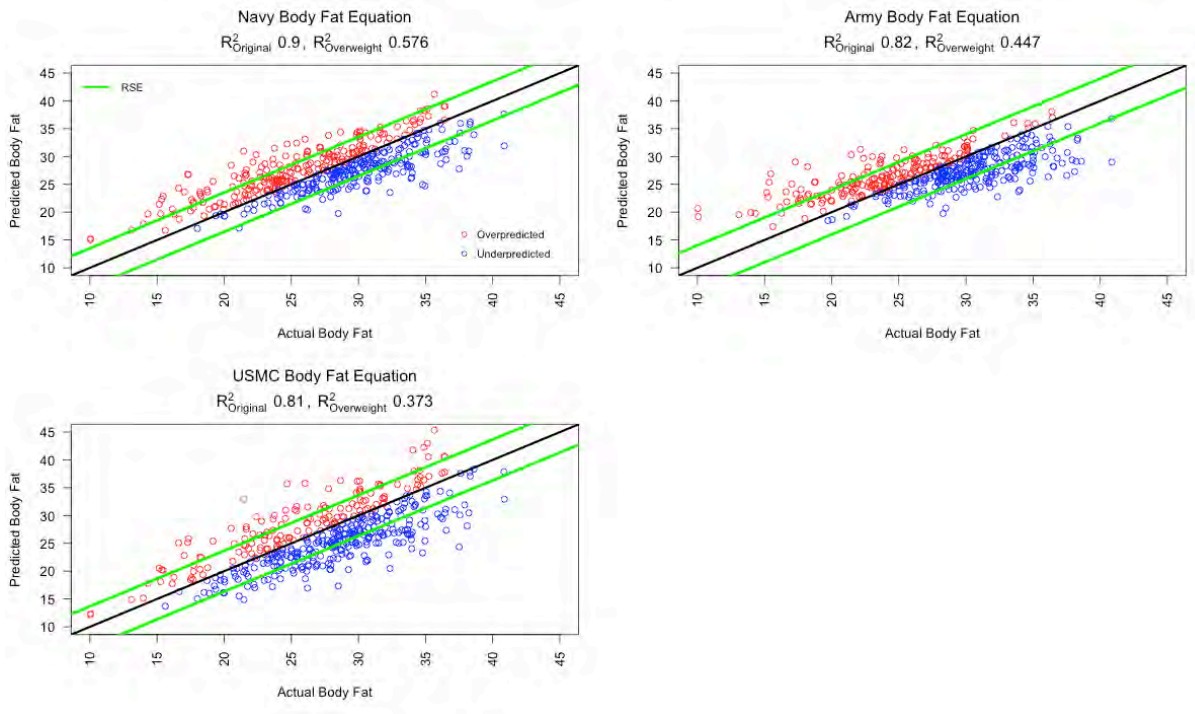

Figure 25. Applied Service Equations on the Overweight Male Body Fat Sample

In Figure 26 we see the three best regression models fit to the overweight male sample. Cross-validation yields an RSE approximately equal to the original. As with the service equations, the models fit to the restricted overweight males exhibit bias by overpredicting at the lower end of the body fat spectrum and underpredicting as actual body fat increases. Models 1 and 2 in particular show a nonlinearity in the predicted versus actual plot.

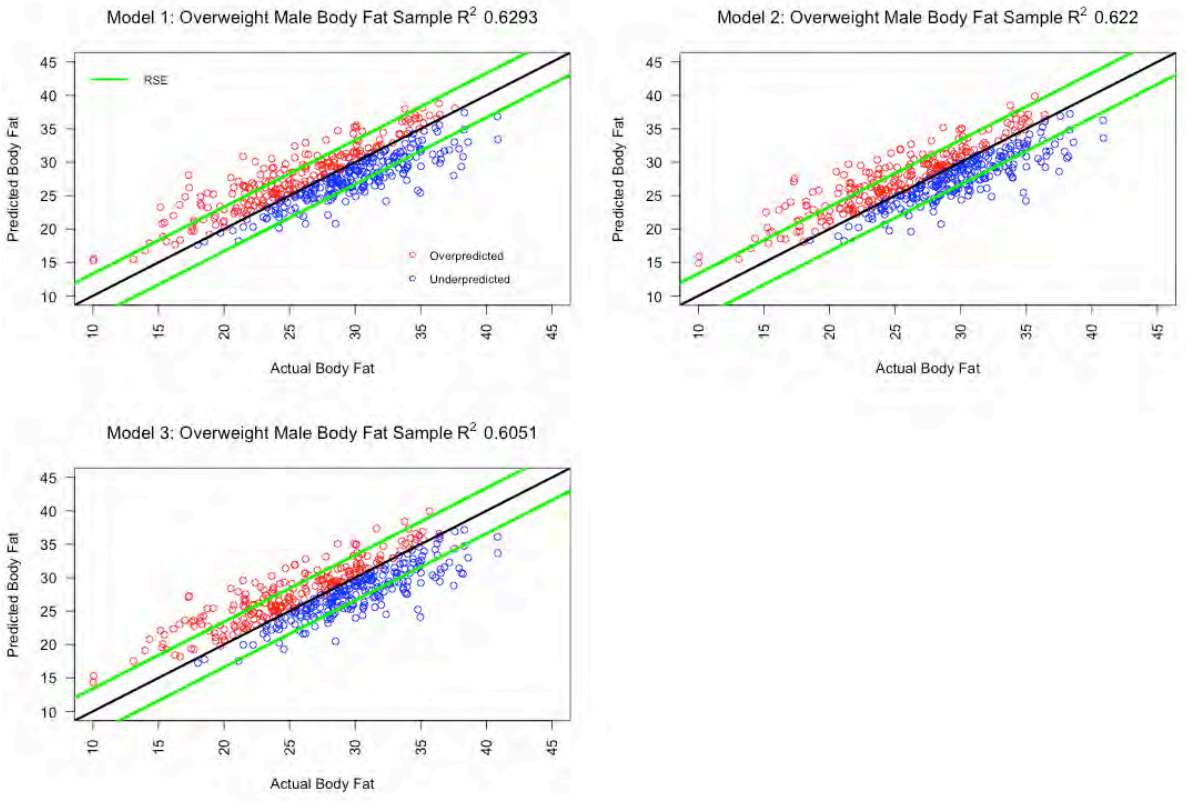

Figure 26. Three Best Linear Regression Models to Predict Percent Body Fat in the Overweight Male Body Fat Sample Based on Regression Models in Table 42

The current Air Force methodology is also analyzed to ascertain if this method could be used in lieu of a regression model. The entire male sample is used, as well as the overweight male sample. Males were determined to be out of standards if their body fat exceeds that allowable for their age, according to MCO 6110.3. The response is recorded as a binary variable, 1 as out of standards, and 0 if within standards. According to the Air Force body composition program, males are within standards if their abdominal circumference is less than or equal to 39 inches, regardless of age. Table 54 gives the confusion matrix for those predicted to be out of standards based on the Air Force methodology versus those out of standards (as determined by body fat). Abdominal circumference is determined by the AB2UMB variable discussed in Section C.

We see that the Air Force model only predicts 54% of males out of body fat standards.

Table 54. Confusion Matrix for the Entire Male Body Fat Sample (1 is out of standards, 0 is within standards)

		Actual		
		1	0	Total
Predicted	1	360	4	364
	0	301	359	660
	Total	661	363	1024

We analyze the overweight sample of males to determine if a two-phased body composition method reduces the number predicted to be in standards among those who are actually out of standards (type II error) in the sample. We see in Table 55 that type II error is still high.

Table 55. Confusion Matrix for the Overweight Male Body Fat Sample (1 is out of standards, 0 is within standards)

		Actual		
		1	0	Total
Predicted	1	331	3	334
	0	83	25	108
	Total	414	28	442

2. Female Body Fat Data

A total of 77 females are considered outside Marine Corps standards in the body fat data. Application of the service models yields significantly lower R^2 when compared to only the overweight females, with minimal change in RSE from the original. We see a slight bias in the Navy equation, significant bias in the Army equation, and a tendency to underpredict actual body fat in the USMC equation. Figure 27 shows each service equation's results when estimating the body fat of the overweight female sample.

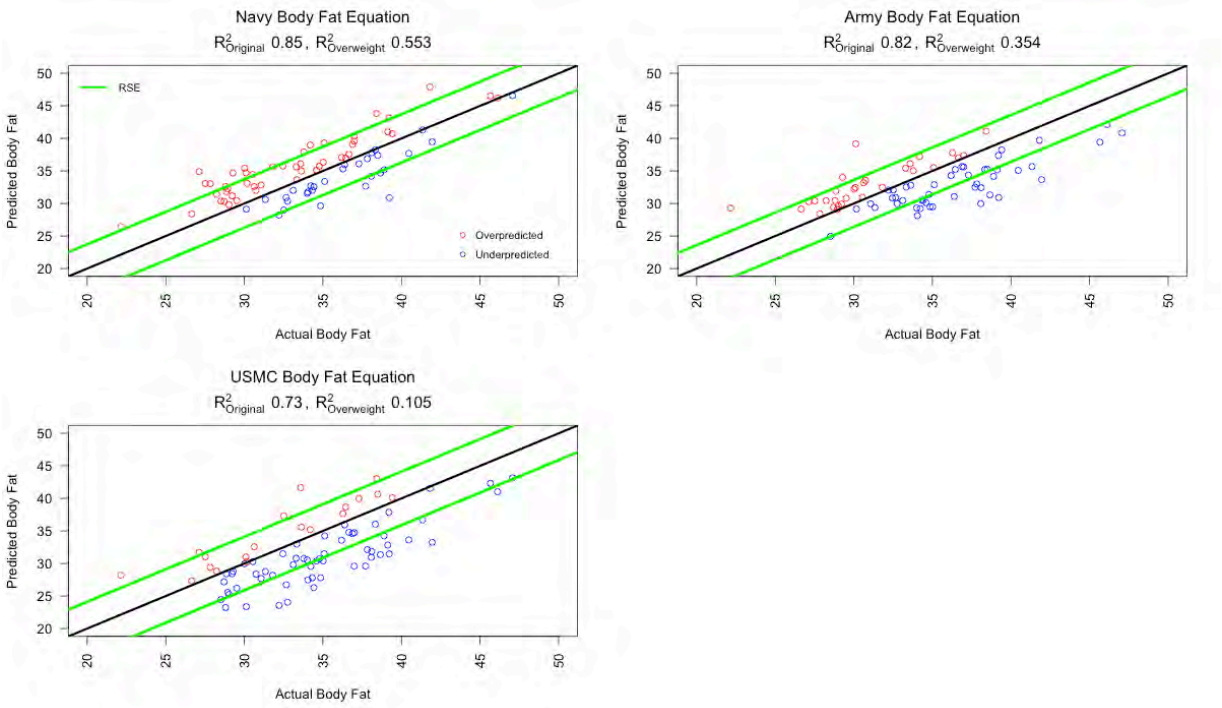

Figure 27. Applied Service Equations for Overweight Female Body Fat Data

In Figure 28 we see the regression models from Table 43. Cross-validated RSE shows little significant difference from the original. All three models tend to be biased with regard to predicting a higher body fat for females with lower body fat.

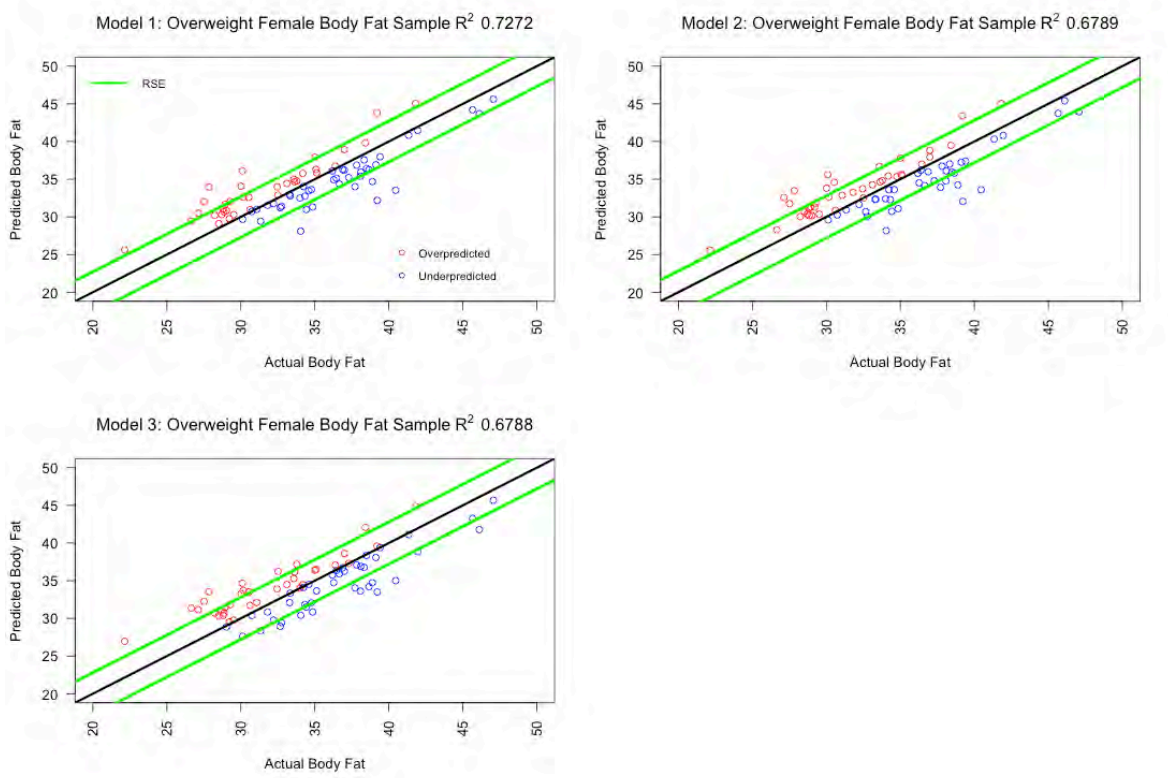

Figure 28. Three Best Linear Regression Models to Estimate Percent Body Fat in the Overweight Female Body Fat Sample Based on Regression Models in Table 43

We apply the Air Force body composition methodology on the entire female body fat sample as well as the overweight female body fat sample. The predicted variable is 1 if a female has an abdominal circumference greater than 35.5 inches. For the purposes of this analysis, the abdominal circumference used is the AB2UMB variable. We see in Table 56 that there is a significant type II error when the Air Force method is applied to the entire sample.

Table 56. Confusion Matrix for the Entire Female Body Fat Sample (1 is out of standards, 0 is within standards)

		Actual		
		1	0	Total
Predicted	1	46	0	46
	0	134	161	295
	Total	180	161	341

We see in Table 57 that type II errors remain an issue when applied to the overweight female sample. However, this may be a biased sample as approximately 99% of the overweight female sample is also out of Marine Corps body fat standards. This methodology may have a different outcome when applied to current data.

