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Tactical Athlete's Body Composition and Performance Effects While Training in a Fasted State

has been read by the undersigned. It is hereby recommended for acceptance by the faculty with credit to the amount of 3 semester hours.

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TACTICAL ATHLETE'S BODY COMPOSITION AND PERFORMANCE EFFECTS WHILE TRAINING IN A FASTED STATE

A Master Capstone Project

Submitted to the Faculty

of

American Military University

by

Mark Edward Jones

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

April 2019

American Military University

Charlestown, WV

Dedication

For my wife, Alayna and children, Lillian, and Xander, I dedicate this capstone project. Over the past couple years their patience and support to the completion of this program has been marvelous. I also want to dedicate this capstone project to our guardians of freedom, the service members past and present of the Army, Air Force, Coast Guard, Navy, Marines, Police Men and Women, Firefighters, and any Emergency Services personnel placing their lives on the line daily for the betterment of our nation. Thank you all, starting with my family and reaching to the ends of the Tactical Athletic realm, I truly appreciate all the support, encouragement and mostly I appreciate knowing you all are supporting me at home and out protecting our freedom where ever you may be.

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ABSTRACT OF THE CAPSTONE PROJECT

TACTICAL ATHLETE'S BODY COMPOSITION AND PERFORMANCE

EFFECTS WHILE TRAINING IN A FASTED STATE

by

Mark Edward Jones

American Public University System, April 28th, 2019

Charlestown, West Virginia

Professor Daniel G. Graetzer

Body composition and performance has long been components analyzed in tactical athletes within organizations assessing rates of obesity and their ability to perform duties. Many times, individuals within these organizations fall short of the standards set forth. Multiple methods of decreasing body composition and increasing performance present when tactical athletes fall out of regulations. Tactical athletes train at high intensities and most of the time for long durations. Thus, fad diets such as caloric deficits and Intermittent Fasting (IF) were investigated to decide if training in a fasted state improved performance or assisted in decreasing body composition. The research method I used was a search of literature relating to IF, calorie deficits and military caloric expenditure. The search yielded multiple sources related to body composition and performance, although

selected articles closely related to tactical athletes and training methods commonly used. The findings of the study presented that fasted training at low intensities does improve body composition, while high intensities don't improve either body composition or performance. Conclusions showed tactical athletes can perform fasted training, although high and low intensities must be varied to accommodate the energy intake for best results, resulting in the need for adequate training on this topic.

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Introduction

The United States Military has long been assessing Tactical Athletes within organizations using two standards; physical capabilities and body composition. While body composition and physical abilities are two solely independent factors, they relate in the sense of physical activity habits that form the individual. At the beginning nearing World War One, looking at the United States Army, this branch had fitness standards that involved a sort of height-to-weight table. This table notably had three criteria for original entry, although some jobs seemed to be a bit stricter with their guidelines. To enter at this time, the recruit had to be at a minimum of 64 inches tall, with their chest measuring at least half of their height and also weigh between 128lb and 190lb (Friedl, 2017, p.286). Looking at current standards in the United States Army there are two components for the body composition standards; first is the height and weight screening (Table 3). If the Soldier does not fall within these categories noted in Table 3., service members will be measured with a flexible tape to determine if they fall under the maximum allowable body fat percentage (Table 4). The body composition testing standards hold four groups for both males and females based on age and are in the previously noted tables (United States, 2013, p.21). Looking at the standards, Soldiers sometimes have issues maintaining within these guidelines. Many problems attribute to this, and when issues are present, actions need addressing to maintain good standing for service. Fad diets, popular training programs, and other solutions come to mind when dealing with Soldiers that do not fall within the standards. Although the initial discussion has been on United States Army Soldiers, this problem persists across the board with all branches; Air Force, Navy Marines, and other tactical environments. These branches will be discussed in detail later as to their standards to service.

With body composition being a big push for military readiness, Soldiers, US Army, are encouraged to stay within the guidelines previously noted for body composition and height to weight ratios (Table 3,4). For some, this seems to be a simple task, while others have a hard time adhering to these standards. The military provides Soldiers time to conduct Physical Readiness Training (PRT) and has developed a program for them to conduct outlined in *Field Manual 7-22 Army Physical Readiness Training*; this allows them to increase and maintain their current level of fitness. With this program, some Soldiers fall short and require extra assistance. While some turn to more physical training, a current trend in the military communities are different forms of dieting. One such diet noted as Intermittent Fasting (IF) breaks down into three categories; Whole Day Fasting (WDF), Alternate Day Fasting (ADF) and Time-Restricted Feeding (TRF). One of the most popular at military bases and trending across the world appears to be TRF. With individuals service members seeking alternative ways to get rid of unwanted body fat or the overall weight, special diets like IF appear to be on the rise.

United States Army Soldiers perform PRT five days a week on average, some specialized Military Occupational Specialties (MOS) conduct PRT as little as three days weekly and individual training plans are on a case by case basis. Time frames for PRT usually begin at or around 0500 or 0600 hours and are roughly one hour in length. Early morning PRT sessions are crucial to mission completion as is addressed by Bendo, Hauret, Loringer, Kao, Mallon, and Jones (2014) that service members work long hours. Aside these extended hours, Bendo et al., displayed Soldiers are at higher risk for injury, and intrinsic factors such as body mass index and physical fitness appeared to be identifiers of risk (p.1311). With these issues presenting themselves such as body mass index and physical fitness, Soldiers find alternative ways to prevent themselves from potentially being placed on the Army Body Composition Program

(ABCP). The ABCP designed and outlined in *Army Regulation 600-9 The Army weight control program*, is designed to enhance the readiness for units by aiding Soldiers not meeting the standards set forth.

Soldiers that need additional attention, which are those generally placed on the ABCP, look for ways to be proactive with training methodologies. If they do become part of the ABCP, the Soldiers look for ways to be removed due to the image of being associated with the program as a whole. IF, particularly TRF, proves to be an excellent way for soldiers to shed weight at a rate that will get them back to the standards set forth by Army Regulation 600-9. With this weight loss, body composition changes and performance measures are affected. While Soldiers seek a shift in weight and overall body fat, performance can decrease due to the fuel source provided by the body's storage.

While the military branches (Army being the only covered thus far), giving time to train and having publications for guidance; it seems that sometimes individuals go astray from the norm and have issues whether it be from complications of adherence to programming. Injuries that limit performance abilities, failing select testing within the branches required state of readiness are also present as reasons that tactical athletes tend to stray. These presented issues whether they are internal to the service member or external factors causing lack of adherence sometimes cause individuals to become obese, and this ultimately limits performance.

Obesity and Body Composition

Obesity is a marker that designates excess adipose tissue within individuals in the population, as well as risks for many chronic diseases such as; sub-clinical inflammation, metabolic irregularities, vascular dysfunction, and hormone imbalances (Jacobs, 2018, p.110).

Obesity is defined by the Center for Disease Control and Prevention (CDC) as an individual with a body mass being equal or greater than 30 on the Body Mass Index (BMI) scale Table 1. Other areas of this scale include Underweight (<18.5), Normal (18.5-24.9), and Overweight (25-29.9) (CDC, 2017). According to Jacobs (2018), the development of this condition is the result of excess caloric intake which exceeds caloric expenditure, via physical fitness and daily lifestyle habits, over time (p.110). Obesity has been noted to be one of the highest potential epidemiological threats on the national public health challenge list seen by many Americans, as currently the prevalence is 35.7% among adults (20-39 years old), 42.8% among the middle-aged group (40-59 years old) and 41% in the older aged adult group (60+) (CDC, 2018). Over time, the occurrence of higher rates of obesity has significantly increased as in 1980 all states had a 15% occurrence of obesity within individual states on average, this number had a continual rise and over fifteen years no state had below a rate of 21.9% (Lewis, 2019). Fast forwarding another nineteen years in 2014, Bornstein et al. (2018) stated twelve of the fifty states had an obesity rate higher than 25%, while thirty states announced rates higher than 30%. This goes to show, obesity is up and coming (potential) epidemic in the U.S.

Table 1
Body Mass Index

Categories	Reference Ranges
Underweight	< 18.5
Normal	18.5 – 24.9
Overweight	25 – 29.9
Obese	30 <

Note. Body Mass Index. Adapted from, Center for Disease Control and Prevention. (2017). *Defining Adult Overweight and Obesity.*

Body Composition differs significantly from BMI; although the two tend to be a misunderstanding in the general population, body composition was said to have begun with Hippocrates in early the 400's who had a theory of the body being a balance of bodily fluids (Lukaski, 2017, p.4). I present scientific literature; body composition is broken down into components within the body with designations for different compartmental models. The models are broken down into two, three and four compartmental models (Represented in Figure 1). In the two compartmental models, the two areas presented are fat mass (FM) and fat-free mass (FFM). In the three compartmental models, the FM still represents as a base and FFM is broken down into bone mineral (BM) and lean soft tissue (LST). With the third and final model, the four compartmental models, FM is still represented as a base while FFM is broken down into three areas Protein, Water and Other Gatterer, Schenk, & Burtscher, 2017, p.14).

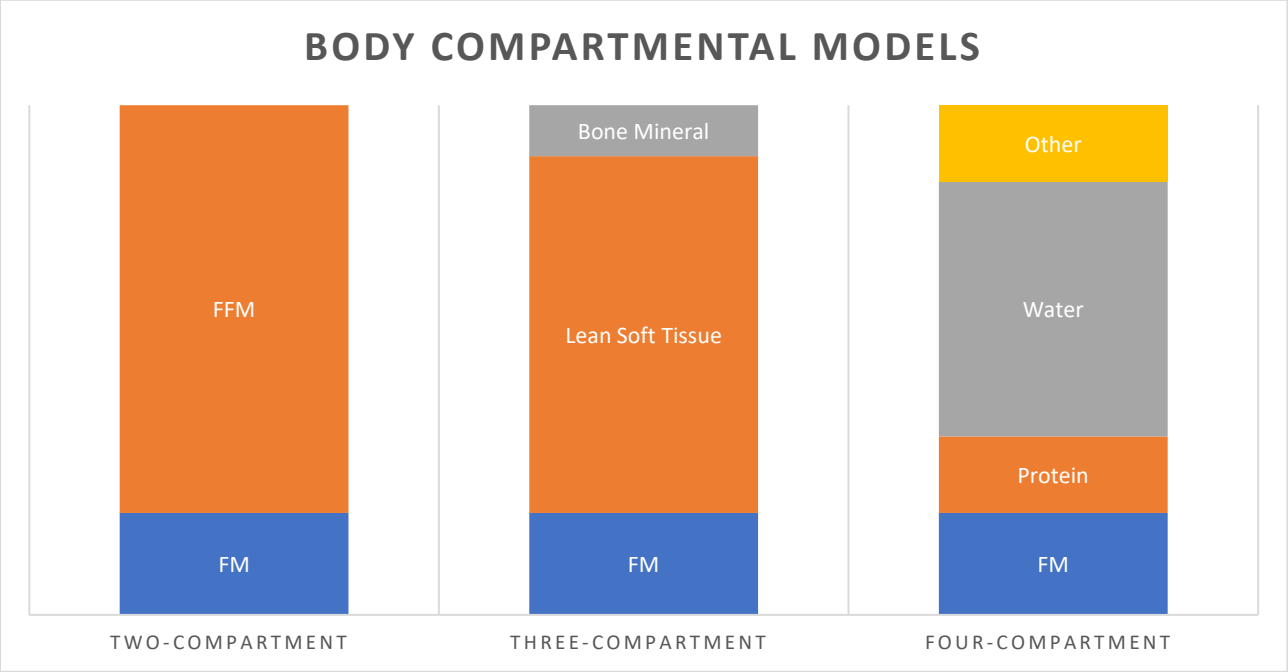

Figure 1. Body Compartmental Models. FM=Fat Mass, FFM= Fat-Free Mass, LST= Lean Soft Tissue, BM= Bone Mineral. Adapted from Gatterer, H., Schenk, K., & Burtscher, M. (2017). Assessment of Human Body Composition: Methods and Limitations. In H.C. Lukaski, *Body Composition: Health and Performance in Exercise and Sport.* Copyrighted Taylor and Francis Group LLC.

When assessing body composition, many different methods have been shown to work depending on the intended outcome of the study. The US Army's approach, previously discussed as a tape measurement of select body parts on males (Waist and Neck) and females (Waist, Neck, and Hips) is one way of determining body fat percentage using a two-compartmental method of collection. Other ways to collect two compartmental readings include; Skinfold thickness, circumferences (other methods than previously discussed), Bioelectrical Impedance (BIA), Air Displacement Plethysmography (ADP), Hydrodensitometry or Underwater weighing (UWW) and Ultrasound technology. One of the most popular three compartmental models is the Dual-Energy X-ray absorptiometry (DXA), and a favorite four compartmental model is known to be Magnetic resonance imaging (MRI) (Gatterer et al., 2017, p.15-21).

Military Obesity

Currently military branches as a whole set forth specific standards for entrance into their services. While some are stricter than others, the overall intent is to enhance the current readiness of the force, while limiting potential musculoskeletal injuries, while in initial entry training (IET). The military draws its recruits from the U.S. general population, looking back at the recorded numbers of obesity from the CDC (2018), the general community for a 20-39-year-old at 35.7%. With this number being one-third of the population, the chance of a recruit joining in an obese state can likely occur. With this number, Tanofsky-Kraft et al. (2013) stated that an estimation of more than nine million young Americans between the ages of seventeen and twenty-four would not be accepted into any branch due to their current state of fitness as it relates to weight. Each branch has a set time frame for accession for all recruits to fall within the standards; this allows them time to prove adaptation to the programming of that branch. Looking forward, in this section, individual branch criteria, as well as the problem statements, hypotheses and significance of the research, will be presented.

Background

With each branch having its own body composition measurement procedures, an understanding that the branches all have individual standards as prepared and laid out according to the mission they are conducting. Lewis (2019) stated the Marine Corps were the first to initiate the measurements via a tape test as well as the requirement to pass a physical assessment test before entrance can occur, while other branches allow time for the recruits to adhere to their standards. It would almost be impossible to measure fitness across the board as all the branches have different height and weight tables and body composition standards. With these standards, if

any service member does not adhere to the standard set forth, the individual will be placed on special duty programs for extracurricular physical training to assist in the service member obtaining below the accession standards for service. If the individual cannot accomplish this requirement, eventually the service member will be removed from service. Once a soldier has been placed on one of the programs like the Army Body Composition Program (ABCP), previously discussed, he or she will not be eligible for awards, deployments, bonuses or specialized schooling. All this ultimately leads up to promotion potential, resulting in soldiers taking drastic measures such as crash diets and popularized training to an extreme to fall in regulatory guidance for the physical readiness testing that occurs annually or bi-annually. Below is a brief description of each branch as it relates to body composition and physical testing.

Air Force

Airmen/women are allowed multiple (four, depending on the situation) attempts to pass the weight standards before being discharged from service. The primary method of measurement is with an abdominal analysis using circumference. This method is used to its easily administrability as it can be virtually done anywhere the administrators of the test needs. The ACSM guidelines also state that this test determines the overall health and well-being of individuals to determine if a possible health risk is presented. These risks present if an individual reaches over a certain point in waist circumference (35inches-Women/40inches-Men). After the body composition (height and weight) are complete, the Air force requires its Airmen/women to fall within a certain body fat percentage. In Table-2 the Air Force regulatory guidance for height and weight is laid out for reference as well as the body fat percentages.

Table 2
U.S. Air Force Height and Weight Regulation

Height in Inches	Max. weight - Males	Max. weight - Females
58	132	120
59	136	124
60	141	128
61	146	132
62	150	137
63	155	141
64	160	146
65	165	150
66	170	155
67	176	160
68	181	164
69	186	169
70	192	174
71	197	179
72	203	184
73	208	189
74	214	195
75	220	200
76	226	205
77	232	211
78	238	216
79	244	222
80	250	228
Body Fat %	18%max	26% Max

Note. Adapted from Air Force Fitness Program (AFI36-2905) by U.S. Air Force, 2013, Washington, DC: Department of the U.S. Air Force.

Army

As previously discussed the Army requires two components for the body composition standards; first is the height and weight screening (Table 3). If the Soldier does not fall within these categories noted in Table 3., service members will be measured with a flexible tape to determine if they fall under the maximum allowable body fat percentage (Table 4). If the Soldiers do not comply with the height/weight standards or fall within the body composition standards according to age after that, the Soldier could face discharge. The program is different for every Soldier, as medical and other underlying issues can prevent soldiers from facing

discharge. Although this would send Soldiers down another road to face discharge through medical evaluation boards. None the less, Soldiers that go on and come off the program have to remain off the program. If the Soldier goes back on within 12 months they can face discharge, and if they go back on the program within 36 months they will have another shot at being removed, but the complete process starts over. Below are the standards laid out for the Army for height/weight and body composition.

Table 3
U.S. Army Weight for height table (screening table weight)

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

Note. Adapted from "The Army body composition program, Army regulation 600-9" p.21, by United States, 2013, Washington, DC: Department of the U.S. Army.

Table 4
Maximum allowable percent body fat standards

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

Note. Adapted from "The Army body composition program, Army regulation 600-9" p.21, by United States, 2013, Washington, DC: Department of the U.S. Army.