Table 57. Confusion Matrix for the Overweight Female Body Fat Sample (1 is out of standards, 0 is within standards)

		Actual		
		1	0	Total
Predicted	1	40	0	40
	0	36	1	37
	Total	76	1	77

F. SUMMARY OF CHAPTER

We find that the service equations do not predict body fat well when applied to the restricted group of overweight males and females taken from the body fat data. The Navy equation, from which the DOD tape method derives, shows bias at the lower body fat scale. This is particularly problematic when used as a secondary measure in body composition assessment. Models fit to the restricted overweight males and females perform just as poorly, with bias at both ends of the body fat spectrum. We also find that the Air Force methodology does not perform well. Type II errors are extremely high in both the male body fat sample and female body fat sample. However, the Air Force methodology may have different results when tested on a current Marine Corps sample.

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V. CURRENT MARINE CORPS BODY FAT SAMPLE DATA AND ANALYSIS

A. INTRODUCTION

> *The Secretary of Defense has directed the Marine Corps to integrate our ground combat arms to the maximum extent possible no later than 1 January 2016.*
>
> —General James A. Amos,
> Commandant of the Marine Corps, 2014

According to the 35th Commandant of the Marine Corps, General James A. Amos, requirements for entering previously closed MOS's will be gender-neutral. Exceptions to policy for closed MOS's must be submitted to the Secretary of Defense by the cutoff date (1 January 2016). In an effort to ensure a measured, deliberate approach to full integration, the Commandant of the Marine Corps assigned Marine Corps Operational Test and Evaluation Activity the responsibility of researching the topic (Commandant of the Marine Corps 2014a).

In May 2014 Marine Administrative Message (MARADMIN) 252/14 called for volunteers to be assigned to the Ground Combat Element Integrated Task Force (GCEITF). This action was predicated on the requirement, by the Secretary of Defense, to integrate females into combat arms units as well as previously closed MOSs (Commandant of the Marine Corps 2014a). The GCEITF would be the test bed for this process and participation in the GCEITF was open to both the active and Reserve component. Enlisted volunteers were restricted to Sergeants and below, and needed to have less than nine years of service to participate (Commandant of the Marine Corps 2014a).

Physical fitness requirements for those volunteering for the combat arms MOS's further restricted volunteers to Marines who could achieve at least a male third class PFT (a score of at least 135). Table 58 below shows the minimum requirements and points associated with the male PFT. Note that these are

minimum requirements only, and additional points would have to be earned in at least one of the three events to achieve the 135 score.

Table 58. Minimum Requirements to Attain a Third Class PFT (after Commandant of the Marine Corps 2008b)

	Minimum Requirment	Associated Score
Pull-ups	3	15
Crunches	40	40
Run	33:00	10

Data are collected on 83 females and 207 males assigned to the GCEITF. Body fat is measured using a bod pod (similar to hydrostatic testing, but uses displaced air instead of water). Height and weight are recorded as well as the estimated body fat using the DOD equation.

B. GCEITF MALE DESCRIPTIVE STATISTICS

Age ranges from 19 to 36 with the medium age of 22. Height ranges from 63 to 77 inches, but due to the small number of Marines at the lower and higher end of the height spectrum, males under 65 inches are combined into a group with heights ≤ 65 while males over 74 inches are combined into a group with heights ≥ 74. Figure 29 provides descriptive statistics for the GCEITF male sample.

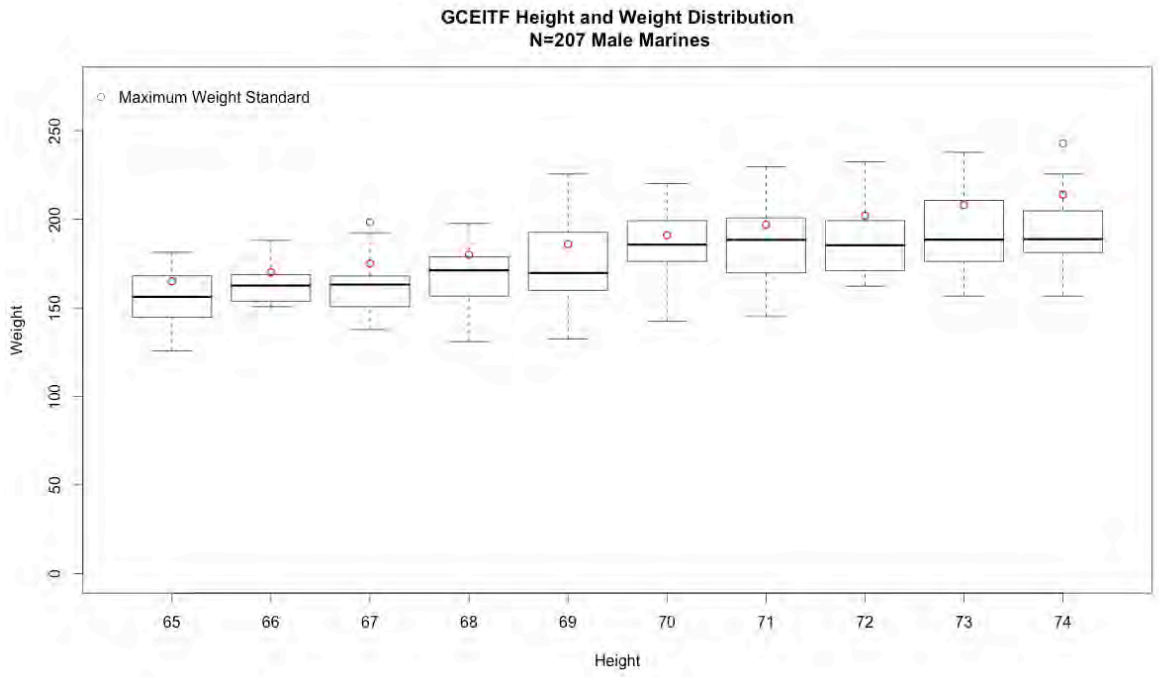

Figure 29. GCEITF Male Sample by Weight (pounds) and Height (inches)

We see in Figure 30 that the GCEITF male sample has a greater difference between the overweight and danger zone proportion. Males within standards range from approximately 55% to 80%, depending on height while the overweight sample ranges from 12% to 40%. The danger zone proportion of the sample tend s to be fairly consistent with the exception of males measuring 66 inches.

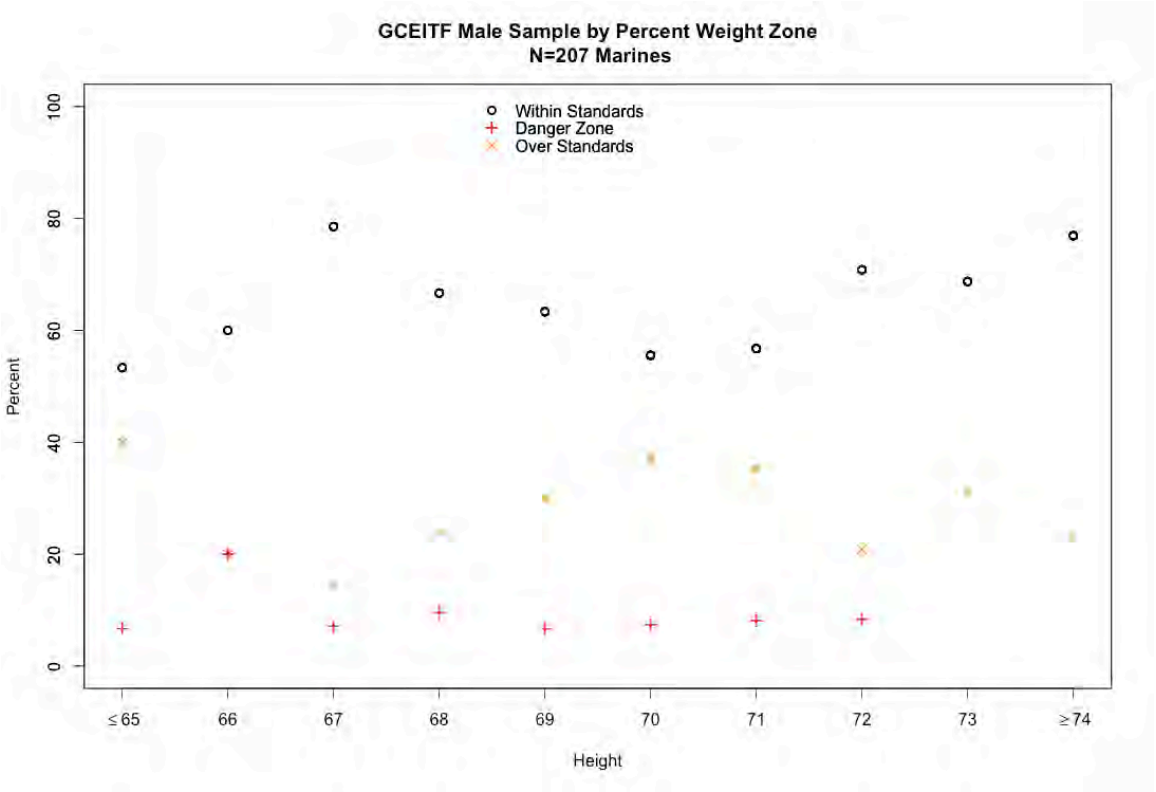

Figure 30. GCEITF Male Sample by Height (inches) and Percent Weight Zone

C. GCEITF FEMALE DESCRIPTIVE STATISTICS

Age ranges from 18 to 29 with a median of 22. Height ranges from 58 to 71. The smallest sample of females is at the tail ends of the height range. Females under 61 inches are combined into a group with heights ≤ 61 inches while females over 68 inches are combined into a group with heights ≥ 68. Figure 31 gives descriptive statistics for the 83 GCEITF females. Note that there are no females measured at 67 inches.

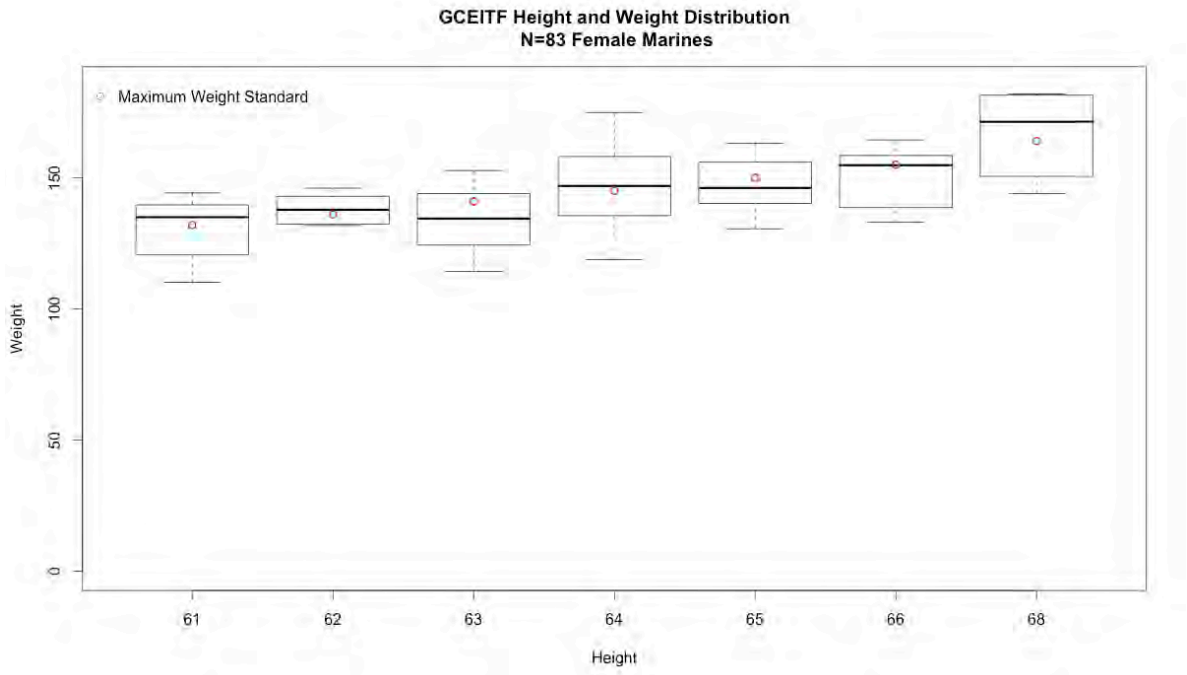

Figure 31. GCEITF Female Sample by Weight (pounds) and Height (inches)

We see in Figure 32 that the GCEITF female sample tends to be on the higher end of the weight standards. With the exception of a few heights, the majority of the sample falls in the danger zone or are over weight. We see that approximately 35% are over standards, 19% are in the danger zone, and 46% are within standards. It is surprising that such a large sample of the GCEITF are over female weight standards, and that more than half the sample is within five pounds of their max or over standards.

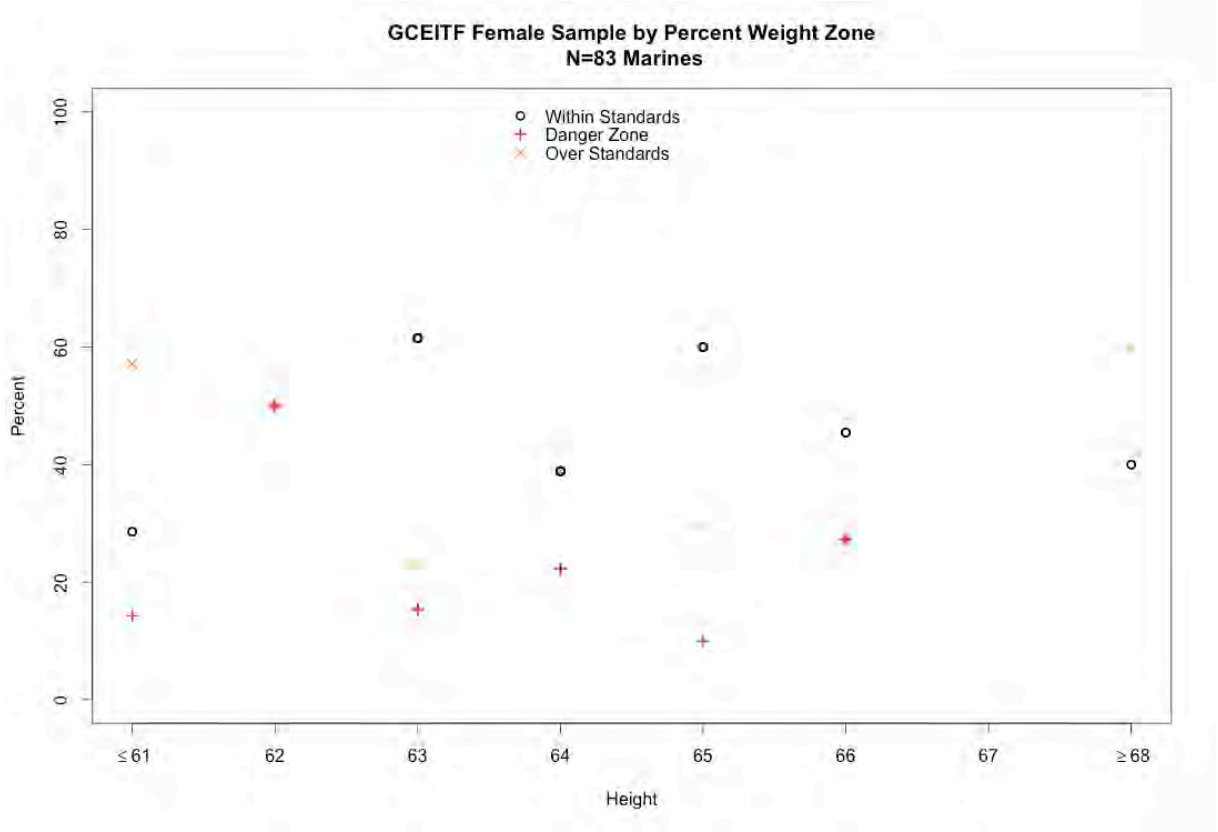

Figure 32. GCEITF Female Sample by Height (inches) and Percent Weight Zone

D. ANALYSIS OF THE DOD MALE BODY FAT ESTIMATION

Body fat is estimated for the 207 GCEITF males. Measurements are taken in accordance with DODI 1808.3 and body fat is attained through the use of a bod pod. Figure 33 shows the entire sample by actual versus predicted body fat. We see a slight bias to overpredict body fat towards the lower end of the body fat spectrum. Overall, we see the DOD taping method tends to underpredict body fat for approximately 72% of the sample.