Navy

The Navy has a physical readiness platform named the Body composition assessment (BCA). The BCA is an assessment of estimated body fat much of like what has been previously discussed from the Air Force and the Army. The components of the test include height to a weight measurement, seen in Table 5. Sailors who fail to meet and maintain the current regulatory guidance for height and weight will be measured for body fat percentage (seen in Table 6), individuals who fail to fall within these standards will be placed on what is called the Fitness Enhancement Program (FEP). The FEP is a dual program aimed to enhance soldiers' capabilities for physical fitness as well as improving body composition (Romero and Hockett). If a Sailor fails to meet these standards three times in 4 years, they can face discharge.

Table 5
U.S. Navy Height and Weight Requirements

Height in Inches	Max. weight - Males	Max. weight - Females
62	150	149
63	155	152
64	160	156
65	165	160
66	170	163
67	175	167
68	181	170
69	186	119
70	191	122
71	196	125
72	201	129
73	206	132
74	211	136
75	216	140
76	221	144
77	226	147
78	231	216
79	236	241
80	241	227

Note. Adapted from Physical Readiness Program (OPNAVINST 6110.1J; p. (6), by U.S. Navy, 2011, Washington, DC: Department of the Navy.

Table 6
U.S. Navy Body Fat Allowances

Age Group: 18-21 Male (% body fat): 22% Female (% body fat): 33%
Age Group: 22-29 Male (% body fat): 23% Female (% body fat): 34%
Age Group: 30-39 Male (% body fat): 24% Female (% body fat): 35%
Age Group: 40+ Male (% body fat): 26% Female (% body fat): 36%

Note. Adapted from Physical Readiness Program (OPNAVINST 6110.1J; p. (6), by U.S. Navy, 2011, Washington, DC: Department of the Navy.

Marine Corp

The Marines hold a program named the Body Composition Program. Table 7 shows the minimum and maximum weight allowed from the service. If Marines do not fall within these guidelines, the Marine will undergo a Health Assessment and determinations are made from there as to how to proceed.

Table 7
U.S. Marine Corps Weight Allowances

Height in Inches	Max. weight - Males	Max. weight - Females	Height in Inches	Max. weight - Males	Max. weight - Females
58	91	132	58	91	120
59	94	136	59	94	124
60	97	141	60	97	128
61	100	146	61	100	132
62	104	150	62	104	137
63	107	155	63	107	141
64	110	160	64	110	146
65	114	165	65	114	150
66	117	170	66	117	155
67	121	176	67	121	160
68	125	181	68	125	164
69	128	186	69	128	169
70	132	192	70	132	174
71	136	197	71	136	179
72	140	203	72	140	184
73	144	208	73	144	189
74	148	214	74	148	195
75	152	20	75	152	200
76	156	226	76	156	205
77	160	232	77	160	211
78	164	238	78	164	216
79	168	244	79	168	222
80	173	250	80	173	228

Note. Adapted from Marine Corps body composition and military appearance program (MCO 6110.3), by Marine Corps, 2016.Washington, DC: Marine Corps.

As it has been shown, across the branches of the United States Military, all have a foundational backing on body composition and how Soldiers, Sailors, Airmen, and Marines should be adhering to these standards. Although across the board the military is facing up and coming surges in obesity due to illness, combat-related injuries and lack of foundational knowledge on what is known as the Performance Triad (P3): proper nutrition, sleep, and activity; but mostly how to couple the P3 together. Stated earlier, an estimated nine million young American's want a chance at joining any one of the military branches, although they cannot do so due to obesity. This issue is alarming as the rates of obesity in the military are rising at a swift pace. Lewis (2019) stated that across the board, the military between the four branches listed had a total of 1,415,490 members. With an average rate of 11.7% being obese and 59.2% being overweight based on the CDCs Body Mass index scale previously mentioned (p.15-16). Looking back to Tanofsky-Kraft et al. (2013) they noted that over 4500 service members discharged from service in 2008 were due to failure to meet and maintain the height and weight and or body composition standards set forth, as previously mentioned. This issue relating to soldiers receiving discharge goes to show that over the years leading up to our current time, the body composition is still an ongoing battle within the military and needs attention in many different areas.

The inception of the Army's program Performance Triad has helped many Soldiers and other Service members on their installations as it encompasses the three areas that are neglected thus leading to a decline in overall performance. Moving forward the Performance Triad will be covered as it will play a more significant role in the project of assisting service members in reaching their body composition goals.

Contributing Factors: Performance Triad (P3)

Many factors contribute to the decline in tactical performance and increase of body fat percentage in Tactical Athletes (service members) such as previous medical history, injury from combat and even post-traumatic stress disorder (PTSD). Although looking at these, three other factors contribute daily and if manipulated can either have a good or bad consequence for tactical athletes; these areas are Nutrition, Activity and Sleep! The Army has a program titled the Performance Triad which encompasses all these to allow soldiers to gain a better understanding of how to manipulate these in a way that will increase their tactical performance and overall lifestyle. The units that encompass tactical athletes across the branches of the military focus on training the force for their current duties as well as preparing the for-war time missions. The individual tactical athlete is responsible for their well-being and extracurricular training that will lead to better physical preparedness for war. While the units have designed training programs, the individual soldiers are the overall determinant of how much they focus on the three components in the Performance Triad (P3). To fully understand how crucial all the parts are concerning this research, it is wise to first look at all three components.

Nutrition

Fueling the body for performance enables Tactical Athlete training to be increased. It not only increases energy and endurance while performing, it shortens the recovery period in between specific activities, while also improving mental focus. Nutrition also helps military leaders and other tactical athletes to look and feel better while performing strenuous tasks. Nutrition has to be understood in all tactical environments, as not all nutrition is easily obtainable for those that are on special diets. Nutrition is critical in many scenarios, especially as a refuel

after activities such as field training exercises and physical training events like daily Physical Readiness Training (PRT). Exercise places the body in a catabolic state, while this is great for tearing muscle fibers, the human body has to be able to recover from this state. Nutrition is the primary driver in the recovery window according to the Performance Triad (2018), and if nutritional intake within 30-60 minutes after exercise is not consumed, recovery will be placed on a longer hold for the complete process to occur. This recovery period if not adequately managed could impact the next days' tasks. This piece is a standout area concerning IF and TRF as discussed earlier. If an individual does not get into a recovery state, the body may not fully recover before the next strenuous activities placed upon them.

Activity

Physical activity according to the P3 (2018) is excellent for lowering the risk of chronic disease and other conditions such as diabetes, high blood pressure, and even cancer. It also aids in weight loss and prevention in weight gain if correctly done. The activities of resistance training will encourage the strengthening of bones and muscles to support healthy joint function. Activity also assists in the reduction of stress and may aid in depression if individuals have extra time to conduct the exercise. According to the CDC (20), average adults should get between 75-150 minutes of vigorous or 150-300 minutes of moderate cardiovascular activity at a minimum-maximum. As well as 2-5 days of resistance training. Tactical athletes usually get this minimum requirement as part of their Physical Readiness Training (PRT) their units conduct. Although, sometimes the other two components of P3 play significant roles in how physical activity sessions are conducted and how it effects on the body.

Sleep

Sleep is vital for the brain to function within a healthy range. The average adult will require 7-8 hours per day for their focus and mental health to be fully operational. According to P3 (2018) getting an adequate amount of quality sleep is vital for maintaining psychological health as well as assisting in the recovery process from the daily physical activities that were previously discussed. Tactical athletes tend to overestimate their daily activity abilities when sleep deprivation is preset. This lack of sleep impairs the brains key capabilities with function and could result in potential physical injuries if the overestimation was during an event that is somewhat dangerous in nature.

With any of the three previous areas discussed, the military allows for tactical athletes to perform all at optimal levels. Although sometimes when missions dictate, one or more may take a hit. It is up to the tactical athlete to take advantage of time and get his/her body ready through ensuring they sleep adequately, train smart and recover through nutrition, so the mission is not affected due to a decrease in performance in one of these areas. Commanders have to determine how to properly train individuals as well as their units as a whole in these three areas, so the message is not lost, and tactical athletes can have time readily available to fulfill the requirements of all.

Purpose of the Project

The aim of this study is not to discuss the obesity rise in the military, in the following sections a discussion of how tactical athletes respond to the increase in obesity within one's self is the purpose. Many different fad diets and specialized training programs exist and are currently being used to lose weight and fall within specific guidelines, which is precisely what tactical

athletes attempt to do as seen in the previous regulatory height and weight tables presented. This capstone project will focus on addressing nutritional and training methods while in a fasted state as to how they relate to body composition and performance changes within the body. Intermittent Fasting (IF) methods mainly Time-Restricted Feeding (TRF) will be covered as this seems to be on the rise. This research may assist leaders in tactical settings on processes that are healthy and those that are not so healthy for their athletes to conduct while attempting to get within regulatory guidelines of height and weight or body fat percentages. P3 is an excellent tool for commanders to use as a base guide for all tactical athletes, and this project could potentially benefit all tactical athletes as it could bring awareness to interventional methods that could be slowing down progress rather than speeding it up, contrary to popular belief. Finally, there is insufficient literature that addresses the increase in performance and decrease in body composition while training in a fasted state, so this project is to fill in the gaps of the literature as it currently stands.