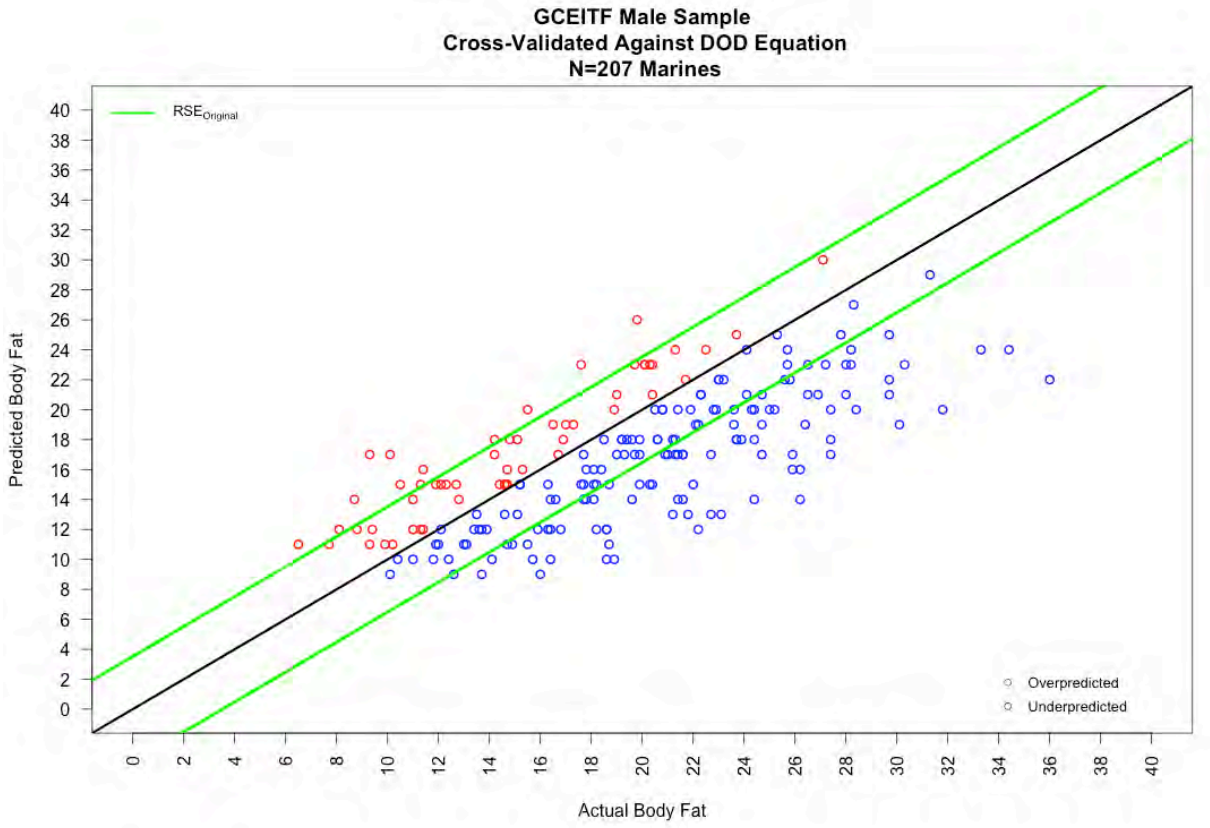

Figure 33. Predicted Body Fat by Actual Body Fat for the GCEITF Male Sample

Of the 207 Marines, 60 are considered overweight, as defined by Marine Corps standards. Figure 34 shows the overweight sample of males by predicted and actual body fat. Again, we see that a bias at the lower end of the body fat spectrum. Overall, we see an even greater bias towards underpredicting body fat in the overweight male sample.

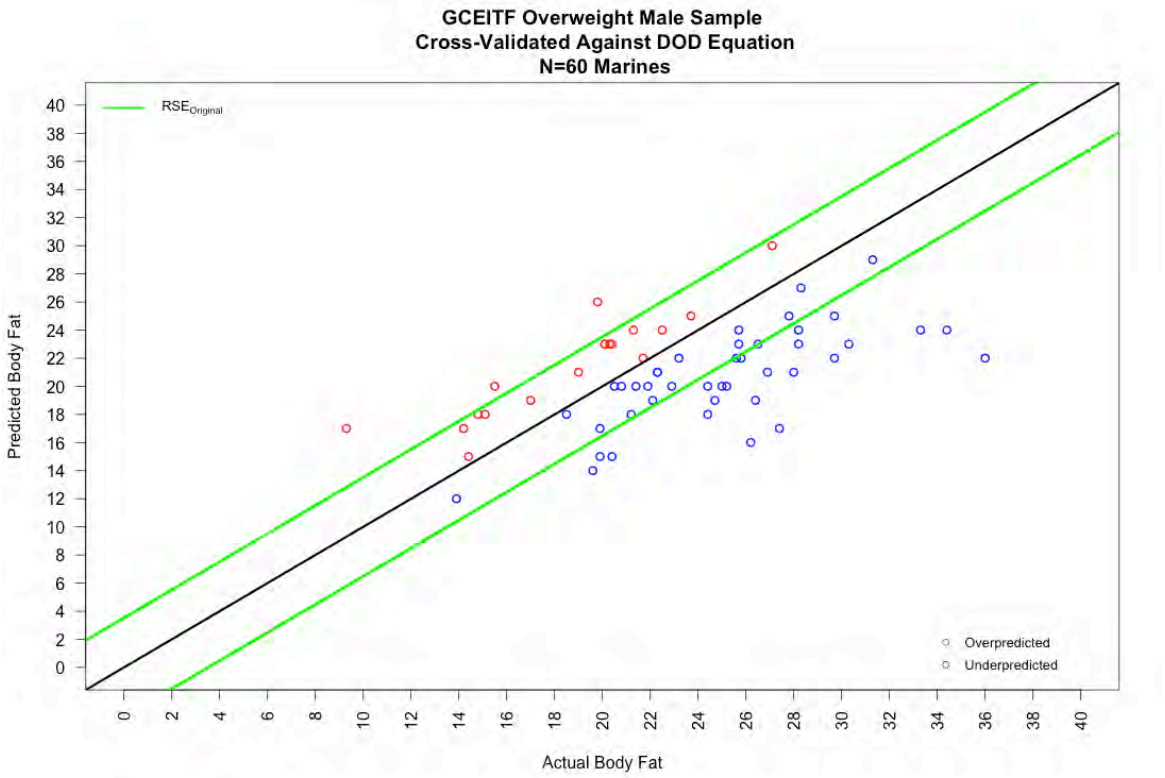

Figure 34. Predicted Body Fat by Actual Body Fat for the GCEITF Overweight Male Sample

E. ANALYSIS OF THE DOD FEMALE BODY FAT ESTIMATION

Body fat estimates and actual body fat calculation (bod pod) are taken on the 83 GCEITF females. In stark contrast to the male sample, the DOD taping technique overpredicts the majority of the time (see Figure 35).

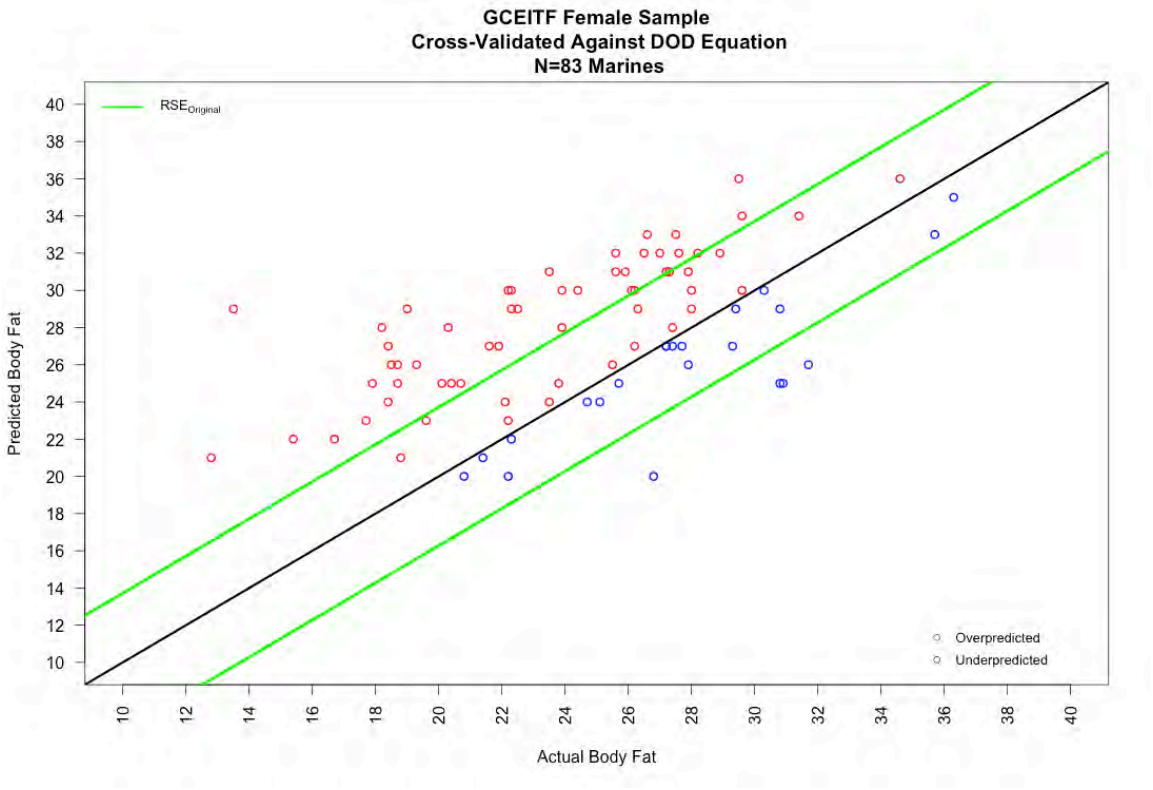

Figure 35. Predicted Body Fat by Actual Body Fat for the GCEITF Female Sample

Of the 83 females, 29 are identified as being over their weight standard. When plotting the predicted versus actual body fat, the DOD taping technique overpredicts female body fat 24 out of the 29 times, see Figure 36.

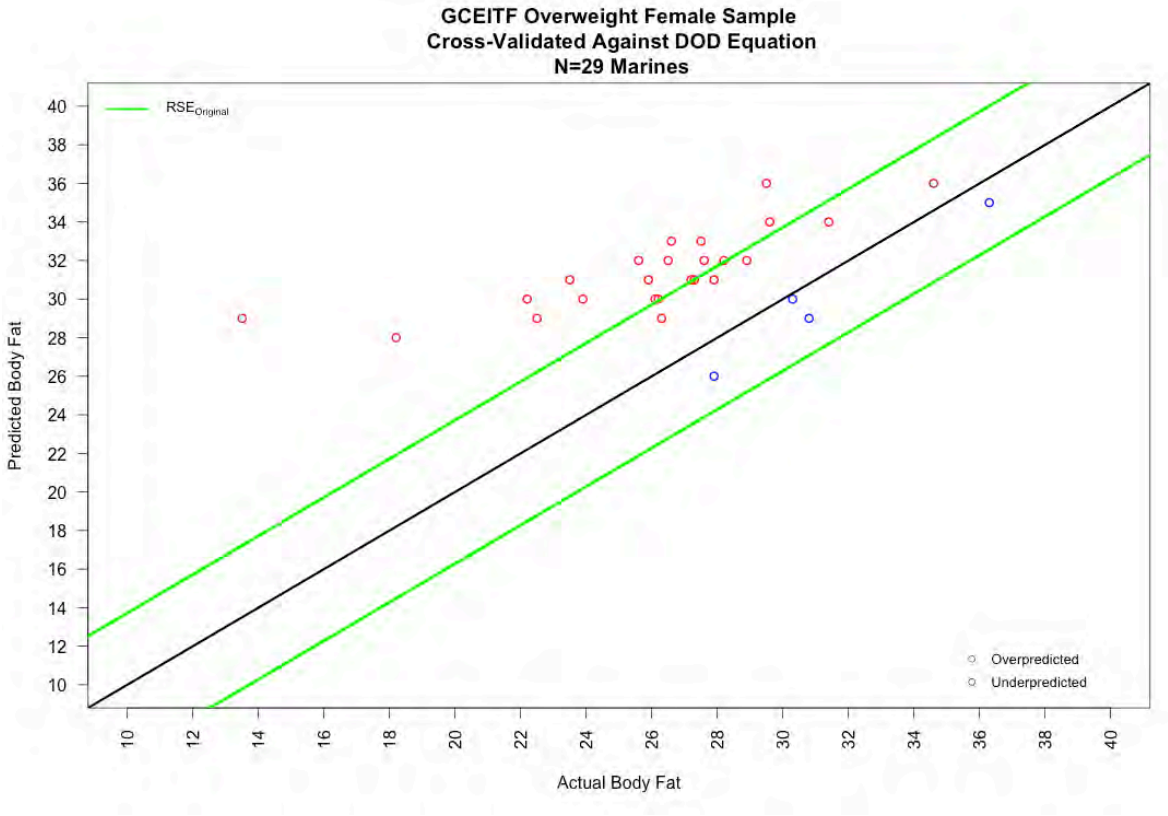

Figure 36. Predicted Body Fat by Actual Body Fat for the GCEITF Overweight Female Sample

F. SUMMARY OF CHAPTER

We find that the DOD tape method underpredicts male body fat for the majority of our sample. However, we also see a bias in the male taping technique towards overpredicting in the lower body fat range. The DOD tape method overpredicts female body fat on 72% of the entire sample, and 83% of the overweight sample.