Hypotheses

Research Question 1: Does training in a fasted state decrease body composition in tactical athletes while training at High or Low Intensities?

Research Question 2: Does high-intensity tactical training improve performance while conducted in a fasted state?

Research Question 3: Can Tactical Athletes perform in a fasted state and it be beneficial to the unit, and the tactical athletes in regards to physical performance and body composition?

Hypotheses Statement: "While fasted cardio is popular in many venues and training programs, the effects are not the same for all clients. Specific populations such as military members do not

generate the same results due to body composition differences, training status or physical demands of some Military Occupational Specialties. Adjustments should be the focal point with training, and nutritional strategies to the specific goals and needs of the military members. The focus placed should be on an individual status during these times of not falling within the individual categories represented by height and weight regulatory guidance by their respective branch. Individuals should focus on more of a long-term approach to fat and weight loss rather than crash diets and experimental training programs. These quick fixes do and will not support long term sustainment in populations that exercise or conduct training at high intensities. If individuals do focus on these long-term fixes rather than agile approaches, the risk of falling back to previous weight will be less likely."

Significance / Justification

In the modern-day tactical athlete, many physiological factors play a role in how the individual readiness of the Soldier is affected. To be effective in combat and their daily MOS duties, Soldiers have to be able to adhere to the physiological demands placed on them, two factors that fall in this readiness category is the previously stated body composition and performance. Although breaking down, performance can be done so in four areas such as muscular strength, muscular endurance, aerobic fitness, and flexibility (Alvar, Sell & Deuster, 2017, p. 508). If the soldiers are in a state of low fuel within the body, one if not both main factors noted can be affected and thus limit their performance causing a weak link in the chain which is overall mission readiness for the United States.

Conclusion

Obesity within the military has presented as a stigma for quite some time. Across the branches, many different standards present themselves, although, most tactical athletes' resort to the same ways of losing weight. Obesity presents as an issue affecting many tactical athletes' fitness, health, and readiness. So far, military obesity and body composition, backgrounds of branches, contributing factors that could potentially affect the rise of obesity, hypotheses and significance/justification were presented.

In the next section, reviews of literature will present from the basic combat training and testing of each branch with physical fitness, research studies on new, up and coming training within individual branches, popular training, as well as nutritional research on select diets popularized among tactical athletes and general populations.

Literature Review

Introduction

In the modern-day tactical athlete, many physiological factors play a role in how the individual readiness is affected. To be effective in combat, as well as their daily MOS duties, tactical athletes have to be able to perform under stress, and in caloric deficits, these practices set forth have different responses to the physiological demands placed on them in certain conditions. Two factors that fall in the readiness category are known to be body composition and performance. Breaking down performance can be done in four areas such as muscular strength, muscular endurance, aerobic fitness, and flexibility (Alvar, Sell & Deuster, 2017, p. 508). While looking at Body composition, the breakdown is Fat Mass and Fat-Free Mass. If the soldiers are in a state of low fuel within the body, one if not both factors noted can be affected and thus limit

their performance, causing a weak link in the chain which is overall mission readiness for the United States.

Obesity is prevalent in the military, especially in the population group suffering from injuries sustained on the battlefield, or in mandatory training events. Looking at one branch of the military, the U.S. Army, these injured Soldiers tend to be placed on the Army Body Composition Program (ABCP) if their weight and performance become diminished. They then require special attention to assist them in reaching higher levels of fitness or in return to duty process. These Soldiers are aided in the removal from the program in many ways, although most Soldiers associated with the program find the fastest means of being removed during this time. Looking at the tactical athletes and their fast pace mindset of being removed, they often find unhealthy mechanisms to facilitate a rapid change within their body. The following subheadings, Obesity and its prevalence in the current populations as a whole will be observed. Injury risk associated with higher Body Mass Index and Body Composition scores with the US Army Soldiers will also be carefully looked at to determine who is actually at risk and what are the best methods to facilitate growth in physical performance while allowing a reduction in body composition. Nutritional strategies often associated with weight loss in the general and tactical populations will be covered to show what fads are trending in the communities for current weight loss protocols. The physiological responses from these fad diets and programs will be discussed to gain a better understanding of how to look at these programs and nutritional methods. These will come together to show that obese Soldiers ultimately need assistance in the removal process from the ABCP and the current trends of dietary and physical training methods that aid in this process. While these programs and training procedures are safe and effective in general populations, military populations have to look at the bigger picture as to determine if

risking a lack in performance to obtain better body compassion (or vice versa) is worth the time and effort.

Nutrition appears to be a significant factor in the performance of tactical athletes whether it is in field training exercises or on combat rotations overseas. The day to day operations has many elements that limit the ability to consume nutrients, while at the same time many of the tasks faced through the day require high levels of energy to perform. Extreme external factors such as sleep deprivation, psychological stressors, extended timelines of missions, unintended weather conditions and many more issues could potentially be issues relating to the physiological factors changing in the tactical athletes. With these changes' nutrition has to be a priority while in the training state so that the tactical athlete can sustain readiness through these adverse conditions. US Army Soldiers on average were noted to expend 4,253kcal (Males, *n*=10) in a field training environment, U.S. Army Rangers were observed to expend 5,158kcal (*n*=8) in a field training environment compared to the garrison environment where they expended 4,518kcal (*n*=8). While looking across the services, US Marine Recruits in basic training during the crucible exercise expended 4,727kcal (Females, *n*=20) and 6,129kcal (Males, *n*=29) and Navy Sailors at sea training was noted to expend 2,776kcal (Female, *n*=16) and 3,446kcal (Males, *n*=9) (Tharion, Lieberman, Montain, Young, Baker-Fulko, Delaney & Hoyt, 2005, p. 49-56). Observing the energy expenditures, attention has to become increased on the energy balance, particularly concerning the demands of the individual. Tharion et al. (2005) noted that combat soldiers tended to expend more calories throughout the day compared to the non-combat supporting roles (p49). This increased expenditure plays into the performance aspects discussed earlier. The muscular endurance, power and ultimately the body composition all play a factor in the energy expenditure of the individual. Although looking at the issue related to this topic, an

individual in a caloric deficit or a fasted state can ultimately reduce the ability to perform, if the energy balance management conducted is not adequate.

Obesity and Body Composition within the Military

In current military regulations, tactical athletes' fall under guidelines that must be followed to remain in good standing within their branches. The Army's body composition program (ABCP) has set standards, and these currently located in "*Army Regulation 600-9, The Army Body Composition program"* (United States, 2013). This program is designed and is primarily placed to ensure all personnel can sustain performance under the physical demands of the duties required in combat scenarios, as well as present a neat and proper appearance. It also notes, body fat found to be in excess implies personal discipline issues while detracting from the appearance standards set forth by the military. (United States, 2013, p.1). With the personal discipline and appearance is noted first in the text, the main issue noted as excess body fat and higher levels of BMI can certainly indicate poor health status and readiness to perform physical fitness activities as needed (Lewis, Nieves, Dixon-Lawson, & Sneed, 2019, p.44). Looking at current standards with the ABCP there are two components for the body composition standards; first is the height and weight screening and Soldier's data will compare to the norms located in Table 1 (Appendix A). If the Soldier does not fall within these categories noted in Table 1., they will then be measured with a flexible tape to determine if they fall under the maximum allowable body fat percentage. The body composition testing standards hold four groups for both males and females based on age; these standards are located in Table 2 (Appendix A) (United States, 2013, p.21).

With the push of military readiness being an essential factor, many soldiers who are overweight also seem to be at risk for musculoskeletal injuries (MI) and overuse syndrome. Cowan, Bendo, Urban, Yi, and Niebuhr (2011) presented findings that individuals in tactical populations that were over their body fat requirements had risks for injury at higher rates compared to those of lower body fat. In a study mentioned in their research named the Assessment of Recruit Motivation and Strength (ARMS), a test was given to soldiers at accession, and if the physical fitness test pre-accession was passed, individuals that were over body fat could join. The individuals were followed for ten weeks post basic training to assess the injury rate. There were 812 over body fat (OBF) and 6,511 weight qualified (WQ) study participants, all of which were men. The study showed that the men who were OBF were 47% more likely to experience any overuse injury compared with WQ as well as having a higher health care utilization for the damages (Cowan et al., 2011, p.250). With Cowan et al., their research proved the use of the current Army body composition program (2013), which was previously the Army weight control program dated 2006, had a premier justification on why body composition standards should become monitored closer, so regulation can become enforced.

Looking at later research in a much larger format from Hruby et al.'s (2016) study from the Total Army Injury and Health Outcomes Database (TAIHOD), a search was conducted using this system on enlisted personnel and retrieved 736,608 staff whom which entered the military between 2001-2011, with current and accurate height, weight, or a calculated BMI in the system. The study aimed to determine the risks associated with musculoskeletal injuries over the years with overweight and obese military recruits. Of 736,608 Soldiers entering the U.S. Army between 2001 and 2011, results found 53.3% had a healthy BMI, compared with 2.4% being

underweight, 34.3% being overweight, and 10.0% being obese. Further breaking down the overweight and obese subjects, men were found to be higher in both categories upon accession compared to that of women. The overweight group had a metric of 35.4% for males vs. 28.8% for females and obese had 11.8% for males vs. 1.3% for females (Hruby et al., 2016, p.e166). Looking at the first time follow up rates for MI, 411,413 cases of any first MI was seen. 55.9% of Soldiers experienced at least one such event, with these metrics 143,553 injuries came from individuals that were overweight at accession and 44,770 were from the obese group.

Looking at the two previous studies, it proves the use and the importance of tactical athletes adhering to the standards set forth. Further research justifies that the course of the military was not headed down the right path in the fight against obesity, as obesity rates were seen rising over the course from 1995 (50.6% of the military were obese) to 2008 (60.8% of the military were obese) (Reyes-Guzman, 2015). Lewis et al., (2019) made a note of a department of defense research from Sanderson et al. (2011) stating 61% and 39% (Men/Women) individuals on active duty were overweight, and 12% overall were classified as obese (p.35). Tactical athletes across the branches all have their standards for service, and the allowances within the regulations are located in Tables 2-7.

As for the U.S. Army Soldiers, the standard previously noted is set within regulations, although when an individual falls out of the regulatory guidance and becomes placed on the ABCP, it is proven that alternate means of training or strategies must be presented to become removed. Exercise and nutritional approaches are the two areas that are first thought of when the need for weight loss is present. Although in some cases, the individual training does not always perform the exercise or nutritional strategies in the correct format.

Current Testing in Tactical Populations

The daily challenges that our tactical athletes face in operational and training scenarios present severe physiological demands to be brought out by the athletes. This requires a vigorous training program to be set up and completed daily to ensure that the tactical athletes across the board are always ready and willing to perform at optimal levels. As stated earlier the overall mission of the U.S. is readiness! To be effective in and out of combat scenarios, tactical athletes have to be able to meet the demands placed on the body in any situation that presents itself, accomplish the mission, push through the fight and WIN (Alvar et al., 2017, p506).

The demands placed on the individual are varied depending on the location, temperature, time of day and the individual operator / tactical athlete. Looking back to the energy expenditures from the previous section, all genders and military occupational specialties play a role in the demands, thus ultimately placing a more or less strenuous load on the body when attempting to lose body fat/weight or improve performance. With this demand placed on the body, the branches have long ago determined the need for physical training and testing within units to assess the individual abilities and potential capabilities. Not all testing is the same, as not all jobs are the same, over the next few sections each branch will be covered in detail as to their training and their testing requirements and the administration.

Air Force

The Air Force uses "*AIR FORCE INSTRUCTION 36-2905*" (2013) as guidance and implementation of the physical training and testing. Looking at testing the body composition assessment was discussed previously. The Muscular Fitness Assessment is the next method of assessments the air force uses. The components of the test include 1 minute of timed pushups

and 1 minute of timed sit-ups, as well as a 1.5-mile run. The push up is used to measure the local muscular endurance while the sit-up is used to measure the Airmen/women's muscular fitness and the run measures the Cardiovascular/Aerobic Fitness) (Air Force, 2013, p.29-31). The Composite Fitness Score Formula for the test will be set at 100 points. The components of the analysis include the three physical tests discussed here and the previously discussed body composition measurement. The Aerobic score is worth 60 points, and Body Composition is worth 20 points, Push-ups 10points and Sit-ups 10 points. Classifications of the testing are set at Excellent (≥90 composite score and all minimums met), Satisfactory (75-89.99 of the composite score and all minimums met), and Unsatisfactory (≤ 74.9and or one or more components not met at the minimum). Air Force members are required to take the test once a year, they have the option to retake the testing at their own free will, although commanders do not have the authority to direct out of cycle fitness assessments. If an Airmen/women do not meet the standard and falls in the unsatisfactory rating, the individual will have to retest within 90 days to determine the future state of the individual. This is when fad diets and popularized training programs tend to present themselves depending on the area of testing failed.

Army

Currently, the Army tests three areas of fitness, just as the Air Force, the Army measures the Push-up, Sit-up (Muscular endurance and fitness) and a Cardiovascular endurance (aerobic). Although with the Army, the Push-up and Sit-up events are extended out to two minutes per testing sequence. The cardiovascular testing is also extended out up to a 2-mile run. Those on a profile limiting duty have options of another physical testing such as a 6.2-mile bike ride, a 2.5-mile walk or an 800-yard swim. Much like the age groups for the body composition assessment,

physical fitness testing has age groups to determine pass or fail minimums. The Army addresses each event in a 100-point fashion for a total of 300-points being a perfect score. With the body composition having four groups for age categories, the Army Physical Fitness Test (APFT) has ten age ranges; 17-21,22-26,27-31,32-36,37-41,42-46,47-51, 52-56, 57-61 & 62+ (Unites States, 2012, A-12). After the APFT has been conducted, the next step is to conduct the Body composition analysis discussed previously. If any of these areas are considered a failure, the individual will be placed on the Army Body Composition Program and have strict regulatory guidance as to how to proceed via the *Army Regulation 600-9: Army body composition program.*

Navy

In the Navy, the Sailors conduct Physical Fitness Assessments (PFA) and Body Composition Assessments (BCA) at a minimum of two times per year. The year is broken down into cycles (January –June, July – December). All PFA's components have to be completed on the same day, and all must receive a "Pass" status. The components of the PFA include Cardio-Respiratory event (Run or Walk, Swim, Elliptical Trainer or Spin Bike), Curl-ups, and Push-ups. The scoring of the events are as follows:

(1) Outstanding: 90-100 points.

(2) Excellent: 75-89 points;

(3) Good: 60 to 74 points;

(4) Satisfactory: 45-59 points; and

(5) Failure: ≤ 44 points.

Sailors must obtain a score of satisfactory or higher for the test to be considered "Pass". The test is broken down by age groups as the other branches are. The groups age brackets are as

follows: 17-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65+ (U.S. Navy, 2011). Sailors can get a medical waiver for the PFA if injuries present themselves, although, if a Sailor goes on a Medical Waiver, two consecutive times, a Medical Evaluation Board will be convened and the Sailor could face discharge.

Marines

Marines have quite a bit more challenging testing compared to the other branches, as they have two tests to conduct; 1. The Physical Fitness Test (PFT) is the first and is designed to determine local muscular endurance and cardiorespiratory endurance. 2. Combat Fitness Test (CFT) is a 300-point test with an emphasis on functional fitness related to operational demands. Males and females will perform all the same exercises, although they are scored differently as well as adjustments for age will be accounted for. In the PFT, the Marines have to conduct Pull-ups, Crunches and a Cardio-respiratory event (3-mile Run, or 5,000meter Row). Adjustments are made if the PFT is conducted at higher elevations (>4,500feet mean sea level). In the CFT Readiness of the individual will be measured, this is done by requiring Marines in battle dress uniform to sprint a timed 880 yards, lift a 30-pound ammunition can overhead from the shoulder until a full lockout has been established, this is done repeatedly for two minutes, and perform a 300-yard shuttle run, this is a maneuver-under-fire event.

As stated, all branches conduct some physical testing to determine fitness in the ranks. With these tests, Soldiers, Sailors, Airmen/women and Marines all have to train and adhere to programs set forth by military regulations, to pass. Service members conduct physical training to prepare for these tests, every branch and also every job within the branches have different schedules, so the training is at different intervals and times. Although looking at the average

across most military installations, the physical training is usually conducted in the early morning between the hours of 0500-0700 hours (also depending on the location). The timing of training plays a massive role like this paper; fad diets such as IF and TRF tend to have individuals in a fasted window when these trainings are conducted. Couple that with the overall lack of caloric intake creating a deficit due to expenditure, this creates a situation that could cause overtraining. An overview from Baker-Fulco (1995) looking at military training from the late 1990s stated service members created an extreme calorie deficit while conducting training, the average deficit was at 1,552kcal. This was an overwhelming 34% of total calorie intake. Overtraining appears to be an issue with tactical athletes creating a limit on their performance increases. Overtraining can occur when special train at high intensities creating these caloric deficits. This could be an issue with popularized training such as High-Intensity Functional Training. Over the next section, a brief overview of new military training being conducted in the Army, as well as popularized training, will be presented. These training styles if not observed and adequately monitored, coupled with nutritional intake, could potentially lead to overtraining states.