This sample is relatively small which may not protect against a biased result and may undercut attempts to generalize findings to the wider Marine Corps population. That said, it is important to point out that if this sample is biased at all—especially the female portion—it is much more likely that the GCEITF Marines are more physically fit than the rest of the Marine Corps

population in general. For example, every female in this sample is capable of performing at least three pull-ups.

The DOD tape method needs revision, as it does not predict body fat well. We are unable to test the Air Force methodology, as we did not have access to this data.

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VI. SUMMARY AND RECOMMENDATION

A. SUMMARY

The Marine Corps has the strictest standards of all four services with regard to physical fitness and appearance. Weight seems to play a minimal role with regard to physical performance. The best linear regression models developed to predict weight in males and females (based on the current Marine Corps population) with low R^2 values and large RSE seem to indicate that there are variables outside of those used that would have better predictive capabilities.

The current DOD body fat prediction equations do not perform well on the overweight individuals taken from the body fat data as it does on the entire data set, regardless of sex. We note that the body fat data set is the original data used to develop the current DOD body fat prediction equations. Linear regression models developed specifically to predict body fat on the overweight male and female samples faired slightly better. That being said, none of the regression models had an R^2 greater than 0.7, and should be used with caution to estimate body fat.

The current Air Force methodology, when applied as a secondary screening measure to the body fat data, performed poorly with an overall misclassification rate of 0.20 in the overweight male body fat sample. The majority of the misclassification stemmed from type II errors (Air Force methodology states that the individual is within body fat standards, but is actually out of standard), which may be nullified pending further research into the current abdominal circumference threshold of 39 inches. For the overweight female body fat sample, the Air Force methodology has a misclassification rate of 0.47, with a slightly better misclassification rate of 0.39 for the entire female body fat sample. The overweight female body fat sample consists of 77 females. Of the 77 females considered overweight, all except one is out of Marine Corps body fat standards.

This is not the case for the female GCEITF sample. Of the overweight GCEITF female sample, approximately half are considered out of body fat standards (based on bod pod measurements for body fat). The Air Force method may be worth investigating on the current male and female GCEITF sample. We note that the GCEITF is a small sample size of male and female Marines. However, the GCEITF consists of males and females trained to ground combat arms MOS's. These Marines are training as a ground combat unit would in an operational environment, which indicates a high level of physical fitness.

The current DOD model applied to the GCEITF sample of male Marines overpredicts body fat 28% of the time. When analyzing just the overweight sample, the DOD model overpredicts 30% of time. When the GCEITF female body fat is predicted using the DOD model, females are overpredicted 72% of the time. When compared to the overweight sample, female body fat is overpredicted 83% of the time.

B. CONCLUSIONS AND RECOMMENDATIONS

Though the DOD standard may have performed fairly well in the past, the evolution of physical fitness standards with emphasis on combat and functional fitness has had an effect on the Marine Corps population. The DOD body fat estimate is not a good model, especially with regard to the female population. Though the female GCEITF sample is a small sample size compared to the rest of the Marine Corps, these are also the females who are performing pull-ups on their PFTs, and maintaining high levels of fitness. As can be seen from the graphs in Chapter V, 45% of the GCEITF female sample is within five pounds of their max, or over standards. This suggests that the females who join the Marine Corps in the future, and be given the opportunity to work in ground combat units and MOS's, will be on the higher end of the weight standards. Serious thought must be put into the current weight standards. A new body composition method needs to be developed that will more accurately reflect the current male and female Marine Corps population.

APPENDIX A. AIR FORCE PHYSICAL FITNESS ASSESSMENT SCORING TABLES (SECRETARY OF THE AIR FORCE 2013)

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 cardiovascular disease, diabetes, certain cancers, and other health problems						36	5.8	≤ 29	0
						35	5.5		
						34	5.3		
Passing Requirements - member ***must***: 1) meet minimum value in each of the four components, ***and*** 2) achieve a composite point total ≥ 75 points						33 *	5.0		
						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									

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 – 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
						7	0	7	0
						6	0	6	0
						5	0	≤ 5	0
						4	0		
						3	0		
						≤2	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 ≤ 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

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APPENDIX B. ARMY PHYSICAL FITNESS TEST SCORING TABLES (SECRETARY OF THE ARMY 2013)

PUSH-UP STANDARDS

AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP
Repetitions	M	F	M	F	M	F	M	F	M	F	Repetitions	M	F	M	F	M	F	M	F	M	F	Repetitions
77					100						77											77
76					99						76											76
75			100		98		100				75											75
74			99		97		99				74											74
73			98		96		98		100		73											73
72			97		95		97		99		72											72
71	100		96		94		96		98		71											71
70	99		94		93		95		97		70											70
69	97		93		92		94		96		69											69
68	96		92		91		93		95		68											68
67	94		91		89		92		94		67											67
66	93		90		88		91		93		66	100										66
65	92		89		87		90		92		65	99										65
64	90		87		86		89		91		64	98										64
63	89		86		85		88		90		63	97										63
62	88		85		84		87		89		62	96										62
61	88		84		83		86		88		61	94										61
60	86		83		82		85		87		60	93										60
59	83		82		81		84		86		59	92		100								59
58	82		81		80		82		85		58	91		99								58
57	81		79		79		82		84		57	90		98								57
56	79		78		78		81		83		56	89		96		100						56
55	78		77		77		79		82		55	88		95		99						55
54	77		76		76		78		81		54	87		94		98						54
53	75		75		75		77		79		53	86		93		97		100				53
52	74		74		74		76		78		52	84		92		96		99				52
51	72		73		73		75		77		51	83		91		94		98				51
50	71		71		72	100	74		76		50	82		89		93		97		100		50
49	70		70		71	99	73		75		49	81		88		92		95		99		49
48	68		69		69	98	72		74		48	80		87		91		94		98		48
47	67		68		68	96	71		73		47	79		86		90		93		96		47
46	66		67	100	67	95	70		72		46	78		85		89		92		95		46
45	64		66	99	66	94	69	100	71		45	77		84		88		91		94		45
44	63		65	97	65	93	68	99	70		44	76		82		87		90		93		44
43	61		63	96	64	92	67	97	68		43	74		81		86		89		92		43
42	60	100	62	94	63	90	66	96	68		42	73		80		84		87		91		42
41	59	98	61	93	62	89	65	95	67		41	72		79		83		86		89		41
40	57	97	60	92	61	88	64	93	66	100	40	71		78		82		85		88		40
39	56	95	59	90	60	87	63	92	65	99	39	70		76		81		84		87		39
38	54	93	58	89	59	85	62	91	64	97	38	69		75		80		83		86		38
37	53	91	57	88	58	84	61	89	63	96	37	68	100	74		79		82		85		37
36	52	90	55	86	57	83	60	88	62	94	36	67	98	73		78		81		84		36
35	50	88	54	85	56	82	59	87	61	93	35	66	97	72		77		79		82		35
34	49	86	53	83	55	81	58	86	60	91	34	64	95	71	100	76		78		81		34
33	48	84	52	82	54	79	57	84	59	90	33	63	94	69	98	74		77		80		33
32	46	83	51	81	53	78	56	83	58	88	32	62	92	68	97	73		76		79		32
31	45	81	50	79	52	77	55	81	57	87	31	61	90	67	95	72	100	75		78		31
30	43	79	49	78	50	76	54	80	56	85	30	60	89	66	93	71	98	74		76		30
29	42	77	47	77	49	75	53	79	55	84	29	59	87	65	92	70	96	73		75		29
28	41	76	46	75	48	73	52	77	54	82	28	58	86	64	90	69	95	71	100	74		28
27	39	74	45	74	47	72	51	76	53	81	27	57	84	62	88	68	93	70	98	73		27
26	38	72	44	72	46	71	50	75	52	79	26	56	82	61	87	67	91	69	96	72		26
25	37	70	43	71	45	70	49	73	51	78	25	54	81	60	85	66	89	68	94	71	100	25
24	35	69	42	70	44	68	48	72	50	76	24	53	79	59	83	64	87	67	92	69	98	24
23	34	67	41	68	43	67	47	71	49	75	23	52	78	58	82	63	85	66	90	68	96	23
22	32	65	39	67	42	66	46	69	48	73	22	51	76	56	80	62	84	65	88	67	93	22
21	31	63	38	66	41	65	45	68	47	72	21	50	74	55	78	61	82	63	86	66	91	21
20	30	62	37	64	40	64	44	67	46	70	20	49	73	54	77	60	80	62	84	65	89	20
19	28	60	36	63	39	62	43	65	45	69	19	48	71	53	75	59	78	61	82	64	87	19
18	27	58	35	61	38	61	42	64	44	67	18	47	70	52	73	58	76	60	80	62	84	18
17	26	57	34	60	37	60	41	63	43	66	17	46	68	51	72	57	75	59	78	61	82	17
16	24	55	33	59	36	59	39	61	42	64	16	44	66	49	70	56	73	58	76	60	80	16
15	23	53	31	57	35	58	38	60	41	63	15	43	65	48	68	54	71	57	74	59	78	15
14	21	51	30	56	34	56	37	59	39	61	14	42	63	47	67	53	69	55	72	58	76	14
13	20	50	29	54	33	55	36	58	38	60	13	41	62	46	65	52	67	54	70	56	73	13
12	19	48	28	52	32	54	35	56	37	59	12	40	60	45	63	51	65	53	68	55	71	12
11	17	46	27	50	31	52	34	54	36	57	11	39	58	44	62	50	64	52	66	54	69	11
10	16	44	26	49	29	50	33	52	35	56	10	38	57	42	60	49	62	51	64	53	67	10
9	14	43	25	49	28	49	32	50	34	54	9	37	55	41	58	48	60	50	62	52	64	9
8	13	41	23	48	27	49	31	49	33	53	8	36	54	40	57	47	58	49	60	51	62	8
7	12	39	22	46	26	48	30	49	32	51	7	34	52	39	55	46	56	47	58	49	60	7
6	10	37	21	45	25	47	29	48	31	50	6	33	50	38	53	44	55	46	56	48	58	6
5	9	36	20	43	24	45	28	47	30	48	5	32	49	36	52	43	53	45	54	47	56	5
4	8	34	19	42	23	44	27	46	29	47	4											4
3	6	32	18	41	22	43	26	44	28	45	3											3
2	5	30	17	39	21	42	25	43	27	44	2											2
1	3	29	15	38	20	41	24	41	26	42	1											1
Repetitions	M	F	M	F	M	F	M	F	M	F	Repetitions	M	F	M	F	M	F	M	F	M	F	Repetitions
AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP

Scoring standards are used to convert raw scores to point scores after test events are completed. Male point scores are indicated by the M at the top and bottom of the shaded column. Female point scores are indicated by the F at the top and bottom of the unshaded column. To convert raw scores to point scores, find the number of repetitions performed in the left-hand column. Next, move right along that row and locate the intersection of the soldiers appropriate age column. Record that number in the Push-Up points block on the front of the scorecard.

APD PE v1.00ES

SIT-UP STANDARDS

AGE GROUP	17-21	22-26	27-31	32-36	37-41	AGE GROUP	42-46	47-51	52-56	57-61	62+	AGE GROUP
Repetitions	M/F	M/F	M/F	M/F	M/F	Repetitions	M/F	M/F	M/F	M/F	M/F	Repetitions
82			100			82						82
81			99			81						81
80		100	98			80						80
79		99	97			79						79
78	100	97	96			78						78
77	98	96	95			77						77
76	97	95	94	100	100	76						76
75	95	93	92	99	99	75						75
74	94	92	91	98	98	74						74
73	92	91	90	96	97	73						73
72	90	89	89	95	96	72	100					72
71	89	88	88	94	95	71	99					71
70	87	87	87	93	94	70	98					70
69	86	85	86	92	93	69	97					69
68	84	84	85	91	92	68	96					68
67	82	83	84	89	91	67	95					67
66	81	81	83	88	89	66	94	100	100			66
65	79	80	82	87	88	65	93	99	99			65
64	78	79	81	86	87	64	92	98	98	100		64
63	76	77	79	85	86	63	91	97	97	98	100	63
62	74	76	78	84	85	62	90	96	96	96	99	62
61	73	75	77	82	84	61	89	94	95	91	98	61
60	71	73	76	81	83	60	88	93	94	94	97	60
59	70	72	75	80	82	59	87	92	93	95	96	59
58	68	71	74	79	81	58	86	91	92	94	95	58
57	66	69	73	78	80	57	85	90	91	92	94	57
56	65	68	72	76	79	56	84	89	89	91	92	56
55	63	67	71	75	78	55	83	88	88	90	91	55
54	62	65	70	74	77	54	82	87	87	89	90	54
53	60	64	69	73	76	53	81	86	86	88	89	53
52	58	63	68	72	75	52	80	84	85	87	88	52
51	57	61	66	71	74	51	79	83	84	86	87	51
50	55	60	65	69	73	50	78	82	83	85	86	50
49	54	59	64	68	72	49	77	81	82	84	85	49
48	52	57	63	67	71	48	76	80	81	83	84	48
47	50	56	62	66	69	47	75	79	80	82	83	47
46	49	55	61	65	68	46	74	78	79	81	82	46
45	47	53	60	64	67	45	73	77	78	79	81	45
44	46	52	59	62	66	44	72	76	77	78	79	44
43	44	50	58	61	65	43	71	74	76	77	78	43
42	42	49	57	60	64	42	70	73	75	76	77	42
41	41	48	56	59	63	41	69	72	74	75	76	41
40	39	47	55	58	62	40	68	71	73	74	75	40
39	38	45	54	56	61	39	67	70	72	73	74	39
38	36	44	52	55	60	38	66	69	71	72	73	38
37	34	43	51	54	59	37	65	68	69	71	72	37
36	33	41	50	53	58	36	64	67	68	70	71	36
35	31	40	49	52	57	35	63	66	67	69	70	35
34	30	39	48	50	56	34	62	64	66	68	69	34
33	28	37	47	48	55	33	61	63	65	66	68	33
32	26	36	46	48	54	32	60	62	64	65	66	32
31	25	35	45	47	53	31	59	61	63	64	65	31
30	23	33	44	46	52	30	58	60	62	63	64	30
29	22	32	43	45	50	29	57	58	61	62	63	29
28	20	31	42	44	48	28	56	56	60	61	62	28
27	18	29	41	42	46	27	55	57	59	60	61	27
26	17	28	39	41	47	26	54	56	58	59	60	26
25	15	27	38	40	46	25	53	54	57	58	59	25
24	14	25	37	39	45	24	52	53	56	51	58	24
23	12	24	36	38	44	23	51	52	55	56	57	23
22	10	23	35	36	43	22	50	51	54	55	56	22
21	9	21	34	35	42	21	49	50	53	54	55	21
Repetitions	M/F	M/F	M/F	M/F	M/F	Repetitions	M/F	M/F	M/F	M/F	M/F	Repetitions
AGE GROUP	17-21	22-26	27-31	32-36	37-41	AGE GROUP	42-46	47-51	52-56	57-61	62+	AGE GROUP

Scoring standards are used to convert raw scores to point scores after test events are completed. To convert raw scores to point scores, find the number of repetitions performed in the left-hand column. Next, move right along that row and locate the intersection of the soldiers appropriate age column. Record that number in the Sit-Up points block on the front of the scorecard.

APD PE v1.00ES

2-MILE RUN STANDARDS

AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP
Time	M	F	M	F	M	F	M	F	M	F	Time	M	F	M	F	M	F	M	F	M	F	Time
12:54											12:54											12:54
13:00	100		100								13:00											13:00
13:06	99		99								13:06											13:06
13:12	97		98								13:12											13:12
13:18	96		97		100		100				13:18											13:18
13:24	94		96		99		99				13:24											13:24
13:30	93		94		98		98				13:30											13:30
13:36	92		93		97		97		100		13:36											13:36
13:42	90		92		96		96		99		13:42											13:42
13:48	89		91		95		95		98		13:48											13:48
13:54	88		90		94		95		97		13:54											13:54
14:00	86		89		92		94		97		14:00											14:00
14:06	85		88		91		93		96		14:06	100										14:06
14:12	83		87		90		92		95		14:12	99										14:12
14:18	82		86		89		91		94		14:18	98										14:18
14:24	81		84		88		90		93		14:24	97		100								14:24
14:30	79		83		87		89		92		14:30	97		99								14:30
14:36	78		82		86		88		91		14:36	96		98								14:36
14:42	77		81		85		87		91		14:42	95		98		100						14:42
14:48	75		80		84		86		90		14:48	94		97		99						14:48
14:54	74		79		83		85		89		14:54	93		96		98						14:54
15:00	72		78		82		85		88		15:00	92		95		98						15:00
15:06	71		77		81		84		87		15:06	91		95		97						15:06
15:12	70		76		79		83		86		15:12	90		94		96						15:12
15:18	68		74		78		82		86		15:18	90		93		95		100				15:18
15:24	67		73		77		81		85		15:24	89		92		95		99				15:24
15:30	66		72		76		80		84		15:30	88		91		94		98				15:30
15:36	64	100	71	100	75		79		83		15:36	87		91		93		97				15:36
15:42	63	99	70	99	74		78		82		15:42	86		90		92		97		100		15:42
15:48	61	98	69	98	73	100	77		81		15:48	85		89		91		96		99		15:48
15:54	60	96	68	97	72	99	76	100	80		15:54	84		88		91		95		98		15:54
16:00	59	95	67	96	71	98	75	99	80		16:00	83		87		90		94		97		16:00
16:06	57	94	66	95	70	97	75	99	79		16:06	83		87		89		93		96		16:06
16:12	56	93	64	94	69	97	74	98	78		16:12	82		86		88		92		95		16:12
16:18	54	92	63	93	68	96	73	97	77		16:18	81		85		87		91		94		16:18
16:24	53	90	62	92	66	95	72	97	76		16:24	80		84		87		91		93		16:24
16:30	52	89	61	91	65	94	71	96	75		16:30	79		84		86		90*		93		16:30
16:36	50	88	60	90	64	93	70	95	74		16:36	78		83		85		89		92		16:36
16:42	49	87	59	89	63	92	69	94	74		16:42	77		82		84		88		91		16:42
16:48	48	85	58	88	62	91	68	94	73		16:48	77		81		84		87		90		16:48
16:54	46	84	57	87	61	91	67	93	72		16:54	76		80		83		86		89		16:54
17:00	45	83	56	86	60	90	66	92	71	100	17:00	75		80		82		85		88		17:00
17:06	43	82	54	85	59	89	65	92	70	99	17:06	74		79		81		84		87		17:06
17:12	42	81	53	84	58	88	65	91	69	99	17:12	73		78		80		83		86		17:12
17:18	41	79	52	83	57	87	64	90	69	98	17:18	72		77		80		83		85		17:18
17:24	39	78	51	82	56	86	63	90	68	97	17:24	71	100	76		79		82		84		17:24
17:30	38	77	50	81	55	86	62	89	67	96	17:30	70	99	76		78		81		83		17:30
17:36	37	76	49	80	54	85	61	88	66	96	17:36	70	99	75	100	77		80		82		17:36
17:42	35	75	48	79	52	84	60	88	65	95	17:42	69	98	74	99	76		79		81		17:42
17:48	34	73	47	78	51	83	59	87	64	94	17:48	68	97	73	99	76		78		80		17:48
17:54	32	72	46	77	50	82	58	86	63	94	17:54	67	97	73	98	75		77		80		17:54
18:00	31	71	44	76	49	81	57	86	63	93	18:00	66	96	72	97	74		77		79		18:00
18:06	30	70	43	75	48	80	56	85	62	92	18:06	65	96	71	97	73		76		78		18:06
18:12	28	68	42	74	47	80	55	84	61	92	18:12	64	95	70	96	73		75		77		18:12
18:18	27	67	41	73	46	79	55	83	60	91	18:18	63	94	69	96	72		74		76		18:18
18:24	26	66	40	72	45	78	54	83	59	90	18:24	63	94	69	95	71		73		75		18:24
18:30	24	65	39	71	44	77	53	82	58	89	18:30	62	93	68	94	70		72		74		18:30
18:36	23	64	38	70	43	76	52	81	57	89	18:36	61	92	67	94	69		71		73		18:36
18:42	21	62	37	69	42	75	51	81	57	88	18:42	60	92	66	93	69		70		72		18:42
18:48	20	61	36	68	41	74	50	80	56	87	18:48	59	91	65	92	68		70		71		18:48
18:54	19	60	34	67	39	74	49	79	55	87	18:54	58	90	65	92	67		69		70		18:54
19:00	17	59	33	66	38	73	48	79	54	86	19:00	57	90	64	91	66	100	68		69		19:00
19:06	16	58	32	65	37	72	47	78	53	85	19:06	57	89	63	91	65	99	67		68		19:06
19:12	14	56	31	64	36	71	46	77	52	85	19:12	56	89	62	90	65	99	66		67		19:12
19:18	13	55	30	63	35	70	45	77	51	84	19:18	55	88	62	89	64	98	65		67		19:18
19:24	12	54	29	62	34	69	45	76	51	83	19:24	54	87	61	89	63	97	64		66		19:24
19:30	10	53	28	61	33	69	44	75	50	82	19:30	53	87	60	88	62	96	63		65		19:30
19:36	9	52	27	60	32	68	43	74	49	82	19:36	52	86	59	87	62	96	63		64		19:36
19:42	8	50	26	59	31	67	42	74	48	81	19:42	51	85	58	87	61	95	62	100	63		19:42
19:48	6	49	24	58	30	66	41	73	47	80	19:48	50	85	58	86	60	94	61	99	62		19:48
19:54	5	48	23	57	29	65	40	72	46	80	19:54	50	84	57	86	59	93	60	98	61		19:54
20:00	3	47	22	56	28	64	39	72	46	79	20:00	49	83	56	85	58	93	59	98	60	100	20:00
20:06	2	45	21	55	26	63	38	71	45	78	20:06	48	83	55	84	58	92	58	97	59	99	20:06
20:12	1	44	20	54	25	63	37	70	44	78	20:12	47	82	55	84	57	91	57	96	58	98	20:12
20:18	0	43	19	53	24	62	36	70	43	77	20:18	46	82	54	83	56	90	57	95	57	98	20:18
20:24		42	18	52	23	61	35	69	42	76	20:24	45	81	53	82	55	90	56	95	56	97	20:24
20:30		41	17	51	22	60	35	68	41	75	20:30	44	80	52	82	55	89	55	94	55	96	20:30
Time	M	F	M	F	M	F	M	F	M	F	Time	M	F	M	F	M	F	M	F	M	F	Time
AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP

2-MILE RUN STANDARDS

AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP
Time	M	F	M	F	M	F	M	F	M	F	Time	M	F	M	F	M	F	M	F	M	F	Time
20:18	0	43	19	53	24	62	36	70	43	77	20:18	46	82	54	83	58	90	57	95	57	98	20:18
20:24		42	18	52	23	61	35	69	42	76	20:24	45	81	53	82	55	90	56	95	56	97	20:24
20:30		41	17	51	22	60	35	68	41	75	20:30	44	80	52	82	55	89	55	94	55	96	20:30
20:36		39	16	50	21	59	34	68	40	75	20:36	43	80	51	81	54	88	54	93	54	95	20:36
20:42		38	14	49	20	58	33	67	40	74	20:42	43	79	51	81	53	87	53	92	53	94	20:42
20:48		37	13	48	19	57	32	66	39	73	20:48	42	78	50	80	52	87	52	91	53	94	20:48
20:54		36	12	47	18	57	31	66	38	73	20:54	41	78	49	79	51	86	51	91	52	93	20:54
21:00		35	11	46	17	56	30	65	37	72	21:00	40	77	48	79	51	85	50	90	51	92	21:00
21:06		33	10	45	16	55	29	64	36	71	21:06	39	77	47	78	50	84	50	89	50	91	21:06
21:12		32	9	44	15	54	28	63	35	71	21:12	38	76	47	77	49	84	49	88	49	90	21:12
21:18		31	8	43	14	53	27	63	34	70	21:18	37	75	46	77	48	83	48	87	48	90	21:18
21:24		30	7	42	12	52	26	62	34	69	21:24	37	75	45	76	47	82	47	87	47	89	21:24
21:30		28	6	41	11	51	25	61	33	68	21:30	36	74	44	76	47	81	46	86	46	88	21:30
21:36		27	4	40	10	51	25	61	32	68	21:36	35	73	44	75	46	81	45	85	45	87	21:36
21:42		26	3	39	9	50	24	60	31	67	21:42	34	73	43	74	45	80	44	84	44	86	21:42
21:48		25	2	38	8	49	23	59	30	66	21:48	33	72	42	74	44	79	43	84	43	86	21:48
21:54		24	1	37	7	48	22	59	29	66	21:54	32	71	41	73	44	79	43	83	42	85	21:54
22:00		22	0	36	6	47	21	58	29	65	22:00	31	71	40	72	43	78	42	82	41	84	22:00
22:06		21		35	5	46	20	57	28	64	22:06	30	70	40	72	42	77	41	81	40	83	22:06
22:12		20		34	4	46	19	57	27	64	22:12	30	70	39	71	41	76	40	80	40	82	22:12
22:18		19		33	3	45	18	56	26	63	22:18	29	69	38	71	40	76	39	80	39	82	22:18
22:24		18		32	2	44	17	55	25	62	22:24	28	68	37	70	40	75	38	79	38	81	22:24
22:30		16		31	1	43	16	54	24	61	22:30	27	68	36	69	39	74	37	78	37	80	22:30
22:36		15		30	0	42	15	54	23	61	22:36	26	67	36	69	38	73	37	77	36	79	22:36
22:42		14		29		41	15	53	23	60	22:42	25	66	35	68	37	73	36	76	35	78	22:42
22:48		13		28		40	14	52	22	59	22:48	24	66	34	67	36	72	35	76	34	78	22:48
22:54		12		27		40	13	52	21	59	22:54	23	65	33	67	36	71	34	75	33	77	22:54
23:00		10		26		39	12	51	20	58	23:00	23	64	33	66	35	70	33	74	32	76	23:00
23:06		9		25		38	11	50	19	57	23:06	22	64	32	66	34	70	32	73	31	75	23:06
23:12		8		24		37	10	49	18	56	23:12	21	63	31	65	33	69	31	73	30	74	23:12
23:18		7		23		36	9	49	17	56	23:18	20	63	30	64	33	68	30	72	29	74	23:18
23:24		5		22		35	8	48	17	55	23:24	19	62	29	64	32	67	30	71	28	73	23:24
23:30		4		21		34	7	48	16	54	23:30	18	61	29	63	31	67	29	70	27	72	23:30
23:36		3		20		34	6	47	15	54	23:36	17	61	28	62	30	66	28	69	27	71	23:36
23:42		2		19		33	5	46	14	53	23:42	17	60	27	62	29	65	27	69	26	70	23:42
23:48		1		18		32	5	46	13	52	23:48	16	59	26	61	29	64	26	68	25	70	23:48
23:54		0		17		31	4	45	12	52	23:54	16	59	26	61	28	64	25	67	24	69	23:54
24:00				16		30	3	44	11	51	24:00	14	58	25	60	27	63	24	66	23	68	24:00
24:06				15		29	2	43	11	50	24:06	13	57	24	59	26	62	23	65	22	67	24:06
24:12				14		29	1	43	10	49	24:12	12	57	23	59	25	61	23	65	21	66	24:12
24:18				13		28	0	42	9	49	24:18	11	56	22	58	25	61	22	64	20	66	24:18
24:24				12		27		41	8	48	24:24	10	56	22	57	24	60	21	63	19	65	24:24
24:30				11		26		41	7	47	24:30	10	55	21	57	23	59	20	62	18	64	24:30
24:36				10		25		40	6	47	24:36	9	54	20	56	22	59	19	62	17	63	24:36
24:42				9		24		39	6	46	24:42	8	54	19	56	22	58	18	61	16	62	24:42
24:48				8		23		39	5	45	24:48	7	53	18	55	21	57	17	60	15	62	24:48
24:54				7		23		38	4	45	24:54	6	52	18	54	20	56	17	59	14	61	24:54
25:00				6		22		37	3	44	25:00	5	52	17	54	19	56	16	58	13	60	25:00
25:06				5		21		37	2	43	25:06	4	51	16	53	18	55	15	58	13	59	25:06
25:12				4		20		36	1	42	25:12	3	50	15	52	18	54	14	57	12	58	25:12
25:18				3		19		35	0	42	25:18	3	50	15	52	17	53	13	56	11	58	25:18
25:24				2		18		34		41	25:24	2	49	14	51	16	53	12	55	10	57	25:24
25:30				1		17		34		40	25:30	1	49	13	51	15	52	11	56	9	56	25:30
25:36				0		17		33		40	25:36	0	48	12	50	15	51	10	54	8	55	25:36
25:42						16		32		39	25:42		47	11	49	14	50	10	53	7	54	25:42
25:48						15		32		38	25:48		47	11	49	13	50	9	52	6	54	25:48
25:54						14		31		38	25:54		46	10	48	12	49	8	51	5	53	25:54
26:00						13		30		37	26:00		45	9	47	11	48	7	51	4	52	26:00
26:06						12		30		36	26:06		45	8	47	11	47	6	50	3	51	26:06
26:12						11		29		35	26:12		44	7	46	10	47	5	49	2	50	26:12
26:18						11		28		35	26:18		43	7	45	9	46	4	48	1	50	26:18
26:24						10		28		34	26:24		43	6	45	8	45	3	47	0	49	26:24
26:30						9		27		33	26:30		42	5	44	7	44	3	47	0	48	26:30
Time	M	F	M	F	M	F	M	F	M	F	Time	M	F	M	F	M	F	M	F	M	F	Time
AGE GROUP	17-21		22-26		27-31		32-36		37-41		AGE GROUP	42-46		47-51		52-56		57-61		62+		AGE GROUP

Scoring standards are used to convert raw scores to point scores after test events are completed. Male point scores are indicated by the M at the top and bottom of the shaded column. Female point scores are indicated by the F at the top and bottom of the unshaded column. To convert raw scores to point scores, find the number of repetitions performed in the left-hand column. Next, move right along that row and locate the intersection of the soldiers appropriate age column. In all cases, when a time falls between two point values, the lower point value is used. Record that number in the 2MR points block on the front of the scorecard.