Popularized Training and New Directions

Army Combat Fitness Test

In October 2018, the Army rolled out a new fitness testing requirement for their branch known as the Army Combat Fitness Test (ACFT). This new test is based for the sole purpose to determine the capabilities of each Soldier on the battlefield. General Townsend stated;

> "Our nation's greatest assets, our Soldiers, face a dynamic, competitive, and lethal operational environment (OE) that has evolved in recent years, one in which our

adversaries will employ a mix of traditional, unconventional, and hybrid strategies." (CALL, 2018).

With this new test, the strategy is to keep up with the ever-changing demands of modern warfare. The test is designed to take full effect in the year 2020; this is to allow Soldiers adjustment time to the newly added physical demands of the testing. Looking at the test, it has six components and is designed to stress every energy system in the body (anaerobic and aerobic systems). Each test has a specific thought process behind it. The components are as follows;

1.) 3-Repetition Maximum Deadlift (MDL) – This test is designed to test the Muscular strength, balance, and flexibility of the tactical athlete. The analysis is stressed to use a 60lb trap bar, and the beginning of the test requires a minimum 140lb load (60 points) reaching a maximum 340lb load (100 points). The functional movements with the MDL are enabling the tactical athletes to be able to better move heavy loads from the ground such as personnel and equipment. Examples would include extracting another tactical athlete or injured personnel on a litter.
2.) Standing Power Throw (SPT) – The SPT is designed to engage and test the abilities of the tactical athlete's explosive power, balance and flexibility. The test requires a 10lb medicine ball being thrown backwards over the head at a minimum of 4.6 meters (60 points) to a maximum of 13.5 meters (100 points). Functional aspects of this test relatable on the battlefield are instances when throwing items over an obstacle or assisting other tactical athletes over a wall or upon a small roof. The SPT also elevates the potential of body throws if hand to hand combat would arise overseas in a combat scenario.

3.) Hand Release Push-Up (HRP) – HRP's are a similar test from the previous Army Physical Fitness Test (APFT), the only change is the release at the bottom end of the movement. The test is designed to measure local muscular endurance over two minutes with a minimum of 10 repetitions (60 points) and a maximum of 70 repetitions (100 points). HRP's functional capabilities are measured in combat by pushing opponents in battle, quick maneuvers as in three to five-second rushes while under enemy fire and pushing vehicles that may be disabled.

4.) Sprint-Drag-Carry (SDC) – The SDC is designed to measure anaerobic and muscular endurance, agility, as well as muscular strength. The SDC requires two 40lb kettlebells and a 90lb sled. The objective is to conduct 5 x 50-meter(m) shuttles for time. The shuttles begin with a sprint down 25m and return, followed by a drag of the sled running in a backpedaling motion for the same distance. Next, the tactical athlete will laterally shuffle the 25m then carry the two 45lb kettlebells the same length. In the end, the tactical athlete will conduct one more sprint to the finish line. As mentioned this test is for time, with a minimum of 3:35/minutes:seconds (60 points) and a maximum of 1:40/minutes: seconds (100 points). The functional relation of this test is seen in movement under direct fire, as well as carrying and transitioning ammo, and other combat-related items or personnel to and from fighting positions.

5.) The Leg Tuck (LTK) – The LTK measures muscular endurance and strength components of fitness. The required equipment is for the tactical athlete to have a climbing bar (pull-up), and complete as many motions of moving the hips and knees up and down from the straight hanging position to knees touching the elbows. The minimum repetition is one (60 points) and a maximum of 20 repetitions (100 points).

The functional patterns seen with the LTK is moving over obstacles as well as climbing ropes and movements across or up/down specific areas in combat.

6.) Two-Mile Run (2MR) – the 2MR is the only item unchanged from the previous APFT. Although the test did not change, the standards did change regarding the minimums and maximums. The 2MR measures the cardiovascular or aerobic endurance which can be tested on flat ground or an approved running track. The minimum requirement is to score at least a 21:00/minutes/seconds (60 points) and a maximum 12:45/minutes:seconds (100 points). The aerobic capacity of tactical athletes is translated to dismounted missions and ruck marches across battlefields.

The test is scored with no regard to gender as the previous APFT. It was stated from Command Sergeant Major (CSM) Edward Mitchell from the Center for Initial Military Training that "War doesn't distinguish between gender and age….the test will assist in warrior tasks and battle drills no matter who you are"! Although looking at the scores, the test has three classifications of minimal passing related to the military occupational specialties (MOS). These are labeled as Heavy, Significant and Moderate. The Army is currently under review for their current MOS areas of concentrations for the three classifications. Once the analysis is complete the new scores can be seen in the Department of the Army Pamphlet (DA PAM) 611-21 that will be ultimately determined by the physical demand category (CALL, 2018).

Reviewing the components of the test, each tactical athlete will perform actions stressing each of the three energy systems within the aerobic and anaerobic systems. Looking at the energy systems, the anaerobic system includes the Phosphagen as the direct energy pathway providing energy for the short-term high-intensity exercises such as the MDL and SPT

previously discussed. The phosphagen system also involves the anaerobic glycolysis, this phase of energy sustains explosive power over greater periods for a test such as the SPC, HRP, and LTK. Lastly, the body reacts with aerobic glycolysis for the longer duration low-intensity exercises which relate to the sixth and final test within the ACFT, the 2MR. (Gagliardi, 2019 & CALL, 2018).

High-Intensity Functional Training

With the new events being implemented into the testing procedures across the Army, other branches have begun looking into changing their specific test to accommodate their tactical athletes at a better advantage. Losey (2019) stated the Air Force is in the planning stages of developing a new formula that in all hopes will depict an accurate representation of fitness and body composition. Pons (2019) added the Air Force is also adding into regulations a gender-neutral testing protocol for select career fields within the branch.

Although this is in the discussion phase for the air force, it will have effects on how tactical athletes within the units look at their training programs. Looking at the Army, the initial ACFT was beginning its phases of discussion back around 2013-2014 depending on which source you ask. Tactical athletes are bright in finding training programs that will suit their needs. One style of training is High-Intensity Functional Training (HIFT), and in a Military Medicine review, the safety of HIFT was looked at to determine the effectiveness of the programs. Haddock (2016) noted the American College of Sports Medicine (ACSM) labeled high-intensity exercise as one of the leaders in the industry (p.e1508). This seems right as most individuals these days live fast paced lifestyles. One of the most popular across the U.S. is CrossFit, as well as other small Functional Fitness Gyms popping up here and there replicating CrossFit and

additional strength and conditioning methods. Haddock (2016) also stated there are currently close to two-hundred and fifty CrossFit affiliations on military installations as of 2016! This goes to show that the HIFT is reaching higher levels of participation for tactical athletes. Not just CrossFit affiliations are showing up on installations, other areas such as SEALFIT, and the Marine Corps personal High Intense Tactical Training (HITT) are also popping up with higher participation.

The benefits of these training systems has been shown to increase the amount of time the tactical athlete has to conduct other training and away from the training field or gym. Looking at a piece of Haddock's review (2016), a 45-minute was shown resulting in significant fitness improvements on the current APFT. This, over three weeks allowed for two-hundred and twenty-five more minutes of training or personal time for the tactical athletes. It was also shown that 75min/wk of HIFT circuits allowed for improvements on all measures of the Air Force Fitness Test. (pe1509).

Along with the previously stated benefits, Poston (2016) posted that the HIFT stresses both aerobic and anaerobic energy pathways and is vital for balancing and addressing flexibility, speed, agility, power, strength, endurance, and coordination which are all used in the training and combat support roles of the tactical athletes (p.627). As this paper is designed to discuss the effects of training in a fasted state, military populations have to understand the energy requirements associated with exercise, these HIFT programs are designed to stress the body maximally. With stressing the body, the fueling has to be correct or the body will breakdown, and severe injury can occur. Injuries have long been an issue when addressing military populations. Poston (2016) stated that among all injuries in the substandard military fitness and

body composition are consistent injury predictors (p.629). The research review also presented a comparison of current physical readiness training (PRT) in the Army to HIFT, in relation to injury rates seen after that. Looking at Figure 2, Poston (2016) discussed a study by Grier, Canham-Chervak, Mcnulty, & Jones, B. (2013) that presented comparisons of the pre and post-injury rates of different programs. One program was called the Advanced Tactical Athlete Conditioning (ATAC), which was ultimately a HIFT program. The other program was the PRT. Looking at the injury rates, the HIFT programs (N=1,032) had a 41% before the beginning of the program and ultimately leading to a 46% rate at the end. While the Army PRT group (N=340) had a 50% injury rate increasing to a 57% rate after that. The program was set to measure the injury rates six months before beginning the program and six months after the full implementation of the program. Looking at the data in Figure 2, it shows that the injury rates are not increased by physical training preferences alone as both the PRT and HIFT groups had a similar increase. Reading through the rest of Grier et al.'s (2013) research, nothing was noted on the individual tactical athletes' nutritional profile. Questions asked were explicitly related to current training volume, tobacco use, and background within the unit.

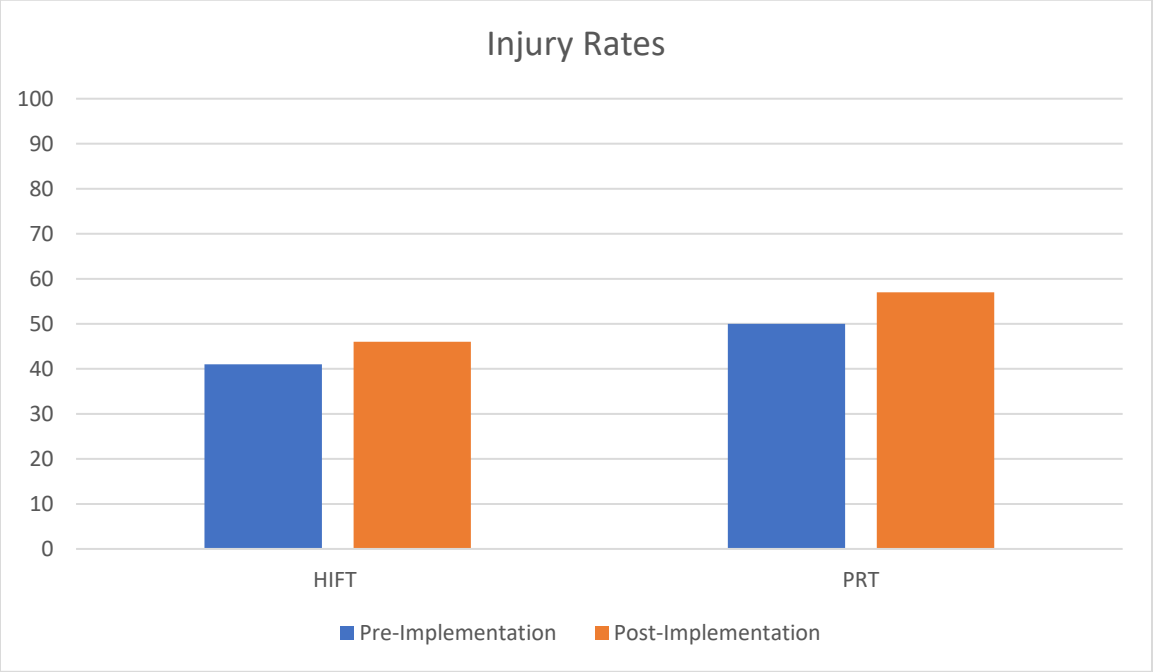

Figure 2. Injury Rates. Adapted from Poston, W.S.C., Haddock, C.K., Heinrich, K.M., Jahnke, S.A., Jitnarin, N., Batchelor, D.B. (2016). Is High-Intensity Functional Training (HIFT)/CrossFit Safe for Military Fitness Training? *Military Medicine. 181.* 7. p.631.

So as shown, all tactical athletes preparing for these tests will have to design training programs that will accommodate their energy needs, this was later shown that HIFT could serve as a method of training that is safe for the tactical athlete. Although looking at how the training is in a high intense state, and nothing was observed in the nutritional aspects related to training a review needs to be completed on how the energy systems fueling affects the body. With tactical athletes training in the early morning hours, an understanding of how the body responds to training in a fasted state is crucial to improvements in performance and body compositing.

Nutritional Methods and Physiological Response

Nutrition largely contributes to the facilitation of the obesity epidemic in military populations, whether it be in the over-consumption or under-consumption roles. Looking at the

timing and methods used with the nutritional intake, these seem to be primarily related to the outcomes in the tactical athlete performance and body composition progress. Many unique factors go against tactical athletes amid their daily duties. An individual task can require them to exert considerable amounts of power, strength, and endurance at any given time, while some of these are combined in the works at hand (Alvar, Sell, & Deuster, 2017, p.70). With power, strength, and endurance being factors that could become crossed at one point or another, tactical athletes have to plan accordingly to the stressors they may face. Although this seems to be the thought process of every tactical athlete, it does not appear this is the case! With body composition being the leading indicator of readiness and the fact military organizations are coming down on service members outside the lines according to regulation, specialized diets are trendy in the military culture. These diets are to allow tactical athletes an approach that is sometimes what is called a "quick fix" or something that seems to be relatively easy to follow.

One such diet noted as Intermittent Fasting (IF), this diet has gained popularity over the years and was thought to be first introduced by Bill Phillips. Phillips (1999) wrote the book "*Body for Life"* where he made this concept famous by stating a twenty-minute workout at high intensities in a fasted state could potentially oxidize fat faster and more efficiently than one hour of cardio postprandial. Original research into the fasted state training dates back to Ahlborg and Felig. In 1976, Ahlborg and Felig designed a study and monitored glucose ingestion over a four-hour window while conducting the cardiovascular exercise. The parameters of the study were to give participants glucose in a specified dosage (200g) at the midpoint of the cardiovascular exercise as well as immediately following the training. The conclusion of the researchers noted the body would use more glucose storage for fuel in the presence of glucose immediately before or during the exercise state. Looking forward many articles and training methods have been

published and or designed to assist strength coaches, personal trainers and health coaches working with tactical athletes in their pursuit to losing stubborn body fat, much like what is needed when dealing with body composition standards in today's military.

Body Composition Responses to Nutritional Methods

Intermittent Fasting (IF) breaks down into many different categories, although the three main categories are: Whole Day Fasting (WDF) where the individual will take one or two days per week and fast for 24 hours, Alternate Day Fasting (ADF) where fasting is conducted every other day (some dieters allow roughly 500kcal on fasting days) and Time-Restricted Feeding (TRF) where the individuals will shift their eating windows to a specific period when food can be consumed. This method usually seen is a 16:8 (Fast:Fed) feeding schedule. One of the most popular at military bases and trending across the world appears to be TRF. With individuals service members seeking alternative ways to get rid of unwanted body fat or the overall weight, special diets like IF appear to be on the rise. In an article by Moro et al. (2016) on time-restricted feeding, the perception is that one of the main distinctions and misinterpretations of IF is that this is not calorie restriction. While calorie restriction is the act of reducing calories by sometimes up to forty percent of individuals daily caloric intake, IF (TRF specifically), like stated earlier is shifting meals to a timeframe that is later in the afternoon to extend the overnight fast.

With this, many tactical athletes performing physical training, do so in the early morning. When shifting the feeding window to the afternoon, this places the physical training session directly in the middle of the fasting cycle. The thought of this is to train in a fasted state, many bodybuilders and other individuals have training protocols like these, to shed unwanted fat. While the focal point should not entirely rely on the specific type diet mentioned here (IF), the

training in a state of fasting should stand highlighted. The thought process behind physical exercise in the fasted state is to maximize fat oxidation. While the bodies primary fuel source is solely dependent on the intensity of the training or state the individual is in, the body can only hold so much muscle and liver glycogen. While an understanding holds strong that muscle glycogen gives the muscles energy to perform a task for the tactical athletes, the liver is usually not so understood at many levels. Once glycogen enters the muscle, it cannot be reversed back into the bloodstream for use by other bodily functions. The liver takes this role in supporting the rest of the body through ongoing metabolism, although looking at the liver, it can only store roughly 75-100g of glycogen for the average individual (Comana, 2016). This amount of glycogen will equate to about 300-400kcal of energy, which looking back on the energy requirements for even the supporting roles this could burn through relatively fast. Overnight the body does not deplete the skeletal glycogen stores, although the liver glycogen slowly diminishes. Looking at the potential lower levels of glycogen stored in the liver the following morning, the body begins to release cortisol slowly. With the release, the body could potentially see a loss of muscle due to the unwanted breakdown occurrence. Also, elevated cortisol has a suppressive effect on the metabolism, if the metabolism is in any state of decline, it will begin to manipulate how the body burns fat, and this could ultimately reduce calories expended throughout the day (Comana, 2016).