APPENDIX C. NAVY PRT SCORING TABLES (CHIEF OF NAVAL OPERATIONS 2011)

Performance Level	Points	Males: Age 17-19 years				
		Curl-ups	Push-ups	1.5-mile run	500-yd swim	450-m swim
"Maximum"	100	109	92	8:15	6:30	6:20
Outstanding	90	102	86	9:00	7:15	7:05
Excellent	75	90	76	9:45	8:30	8:20
Good	60	62	51	11:00	11:15	11:05
Satisfactory	45	50	42	12:30	12:45	12:35
Failure	<45	<50	<42	>12:30	>12:45	>12:35
		Males: Age 20-24 years				
"Maximum"	100	105	87	8:30	6:30	6:20
Outstanding	90	98	81	9:15	7:30	7:20
Excellent	75	87	71	10:30	8:45	8:35
Good	60	58	47	12:00	11:30	11:20
Satisfactory	45	46	37	13:30	13:00	12:50
Failure	<45	<46	<37	>13:30	>13:00	>12:50
		Males: Age 25-29 years				
"Maximum"	100	101	84	8:55	6:38	6:28
Outstanding	90	95	77	9:38	7:38	7:28
Excellent	75	84	67	10:52	8:53	8:43
Good	60	54	44	12:53	11:38	11:28
Satisfactory	45	43	34	14:00	13:08	12:58
Failure	<45	<43	<34	>14:00	>13:08	>12:58
		Males: Age 30-34 years				
"Maximum"	100	98	80	9:20	6:45	6:35
Outstanding	90	92	74	10:00	7:45	7:35
Excellent	75	81	64	11:15	9:00	8:50
Good	60	51	41	13:45	11:45	11:35
Satisfactory	45	40	31	14:30	13:15	13:05
Failure	<45	<40	<31	>14:30	>13:15	>13:05
		Males: Age 35-39 years				
"Maximum"	100	95	76	9:25	6:53	6:43
Outstanding	90	88	70	10:08	7:53	7:43
Excellent	75	78	60	11:23	9:08	8:58
Good	60	47	37	14:08	11:53	11:43
Satisfactory	45	37	27	15:00	13:23	13:13
Failure	<45	<37	<27	>15:00	>13:23	>13:13
		Males: Age 40-44 years				
"Maximum"	100	92	72	9:30	7:00	6:50
Outstanding	90	85	67	10:15	8:00	7:50
Excellent	75	76	56	11:45	9:15	9:05
Good	60	44	34	14:30	12:00	11:50
Satisfactory	45	35	24	15:30	13:30	13:20
Failure	<45	<35	<24	>15:30	>13:30	>13:20

TABLE 2 (CONT'D)
PRT STANDARDS FOR MALES
"Maximum" is the highest number of points attainable for an event.

Performance Level	Points	Curl-ups	Push-ups	1.5-mile run	500-yd swim	450-m swim
		Males: Age 45-49 years				
"Maximum"	100	88	68	9:33	7:08	6:58
Outstanding	90	81	63	10:30	8:08	7:58
Excellent	75	73	52	12:08	9:23	9:13
Good	60	40	32	14:53	12:08	11:58
Satisfactory	45	31	21	16:08	13:38	13:28
Failure	<45	<31	<21	>16:08	>13:08	>13:28
		Males: Age 50-54 years				
"Maximum"	100	85	64	9:35	7:15	7:05
Outstanding	90	78	59	10:45	8:15	8:05
Excellent	75	71	49	12:30	9:30	9:20
Good	60	37	30	15:15	12:15	12:05
Satisfactory	45	29	19	16:45	13:45	13:35
Failure	<45	<29	<19	>16:45	>13:45	>13:35
		Males: Age 55-59 years				
"Maximum"	100	81	60	10:42	7:17	7:07
Outstanding	90	74	56	11:25	8:17	8:07
Excellent	75	62	46	13:12	9:47	9:37
Good	60	36	16	16:15	12:33	12:23
Satisfactory	45	26	10	17:09	13:55	13:45
Failure	<45	<26	<10	>17:09	>13:55	>13:45
		Males: Age 60-64 years				
"Maximum"	100	75	57	11:21	7:20	7:10
Outstanding	90	70	52	12:04	8:20	8:10
Excellent	75	56	44	13:53	10:05	9:55
Good	60	26	14	17:47	12:50	12:40
Satisfactory	45	20	8	18:52	14:05	13:55
Failure	<45	<20	<8	>18:52	>14:05	>13:55
		Males: Age 65+ years				
"Maximum"	100	65	48	11:41	7:25	7:15
Outstanding	90	60	44	12:43	8:25	8:15
Excellent	75	44	36	14:34	10:30	10:20
Good	60	20	10	18:13	13:20	13:10
Satisfactory	45	10	4	20:35	14:15	14:05
Failure	<45	<10	<4	>20:35	>14:15	>14:05

PRT STANDARDS FOR FEMALES

"Maximum" is the highest number of points attainable for an event.

Performance Level	Points	Females: Age 17-19 years				
		Curl-ups	Push-ups	1.5-mile run	500-yd swim	450-m swim
"Maximum"	100	109	51	9:29	6:45	6:35
Outstanding	90	102	47	11:30	8:30	8:20
Excellent	75	90	42	12:30	9:45	9:35
Good	60	62	24	13:30	13:00	12:50
Satisfactory	45	50	19	15:00	14:15	14:05
Failure	<45	<50	<19	>15:00	>14:15	>14:05
		Females: Age 20-24 years				
"Maximum"	100	105	48	9:47	7:15	7:05
Outstanding	90	98	44	11:30	8:45	8:35
Excellent	75	87	39	13:15	10:00	9:50
Good	60	58	21	14:15	13:15	13:05
Satisfactory	45	46	16	15:30	14:30	14:20
Failure	<45	<46	<16	>15:30	>14:30	>14:20
		Females: Age 25-29 years				
"Maximum"	100	101	46	10:17	7:23	7:13
Outstanding	90	95	43	11:45	9:00	8:50
Excellent	75	84	37	13:23	10:15	10:05
Good	60	54	19	14:53	13:30	13:20
Satisfactory	45	43	13	16:08	14:45	14:35
Failure	<45	<43	<13	>16:08	>14:45	>14:35
		Females: Age 30-34 years				
"Maximum"	100	98	44	10:46	7:30	7:20
Outstanding	90	92	41	12:00	9:15	9:05
Excellent	75	81	35	13:30	10:30	10:20
Good	60	51	17	15:30	13:45	13:35
Satisfactory	45	40	11	16:45	15:00	14:50
Failure	<45	<40	<11	>16:45	>15:00	>14:50
		Females: Age 35-39 years				
"Maximum"	100	95	43	10:51	7:45	7:35
Outstanding	90	88	39	12:08	9:30	9:20
Excellent	75	78	34	13:45	10:45	10:35
Good	60	47	14	15:53	14:00	13:50
Satisfactory	45	37	9	17:00	15:15	15:05
Failure	<45	<37	<9	>17:00	>15:15	>15:05
		Females: Age 40-44 years				
"Maximum"	100	92	41	10:56	8:00	7:50
Outstanding	90	85	37	12:15	9:45	9:35
Excellent	75	76	32	14:00	11:00	10:50
Good	60	44	12	16:15	14:15	14:05
Satisfactory	45	35	7	17:15	15:30	15:20
Failure	<45	<35	<7	>17:15	>15:30	>15:20

TABLE 3 (CONT'D)
PRT STANDARDS FOR FEMALES
"Maximum" is the highest number of points attainable for an event.

Performance Level	Points	Females: Age 45-49 years				
		Curl-ups	Push-ups	1.5-mile run	500-yd swim	450-m swim
"Maximum"	100	88	40	10:58	8:15	8:05
Outstanding	90	81	35	12:30	9:53	9:43
Excellent	75	73	30	14:08	11:08	10:58
Good	60	40	11	16:30	14:30	14:20
Satisfactory	45	31	5	17:23	15:38	15:28
Failure	<45	<31	<5	>17:23	>15:38	>15:28
		Females: Age 50-54 years				
"Maximum"	100	85	38	11:00	8:30	8:20
Outstanding	90	78	33	12:45	10:00	9:50
Excellent	75	71	28	14:15	11:15	11:05
Good	60	37	10	16:45	14:45	14:35
Satisfactory	45	29	2	17:30	15:45	15:35
Failure	<45	<29	<2	>17:30	>15:45	>15:35
		Females: Age 55-59 years				
"Maximum"	100	81	30	12:23	8:45	8:35
Outstanding	90	74	26	13:57	10:07	9:57
Excellent	75	62	20	15:20	11:25	11:15
Good	60	36	6	17:48	15:00	14:50
Satisfactory	45	26	2	18:34	16:00	15:50
Failure	<45	<26	<2	>18:34	>16:00	>15:50
		Females: Age 60-64 years				
"Maximum"	100	75	26	13:34	9:00	8:50
Outstanding	90	70	22	15:08	10:15	10:05
Excellent	75	56	16	16:25	11:35	11:25
Good	60	26	5	18:51	15:15	15:05
Satisfactory	45	20	2	19:43	16:15	16:05
Failure	<45	<20	<2	>19:43	>16:15	>16:05
		Females: Age 65+ years				
"Maximum"	100	65	22	14:45	9:15	9:05
Outstanding	90	60	18	16:19	10:23	10:13
Excellent	75	44	12	17:30	11:50	11:40
Good	60	20	4	19:54	15:30	15:20
Satisfactory	45	10	1	20:52	16:30	16:20
Failure	<45	<10	<1	>20:52	>16:30	>16:20

APPENDIX D. MARINE CORPS PFT SCORING TABLES (COMMANDANT OF THE MARINE CORPS 2008B)

PFT SCORING TABLE (FEMALES)

Points	Flexed-Arm Hang	Crunches	3-Mile Run	Points	Flexed-Arm Hang	Crunches	3-Mile Run
100	70 sec	100	21:00	50	45 sec	50	29:20
99		99	21:10	49		49	29:30
98	69 sec	98	21:20	48	44 sec	48	29:40
97		97	21:30	47		47	29:50
96	68 sec	96	21:40	46	43 sec	46	30:00
95		95	21:50	45		45	30:10
94	67 sec	94	22:00	44	42 sec	44	30:20
93		93	22:10	43		43	30:30
92	66 sec	92	22:20	42	41 sec	42	30:40
91		91	22:30	41		41	30:50
90	65 sec	90	22:40	40	40 sec	40	31:00
89		89	22:50	39	39 sec	x	31:10
88	64 sec	88	23:00	38	38 sec	x	31:20
87		87	23:10	37	37 sec	x	31:30
86	63 sec	86	23:20	36	36 sec	x	31:40
85		85	23:30	35	35 sec	x	31:50
84	62 sec	84	23:40	34	34 sec	x	32:00
83		83	23:50	33	33 sec	x	32:10
82	61 sec	82	24:00	32	32 sec	x	32:20
81		81	24:10	31	31 sec	x	32:30
80	60 sec	80	24:20	30	30 sec	x	32:40
79		79	24:30	29	29 sec	x	32:50
78	59 sec	78	24:40	28	28 sec	x	33:00
77		77	24:50	27	27 sec	x	33:10
76	58 sec	76	25:00	26	26 sec	x	33:20
75		75	25:10	25	25 sec	x	33:30
74	57 sec	74	25:20	24	24 sec	x	33:40
73		73	25:30	23	23 sec	x	33:50
72	56 sec	72	25:40	22	22 sec	x	34:00
71		71	25:50	21	21 sec	x	34:10
70	55 sec	70	26:00	20	20 sec	x	34:20
69		69	26:10	19	19 sec	x	34:30
68	54 sec	68	26:20	18	18 sec	x	34:40
67		67	26:30	17	17 sec	x	34:50
66	53 sec	66	26:40	16	16 sec	x	35:00
65		65	26:50	15	15 sec	x	35:10
64	52 sec	64	27:00	14	x	x	35:20
63		63	27:10	13	x	x	35:30
62	51 sec	62	27:20	12	x	x	35:40
61		61	27:30	11	x	x	35:50
60	50 sec	60	27:40	10	x	x	36:00
59		59	27:50	9	x	x	X
58	49 sec	58	28:00	8	x	x	X
57		57	28:10	7	x	x	X
56	48 sec	56	28:20	6	x	x	X
55		55	28:30	5	x	x	X
54	47 sec	54	28:40	4	x	x	X
53		53	28:50	3	x	x	X
52	46 sec	52	29:00	2	x	x	X
51		51	29:10	1	x	x	X

***Round up all values (e.g., 21:01 to 21:09 equals 99 points)**

PFT SCORING TABLE (MALES)

Points	Pull-ups	Crunches	3-Mile Run	Points	Pull-ups	Crunches	3-Mile Run
100	20	100	18:00	50	10	50	26:20
99		99	18:10	49		49	26:30
98		98	18:20	48		48	26:40
97		97	18:30	47		47	26:50
96		96	18:40	46		46	27:00
95	19	95	18:50	45	9	45	27:10
94		94	19:00	44		44	27:20
93		93	19:10	43		43	27:30
92		92	19:20	42		42	27:40
91		91	19:30	41		41	27:50
90	18	90	19:40	40	8	40	28:00
89		89	19:50	39		x	28:10
88		88	20:00	38		x	28:20
87		87	20:10	37		x	28:30
86		86	20:20	36		x	28:40
85	17	85	20:30	35	7	x	28:50
84		84	20:40	34		x	29:00
83		83	20:50	33		x	29:10
82		82	21:00	32		x	29:20
81		81	21:10	31		x	29:30
80	16	80	21:20	30	6	x	29:40
79		79	21:30	29		x	29:50
78		78	21:40	28		x	30:00
77		77	21:50	27		x	30:10
76		76	22:00	26		x	30:20
75	15	75	22:10	25	5	x	30:30
74		74	22:20	24		x	30:40
73		73	22:30	23		x	30:50
72		72	22:40	22		x	31:00
71		71	22:50	21		x	31:10
70	14	70	23:00	20	4	x	31:20
69		69	23:10	19		x	31:30
68		68	23:20	18		x	31:40
67		67	23:30	17		x	31:50
66		66	23:40	16		x	32:00
65	13	65	23:50	15	3	x	32:10
64		64	24:00	14	x	x	32:20
63		63	24:10	13	x	x	32:30
62		62	24:20	12	x	x	32:40
61		61	24:30	11	x	x	32:50
60	12	60	24:40	10	x	x	33:00
59		59	24:50	9	x	x	x
58		58	25:00	8	x	x	x
57		57	25:10	7	x	x	x
56		56	25:20	6	x	x	x
55	11	55	25:30	5	x	x	x
54		54	25:40	4	x	x	x
53		53	25:50	3	x	x	x
52		52	26:00	2	x	X	x
51		51	26:10	1	x	x	x

*** Round up all values (e.g., 18:01 to 18:09 equals 99 points)**

APPENDIX E. MARINE CORPS CFT SCORING TABLES (COMMANDANT OF THE MARINE CORPS 2008B)

MOVEMENT TO CONTACT

	17-26		27-39		40-45		46+	
TIME	M	F	M	F	M	F	M	F
2:45	100	x	x	x	x	x	x	x
2:46	99	x	x	x	x	x	x	x
2:47	99	x	x	x	x	x	x	x
2:48	98	x	x	x	x	x	x	x
2:49	98	x	x	x	x	x	x	x
2:50	97	x	x	x	x	x	x	x
2:51	97	x	100	x	x	x	x	x
2:52	96	x	99	x	x	x	x	x
2:53	96	x	99	x	x	x	x	x
2:54	95	x	98	x	x	x	x	x
2:55	95	x	98	x	x	x	x	x
2:56	95	x	97	x	x	x	x	x
2:57	94	x	97	x	x	x	x	x
2:58	94	x	97	x	x	x	x	x
2:59	93	x	96	x	x	x	x	x
3:00	93	x	96	x	x	x	x	x
3:01	92	x	95	x	x	x	x	x
3:02	92	x	95	x	x	x	x	x
3:03	91	x	95	x	100	x	x	x
3:04	91	x	94	x	99	x	x	x
3:05	91	x	94	x	99	x	100	x
3:06	90	x	93	x	99	x	99	x
3:07	90	x	93	x	99	x	99	x
3:08	89	x	93	x	98	x	99	x
3:09	89	x	92	x	98	x	99	x
3:10	88	x	92	x	98	x	98	x
3:11	88	x	91	x	97	x	98	x
3:12	87	x	91	x	97	x	98	x
3:13	87	x	91	x	97	x	97	x
3:14	87	x	90	x	97	x	97	x
3:15	86	x	90	x	96	x	97	x
3:16	86	x	89	x	96	x	96	x
3:17	85	x	89	x	96	x	96	x
3:18	85	x	88	x	95	x	96	x
3:19	84	x	88	x	95	x	95	x
3:20	84	x	88	x	95	x	95	x
3:21	83	x	87	x	94	x	95	x
3:22	83	x	87	x	94	x	95	x

MOVEMENT TO CONTACT

	17-26		27-39		40-45		46+	
TIME	M	F	M	F	M	F	M	F
3:23	83	100	86	x	94	x	94	x
3:24	82	99	86	x	93	x	94	x
3:25	82	99	86	x	93	x	94	x
3:26	81	98	85	x	93	x	93	x
3:27	81	98	85	x	92	x	93	x
3:28	80	98	84	x	92	x	93	x
3:29	80	97	84	x	92	x	92	x
3:30	79	97	84	100	91	x	92	x
3:31	79	97	83	99	91	x	92	x
3:32	79	96	83	99	91	x	91	x
3:33	78	96	82	98	90	x	91	x
3:34	78	96	82	98	90	x	91	x
3:35	77	96	82	98	90	x	90	x
3:36	77	95	81	97	89	x	90	x
3:37	76	95	81	97	89	x	90	x
3:38	76	95	80	97	89	x	89	x
3:39	75	94	80	96	88	x	89	x
3:40	75	94	80	96	88	x	89	x
3:41	75	94	79	96	88	x	88	x
3:42	74	93	79	95	87	x	88	x
3:43	74	93	78	95	87	x	88	x
3:44	73	93	78	95	86	x	87	x
3:45	73	92	78	94	86	x	87	x
3:46	72	92	77	94	86	x	87	x
3:47	72	92	77	94	85	x	86	x
3:48	71	91	76	93	85	x	86	x
3:49	71	91	76	93	84	100	86	x
3:50	71	91	76	93	84	99	85	x
3:51	70	90	75	92	84	99	85	x
3:52	70	90	75	92	84	98	85	x
3:53	69	90	74	92	83	98	84	x
3:54	69	90	74	91	83	98	84	x
3:55	68	89	74	91	83	97	84	100
3:56	68	89	73	91	82	97	84	99
3:57	67	89	73	90	82	96	83	99
3:58	67	88	72	90	82	96	83	99
3:59	67	88	72	90	81	96	83	99
4:00	66	88	72	89	81	95	82	98
4:01	66	87	71	89	81	95	82	98
4:02	65	87	71	89	80	95	82	98
4:03	65	87	70	88	80	94	81	97
4:04	64	86	70	88	80	94	81	97

MOVEMENT TO CONTACT

	17-26		27-39		40-45		46+	
TIME	M	F	M	F	M	F	M	F
4:05	64	86	70	88	79	93	81	97
4:06	63	86	69	87	79	93	80	96
4:07	63	85	69	87	79	93	80	96
4:08	63	85	68	87	78	92	80	96
4:09	62	85	68	86	78	92	79	95
4:10	62	85	67	86	78	92	79	95
4:11	61	84	67	86	77	91	79	95
4:12	61	84	67	85	77	91	78	94
4:13	60	84	66	85	77	90	78	94
4:14	x	83	66	85	77	90	78	94
4:15	x	83	65	84	76	90	77	93
4:16	x	83	65	84	76	89	77	93
4:17	x	82	65	84	76	89	77	93
4:18	x	82	64	83	75	89	76	92
4:19	x	82	64	83	75	88	76	92
4:20	x	81	63	83	75	88	76	92
4:21	x	81	63	83	74	88	75	91
4:22	x	81	63	82	74	87	75	91
4:23	x	80	62	82	74	87	75	91
4:24	x	80	62	82	73	86	74	90
4:25	x	80	61	81	73	86	74	90
4:26	x	79	61	81	73	86	74	89
4:27	x	79	61	81	72	85	74	89
4:28	x	79	60	80	72	85	73	89
4:29	x	79	x	80	72	85	73	88
4:30	x	78	x	80	71	84	73	88
4:31	x	78	x	79	71	84	72	88
4:32	x	78	x	79	71	83	72	87
4:33	x	77	x	79	71	83	72	87
4:34	x	77	x	78	70	83	71	87
4:35	x	77	x	78	70	82	71	86
4:36	x	76	x	78	70	82	71	86
4:37	x	76	x	77	69	82	70	86
4:38	x	76	x	77	69	81	70	85
4:39	x	75	x	77	69	81	70	85
4:40	x	75	x	76	68	80	69	85
4:41	x	75	x	76	68	80	69	84
4:42	x	74	x	76	68	80	69	84
4:43	x	74	x	75	67	79	68	84
4:44	x	74	x	75	67	79	68	83
4:45	x	73	x	75	67	79	68	83
4:46	x	73	x	74	66	78	67	83
4:47	x	73	x	74	66	78	67	82

MOVEMENT TO CONTACT

	17-26		27-39		40-45		46+	
TIME	M	F	M	F	M	F	M	F
4:48	x	73	x	74	66	78	67	82
4:49	x	72	x	73	65	77	66	82
4:50	x	72	x	73	65	77	66	81
4:51	x	72	x	73	65	76	66	81
4:52	x	71	x	72	64	76	65	81
4:53	x	71	x	72	64	76	65	80
4:54	x	71	x	72	64	75	65	80
4:55	x	70	x	71	64	75	64	80
4:56	x	70	x	71	63	75	64	79
4:57	x	70	x	71	63	74	64	79
4:58	x	69	x	70	63	74	63	79
4:59	x	69	x	70	62	73	63	78
5:00	x	69	x	70	62	73	63	78
5:01	x	68	x	69	62	73	62	78
5:02	x	68	x	69	61	72	62	77
5:03	x	68	x	69	61	72	62	77
5:04	x	68	x	68	61	72	61	77
5:05	x	67	x	68	60	71	61	76
5:06	x	67	x	68	x	71	61	76
5:07	x	67	x	67	x	71	60	76
5:08	x	66	x	67	x	70	x	75
5:09	x	66	x	67	x	70	x	75
5:10	x	66	x	66	x	69	x	75
5:11	x	65	x	66	x	69	x	74
5:12	x	65	x	66	x	69	x	74
5:13	x	65	x	65	x	68	x	74
5:14	x	64	x	65	x	68	x	73
5:15	x	64	x	65	x	68	x	73
5:16	x	64	x	64	x	67	x	73
5:17	x	63	x	64	x	67	x	72
5:18	x	63	x	64	x	66	x	72
5:19	x	63	x	63	x	66	x	72
5:20	x	62	x	63	x	66	x	71
5:21	x	62	x	63	x	65	x	71
5:22	x	62	x	62	x	65	x	71
5:23	x	62	x	62	x	65	x	70
5:24	x	61	x	62	x	64	x	70
5:25	x	61	x	61	x	64	x	69
5:26	x	61	x	61	x	63	x	69
5:27	x	60	x	61	x	63	x	69
5:28	x	x	x	60	x	63	x	68
5:29	x	x	x	x	x	62	x	68
5:30	x	x	x	x	x	62	x	68

MOVEMENT TO CONTACT

	17-26		27-39		40-45		46+	
TIME	M	F	M	F	M	F	M	F
5:31	x	x	x	x	x	62	x	67
5:32	x	x	x	x	x	61	x	67
5:33	x	x	x	x	x	61	x	67
5:34	x	x	x	x	x	61	x	66
5:35	x	x	x	x	x	60	x	66
5:36	x	x	x	x	x	60	x	66
5:37	x	x	x	x	x	x	x	65
5:38	x	x	x	x	x	x	x	65
5:39	x	x	x	x	x	x	x	65
5:40	x	x	x	x	x	x	x	64
5:41	x	x	x	x	x	x	x	64
5:42	x	x	x	x	x	x	x	64
5:43	x	x	x	x	x	x	x	63
5:44	x	x	x	x	x	x	x	63
5:45	x	x	x	x	x	x	x	63
5:46	x	x	x	x	x	x	x	62
5:47	x	x	x	x	x	x	x	62
5:48	x	x	x	x	x	x	x	62
5:49	x	x	x	x	x	x	x	61
5:50	x	x	x	x	x	x	x	61
5:51	x	x	x	x	x	x	x	61
5:52	x	x	x	x	x	x	x	60

AMMO LIFT

REPS	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
97	x	x	100	x	x	x	x	x
96	x	x	99	x	x	x	x	x
95	x	x	99	x	x	x	x	x
94	x	x	98	x	x	x	x	x
93	x	x	98	x	x	x	x	x
92	x	x	97	x	x	x	x	x
91	100	x	97	x	x	x	x	x
90	99	x	96	x	x	x	x	x
89	99	x	95	x	100	x	x	x
88	98	x	95	x	99	x	x	x
87	97	x	94	x	99	x	x	x
86	97	x	94	x	98	x	100	x
85	96	x	93	x	98	x	99	x
84	95	x	92	x	97	x	99	x
83	94	x	92	x	97	x	98	x
82	94	x	91	x	96	x	98	x
81	93	x	91	x	96	x	97	x
80	92	x	90	x	95	x	97	x
79	92	x	90	x	95	x	96	x
78	91	x	89	x	94	x	95	x
77	90	x	88	x	93	x	95	x
76	90	x	88	x	93	x	94	x
75	89	x	87	x	92	x	94	x
74	88	x	87	x	92	x	93	x
73	88	x	86	x	91	x	93	x
72	87	x	86	x	91	x	92	x
71	86	x	85	x	90	x	91	x
70	86	x	84	x	90	x	91	x
69	85	x	84	x	89	x	90	x
68	84	x	83	x	88	x	90	x
67	83	x	83	x	88	x	89	x
66	83	x	82	x	87	x	89	x
65	82	x	81	x	87	x	88	x
64	81	x	81	x	86	x	87	x
63	81	x	80	100	86	x	87	x
62	80	x	80	99	85	x	86	x
61	79	x	79	98	85	x	86	x
60	79	100	79	98	84	x	85	x
59	78	99	78	97	84	x	85	x
58	77	98	77	96	83	x	84	x
57	77	97	77	95	82	x	83	x
56	76	96	76	94	82	x	83	x
55	75	95	76	94	81	x	82	x
54	74	94	75	93	81	x	82	x
53	74	93	74	92	80	x	81	x
52	73	93	74	91	80	x	81	x

AMMO LIFT

REPS	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
51	72	92	73	90	79	x	80	x
50	72	91	73	90	79	x	79	x
49	71	90	72	89	78	x	79	x
48	70	89	72	88	77	x	78	x
47	70	88	71	87	77	x	78	x
46	69	87	70	86	76	x	77	x
45	68	86	70	86	76	100	77	x
44	68	85	69	85	75	99	76	x
43	67	84	69	84	75	98	75	x
42	66	83	68	83	74	97	75	x
41	66	82	68	82	74	96	74	100
40	65	81	67	82	73	95	74	99
39	64	80	66	81	73	94	73	98
38	63	80	66	80	72	93	73	97
37	63	79	65	79	71	92	72	96
36	62	78	65	78	71	91	72	95
35	61	77	64	78	70	90	71	94
34	61	76	63	77	70	89	70	93
33	60	75	63	76	69	88	70	92
32	x	74	62	75	69	87	69	91
31	x	73	62	74	68	86	69	90
30	x	72	61	74	68	85	68	89
29	x	71	61	73	67	84	68	88
28	x	70	60	72	66	83	67	86
27	x	69	x	71	66	82	66	85
26	x	68	x	70	65	81	66	84
25	x	67	x	70	65	80	65	83
24	x	67	x	69	64	79	65	81
23	x	66	x	68	64	78	64	80
22	x	65	x	67	63	77	64	79
21	x	64	x	66	63	76	63	78
20	x	63	x	66	62	75	62	76
19	x	62	x	65	62	74	62	75
18	x	61	x	64	61	73	61	74
17	x	60	x	63	60	72	61	73
16	x	x	x	62	x	71	60	71
15	x	x	x	62	x	70	x	70
14	x	x	x	61	x	69	x	69
13	x	x	x	60	x	68	x	68
12	x	x	x	x	x	66	x	66
11	x	x	x	x	x	65	x	65
10	x	x	x	x	x	64	x	64
9	x	x	x	x	x	63	x	63
8	x	x	x	x	x	61	x	62
7	x	x	x	x	x	60	x	61
6	x	x	x	x	x	x	x	60

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
2:14	100	x	x	x	x	x	x	x
2:15	99	x	x	x	x	x	x	x
2:16	99	x	x	x	x	x	x	x
2:17	98	x	x	x	x	x	x	x
2:18	98	x	x	x	x	x	x	x
2:19	97	x	x	x	x	x	x	x
2:20	97	x	x	x	x	x	x	x
2:21	97	x	x	x	x	x	x	x
2:22	96	x	x	x	x	x	x	x
2:23	96	x	x	x	x	x	x	x
2:24	96	x	x	x	x	x	x	x
2:25	95	x	x	x	x	x	x	x
2:26	95	x	100	x	x	x	x	x
2:27	94	x	99	x	x	x	x	x
2:28	94	x	99	x	x	x	x	x
2:29	94	x	99	x	x	x	x	x
2:30	93	x	99	x	x	x	x	x
2:31	93	x	99	x	x	x	x	x
2:32	93	x	98	x	x	x	x	x
2:33	92	x	98	x	x	x	x	x
2:34	92	x	98	x	100	x	x	x
2:35	91	x	97	x	99	x	x	x
2:36	91	x	97	x	99	x	x	x
2:37	91	x	97	x	99	x	x	x
2:38	90	x	96	x	99	x	x	x
2:39	90	x	96	x	98	x	x	x
2:40	90	x	96	x	98	x	x	x
2:41	89	x	96	x	98	x	x	x
2:42	89	x	95	x	98	x	x	x
2:43	88	x	95	x	98	x	x	x
2:44	88	x	95	x	97	x	x	x
2:45	88	x	94	x	97	x	x	x
2:46	87	x	94	x	97	x	x	x
2:47	87	x	94	x	97	x	x	x
2:48	87	x	94	x	97	x	x	x
2:49	86	x	93	x	97	x	x	x
2:50	86	x	93	x	96	x	x	x
2:51	85	x	93	x	96	x	x	x
2:52	85	x	92	x	96	x	100	x
2:53	85	x	92	x	96	x	99	x
2:54	84	x	92	x	96	x	99	x
2:55	84	x	92	x	95	x	99	x
2:56	84	x	91	x	95	x	99	x
2:57	83	x	91	x	95	x	98	x
2:58	83	x	91	x	95	x	98	x
2:59	82	x	90	x	95	x	98	x
3:00	82	x	90	x	94	x	98	x

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
3:01	82	100	90	x	94	x	98	x
3:02	81	99	89	x	94	x	97	x
3:03	81	99	89	x	94	x	97	x
3:04	81	99	89	x	94	x	97	x
3:05	80	99	89	x	93	x	97	x
3:06	80	99	88	x	93	x	97	x
3:07	79	99	88	100	93	x	96	x
3:08	79	98	88	99	93	x	96	x
3:09	79	98	87	99	93	x	96	x
3:10	78	98	87	99	93	x	96	x
3:11	78	98	87	99	92	x	96	x
3:12	78	98	87	98	92	x	95	x
3:13	77	97	86	98	92	x	95	x
3:14	77	97	86	98	92	x	95	x
3:15	76	97	86	98	92	x	95	x
3:16	76	97	85	97	91	x	95	x
3:17	76	96	85	97	91	x	94	x
3:18	75	96	85	97	91	x	94	x
3:19	75	96	85	97	91	x	94	x
3:20	74	96	84	97	91	x	94	x
3:21	74	96	84	96	90	100	94	x
3:22	74	95	84	96	90	99	93	x
3:23	73	95	83	96	90	99	93	x
3:24	73	95	83	96	90	99	93	x
3:25	73	95	83	95	90	99	93	x
3:26	72	95	82	95	90	98	93	x
3:27	72	94	82	95	89	98	92	x
3:28	71	94	82	95	89	98	92	x
3:29	71	94	82	95	89	98	92	x
3:30	71	94	81	94	89	98	92	x
3:31	70	93	81	94	89	97	92	x
3:32	70	93	81	94	88	97	91	x
3:33	70	93	80	94	88	97	91	x
3:34	69	93	80	93	88	97	91	x
3:35	69	93	80	93	88	96	91	x
3:36	68	92	80	93	88	96	91	x
3:37	68	92	79	93	87	96	90	x
3:38	68	92	79	93	87	96	90	x
3:39	67	92	79	92	87	96	90	x
3:40	67	91	78	92	87	95	90	x
3:41	67	91	78	92	87	95	90	x
3:42	66	91	78	92	86	95	89	x
3:43	66	91	78	91	86	95	89	x
3:44	65	91	77	91	86	95	89	100
3:45	65	90	77	91	86	94	89	99
3:46	65	90	77	91	86	94	88	99

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
3:47	64	90	76	91	86	94	88	99
3:48	64	90	76	90	85	94	88	99
3:49	64	89	76	90	85	93	88	99
3:50	63	89	75	90	85	93	88	99
3:51	63	89	75	90	85	93	87	98
3:52	62	89	75	89	85	93	87	98
3:53	62	89	75	89	84	93	87	98
3:54	62	88	74	89	84	92	87	98
3:55	61	88	74	89	84	92	87	97
3:56	61	88	74	89	84	92	86	97
3:57	61	88	73	88	84	92	86	97
3:58	60	88	73	88	83	92	86	97
3:59	x	87	73	88	83	91	86	96
4:00	x	87	73	88	83	91	86	96
4:01	x	87	72	88	83	91	85	96
4:02	x	87	72	87	83	91	85	96
4:03	x	86	72	87	82	91	85	96
4:04	x	86	71	87	82	90	85	95
4:05	x	86	71	87	82	90	85	95
4:06	x	86	71	86	82	90	84	95
4:07	x	86	71	86	82	90	84	95
4:08	x	85	70	86	82	89	84	94
4:09	x	85	70	86	81	89	84	94
4:10	x	85	70	86	81	89	84	94
4:11	x	85	69	85	81	89	83	94
4:12	x	84	69	85	81	89	83	93
4:13	x	84	69	85	81	88	83	93
4:14	x	84	68	85	80	88	83	93
4:15	x	84	68	84	80	88	83	93
4:16	x	84	68	84	80	88	82	92
4:17	x	83	68	84	80	88	82	92
4:18	x	83	67	84	80	87	82	92
4:19	x	83	67	84	79	87	82	92
4:20	x	83	67	83	79	87	82	92
4:21	x	82	66	83	79	87	81	91
4:22	x	82	66	83	79	86	81	91
4:23	x	82	66	83	79	86	81	91
4:24	x	82	66	82	78	86	81	91
4:25	x	82	65	82	78	86	81	90
4:26	x	81	65	82	78	86	80	90
4:27	x	81	65	82	78	85	80	90
4:28	x	81	64	82	78	85	80	90
4:29	x	81	64	81	78	85	80	89
4:30	x	81	64	81	77	85	80	89

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
4:31	x	80	63	81	77	85	79	89
4:32	x	80	63	81	77	84	79	89
4:33	x	80	63	80	77	84	79	88
4:34	x	80	63	80	77	84	79	88
4:35	x	79	62	80	76	84	79	88
4:35	x	79	62	80	76	84	79	88
4:36	x	79	62	80	76	84	78	88
4:37	x	79	62	80	76	83	78	88
4:38	x	79	61	79	76	83	78	87
4:39	x	79	61	79	76	83	78	87
4:40	x	78	61	79	75	83	78	87
4:41	x	78	61	79	75	82	77	87
4:42	x	78	60	78	75	82	77	86
4:43	x	78	x	78	75	82	77	86
4:44	x	77	x	78	75	82	77	86
4:45	x	77	x	78	74	82	77	86
4:46	x	77	x	78	74	81	76	85
4:47	x	77	x	77	74	81	76	85
4:48	x	77	x	77	74	81	76	85
4:49	x	76	x	77	74	81	76	85
4:50	x	76	x	77	74	81	76	84
4:51	x	76	x	76	73	80	75	84
4:52	x	76	x	76	73	80	75	84
4:53	x	75	x	76	73	80	75	84
4:54	x	75	x	76	73	80	75	84
4:55	x	75	x	76	73	79	75	83
4:56	x	75	x	75	72	79	74	83
4:57	x	75	x	75	72	79	74	83
4:58	x	74	x	75	72	79	74	83
4:59	x	74	x	75	72	79	74	82
5:00	x	74	x	74	72	78	74	82
5:01	x	74	x	74	71	78	73	82
5:02	x	74	x	74	71	78	73	82
5:03	x	73	x	74	71	78	73	81
5:04	x	73	x	74	71	78	73	81
5:05	x	73	x	73	71	77	73	81
5:06	x	73	x	73	71	77	72	81
5:07	x	72	x	73	70	77	72	80
5:08	x	72	x	73	70	77	72	80
5:09	x	72	x	72	70	77	72	80
5:10	x	72	x	72	70	76	72	80
5:11	x	72	x	72	70	76	71	80
5:12	x	71	x	72	69	76	71	79
5:13	x	71	x	72	69	76	71	79

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
5:13	x	71	x	72	69	76	71	79
5:14	x	71	x	71	69	75	71	79
5:15	x	71	x	71	69	75	71	79
5:16	x	70	x	71	69	75	70	78
5:17	x	70	x	71	68	75	70	78
5:18	x	70	x	70	68	75	70	78
5:19	x	70	x	70	68	74	70	78
5:20	x	70	x	70	68	74	70	77
5:21	x	69	x	70	68	74	69	77
5:22	x	69	x	70	67	74	69	77
5:23	x	69	x	69	67	74	69	77
5:24	x	69	x	69	67	73	69	77
5:25	x	68	x	69	67	73	68	76
5:26	x	68	x	69	67	73	68	76
5:27	x	68	x	69	67	73	68	76
5:28	x	68	x	68	66	72	68	76
5:29	x	68	x	68	66	72	68	75
5:30	x	67	x	68	66	72	67	75
5:31	x	67	x	68	66	72	67	75
5:32	x	67	x	67	66	72	67	75
5:33	x	67	x	67	65	71	67	74
5:34	x	66	x	67	65	71	67	74
5:35	x	66	x	67	65	71	66	74
5:36	x	66	x	67	65	71	66	74
5:37	x	66	x	66	65	71	66	73
5:38	x	66	x	66	64	70	66	73
5:39	x	65	x	66	64	70	66	73
5:40	x	65	x	66	64	70	65	73
5:41	x	65	x	65	64	70	65	73
5:42	x	65	x	65	64	70	65	72
5:43	x	65	x	65	63	69	65	72
5:44	x	64	x	65	63	69	65	72
5:45	x	64	x	65	63	69	64	72
5:46	x	64	x	64	63	69	64	71
5:47	x	64	x	64	63	68	64	71
5:48	x	63	x	64	63	68	64	71
5:49	x	63	x	64	62	68	64	71
5:50	x	63	x	63	62	68	63	70
5:51	x	63	x	63	62	68	63	70
5:52	x	63	x	63	62	67	63	70
5:53	x	62	x	63	62	67	63	70
5:54	x	62	x	63	61	67	63	69
5:55	x	62	x	62	61	67	62	69
5:56	x	62	x	62	61	67	62	69

MANEUVER UNDER FIRE

TIME	17-26		27-39		40-45		46+	
	M	F	M	F	M	F	M	F
5:57	x	61	x	62	61	66	62	69
5:58	x	61	x	62	61	66	62	69
5:59	x	61	x	61	60	66	62	68
6:00	x	61	x	61	x	66	61	68
6:01	x	61	x	61	x	66	61	68
6:02	x	60	x	61	x	65	61	68
6:03	x	x	x	61	x	65	61	67
6:04	x	x	x	60	x	65	61	67
6:05	x	x	x	x	x	65	60	67
6:06	x	x	x	x	x	64	60	67
6:07	x	x	x	x	x	64	60	66
6:08	x	x	x	x	x	64	60	66
6:09	x	x	x	x	x	64	60	66
6:10	x	x	x	x	x	64	x	66
6:11	x	x	x	x	x	63	x	65
6:12	x	x	x	x	x	63	x	65
6:13	x	x	x	x	x	63	x	65
6:14	x	x	x	x	x	63	x	65
6:15	x	x	x	x	x	63	x	65
6:16	x	x	x	x	x	62	x	64
6:17	x	x	x	x	x	62	x	64
6:18	x	x	x	x	x	62	x	64
6:19	x	x	x	x	x	62	x	64
6:20	x	x	x	x	x	61	x	63
6:21	x	x	x	x	x	61	x	63
6:22	x	x	x	x	x	61	x	63
6:23	x	x	x	x	x	61	x	63
6:24	x	x	x	x	x	61	x	62
6:25	x	x	x	x	x	60	x	62
6:26	x	x	x	x	x	x	x	62
6:27	x	x	x	x	x	x	x	62
6:28	x	x	x	x	x	x	x	61
6:29	x	x	x	x	x	x	x	61
6:30	x	x	x	x	x	x	x	61
6:31	x	x	x	x	x	x	x	61
6:32	x	x	x	x	x	x	x	61
6:33	x	x	x	x	x	x	x	60

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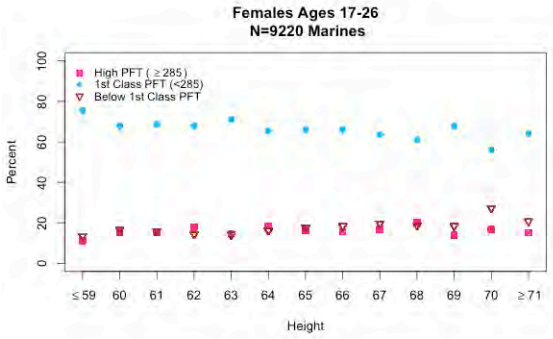
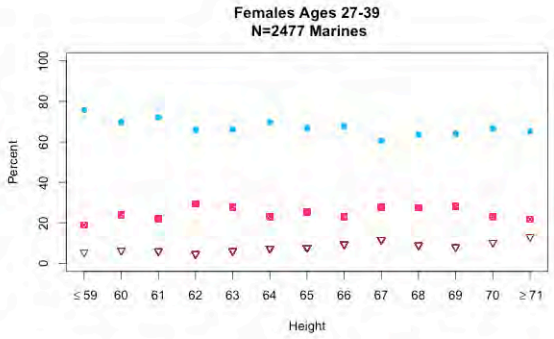
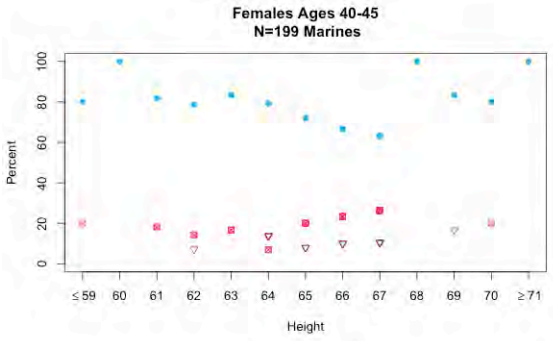
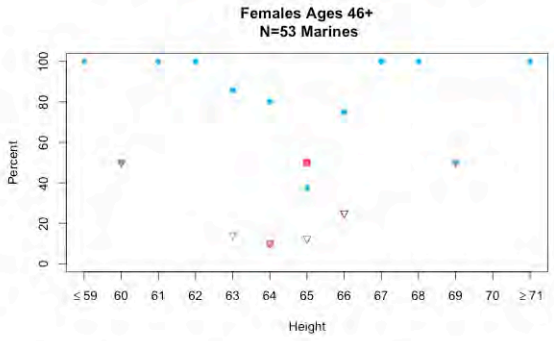
APPENDIX F: FEMALE MARINES BY AGE GROUP AND PERCENT PFT ZONE









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