While all this happens physiologically, the body does see some progress with composition when training in a fasted state if in the right intensities. According to some of the most recent research, previously noted by Purdom, Kravitz, Dokladny, and Mermier (2018) maximal fat oxidation occurs between roughly 47% and 75% of the individuals VO_{2max}, although this is according to the individual state of fitness as to the actual range. This was merely an

observation of their study. Looking at earlier research from Horwitz et al. (1997) followed six through different training intensities while the examination primarily focused on fat oxidation. The six participants conducted four training sessions, all on separate occasions. Each trial set was for two hours of continuous cycling at different intensities. The first FED state training had cyclists train at 25% of the individuals peak oxygen consumption, and the second trial was set to an intensity of 68% of the individuals peak oxygen consumption. This exercise protocol set was for both the fasted state training and the FED trials. In the FED states, the cyclist was fed at different intervals (30,60,90 minute markers). With the low-intensity groups, lipolysis showed suppressed markers in the FED state compared to that of the fasting groups, with fat oxidation progression being similar up to 80-90 minutes of training in all groups. Once the cyclist reached the 80-90-minute mark, the fat oxidation rates were shown to occur more in the fasted groups. With this study, the ingestion of carbohydrates seems to be quite an issue if being ingested before exercise, and this is due to the suppression of lipolysis while the activity was occurring. Body fat loss could potentially arise if trained in a lower intensity while in a fasted state. Although once higher intensities reached are noted, and the individual has fasted, performance declines could become present.

In the previous study, the rates of fat oxidation were presented positively in the thought process of fasted training. Looking forward, Schoenfeld et al. (2014), set out a four-week training program designed to measure body composition in non-obese, previously physically active women, between the ages 18-35. The structure of fat-free mass and fat mass showed comparisons at the beginning and end of this four-week training program where young women followed a hypocaloric diet. The internal variables of the study were broken down to two groups; one as a fasted group (n=10) and the other being post-prandial (n=10). The fasted training

conducted sixty minutes of continuous cardiovascular exercise after the overnight fast. The sessions were performed three times per week for the duration of the study. The post-prandial group executed the same sequence of training, and the only difference was the ingestion of a meal immediately before the exercise. The instruction executed as a warmup (Intensity=50%) for five minutes, training session (Intensity=70%) for fifty minutes and a cooldown (Intensity=50%) for five minutes, for a total of sixty minutes.

Dietary protocols placed were on all participants, and all were expected to adhere to their caloric requirements set forth. When tracking their intake, the FASTED group consumed 1236 ± 177kcals, and the FED consumed 1277 ± 137kcals. A dietary protein initially set was at 1.8g/kg; this was based on their total body mass. Fats then were set to 25%-30% of the remaining calories based off resting metabolic rate requirements, with carbohydrates acquiring the remaining balance. On exercise days, the two groups were to consume a meal replacement shake, the FASTED group ingested theirs immediately following training, while the FED group ingested theirs immediately before the training. The results of the four-week study concluded a significant weight loss change (P=0.0005) as well as a notable change in fat mass (P=0.02) in both groups participating. With between groups analysis, there were no differences noted that suggest fasting before training was conducive to a change in body composition. Ultimately showing diets in a hypocaloric state with cardiovascular exercise over the four weeks produced similar results in post-prandial and FASTED conditions.

As one can see, body composition seems to vary from study to study, although it appears to have lots to do with the intensity of the training that plays a role in the body composition and the experience levels of the individuals being trained. While it also seems to be a topic mostly

followed, tactical athletes have to worry about one scenario above all else; Performance! The tactical athlete has to be able to perform under pressure and fight when faced with enemy fire. As body composition is a central focal point sometimes, performance gets sat to the side, although if the individual does not focus on both, the PT test could begin to decline and ultimately hinder the overall mission readiness.

Performance Responses to Nutritional Methods

Like previously stated, performance is the key to mission success; it has to be, at least maintained while attempting to lose body fat. Looking at the research Aird, Davies & Carson (2018) discussed findings of athletes training in a FED versus Fasted state had different responses. Exercising in a FED state enhance performance that lasted over 60 minutes in duration (p.15). This correlation seems to be reasonably crucial for tactical athletes as their training programs usually run at a minimum of 60 minutes for the average session and up to four hours if tactical field marches are on the schedule. Galloway, Lott, & Toulouse (2014) noted on feeding windows before exercise. Their study had subjects ingest a carbohydrate and electrolyte solution 30 and 120 minutes before high-intensity training. The capacity of the athletes was much more notable if the ingestion was at the 30-minute mark rather than the placebo or the 120-minute groups. It goes to show, with feedings before exercise whether it be a long duration (>60minutes) or High-Intensity Training (<60minutes) the performance and capacity of activity are more excellent compared to the fasting state. Not only does this improve performance, but it also assists in the fat burning potential through the rest of the day.

When discussing after exercise effects on performance, a study designed to investigate cardiovascular exercise and how to post consumption of protein effects fat oxidation rates were

published. Gieske et al. (2018) monitored individuals in a FED state rather than a FASTED state while using solutions in four categories. The solutions were to be ingested before exercise, and the groups included 25g each of either maltodextrin (MA), whey protein (WP), casein protein (CA) or that of a control group with no calories in their solution. For the study, researchers found eleven males all college-aged, and all had received medical clearance for testing purposes. Also, they were instructed to not drink any more than 300mg of caffeine per day during the testing and refrain from using any style of supplements. With most studies in this lane, fat oxidation is the key focal point. Although Gieske et al. (2018) aimed for measuring resting energy expenditure at the before, during and after states of the training. A post-hoc comparison explained that the comparisons of the three readings within the groups had a change following the WP showing an increase of 3.41±1.63kcal/kg and in the CA with an increase of 3.39±0.82kcal/kg. Of expenditure. These results yielded significant findings (P=0.05) in that compared to the other two groups, MA and the control. (1.57±0.99kcal/kg & 2.00±1.91kcal/kg)

While looking at the performance setting of the individuals being tested, none of their performance showed an actual increase. Although looking at Devries, Oikawa & Phillips (2017), it is noted protein ingestions before resistance training increases strength and power output. The only drawback is that it takes the body an acclimation period for this to occur and the body to be able to adapt to the ingestion and usage of the fuels. Further providing input that FED training could potentially enhance the rate of fat burning properties through the rest of the day from Gieske et al., as well as increase strength and power in the long term by Devries et al. This overall would give tactical athletes the edge in combating the obesity epidemic the military is facing now by allowing for more lean muscle mass, which is known to assist in the fat oxidation rates in the overall 24hour period. This not only assists in the fat oxidation rates, but it will also

assist in overall mission success, this is mentioned earlier as an overall goal of the forces of our United States military.

In conclusion of section four, looking at tactical training, these athletes have to be able to perform while losing adequate amounts of body fat to remain within the military standards set forth. No matter the training programs, tactical athletes have to be able to adjust to the stressors placed on them. Looking at individuals following specialized diets, this could pose higher resistance in their journeys to a healthier lifestyle with falling under the regulatory guidance. While Soldiers are looking for enhancements in their lives, it sometimes takes a structured plan to put in place for them to follow. Guidelines are already set forth from the Center for Disease and Control (CDC) and other organizations, although not all tactical athletes are built the same. This problem proves an educational overview of how the body responds with all energy systems in and out of a fasted state is warranted to provide guidance for all and to encourage these athletes to take charge with nutrition and exercise before being in harm's way or being potentially chaptered out of the military.

Discussion

It has been well documented thus far that training and testing in tactical athletes is a significant part of their careers. The growth of the body composition and obesity rates across the board in tactical populations has been shown to be increasing, as well as the musculoskeletal injury rates associated with obesity at accession into service. All service members have specific occupations; with those specialties no matter the specifications of duty, testing remains the same for the majority of the tactical athletes. The part of this that always seem to appear different heavily weighs on three areas: 1. Military Occupation Stressors (how the body is stressed metabolically

in their duty day), 2. Physical Training conducted at the unit and individual level, and lastly 3. Nutritional Methods, these being undertaken to maintain or improve the performance of the individual. In all these, it appears to fall back to one area that any tactical athlete wants to avoid and that is obesity! Obesity has been stated by Lewis (2019) to directly affect the readiness of the force by inadequate amounts of recruits joining, as well as the current tactical athlete's ability to adhere to the standards of service already set forth (p.123).

With obesity being a huge factor that negatively affects the readiness of the force, programming of nutritional aspects, physical training and sleep, as discussed earlier, should be implemented at unit levels to allow adherence to the individual progression of tactical athletes. Looking at tactical athletes, an understanding of how bioenergetics play a role in the body and how the fueling system goes hand in hand for performance improvements is vital. One branch of the military, The Army, has a plethora of useful information being brought out via Army Wellness Centers (AWC), Performance Triad (P3), and a newly organized group the Holistic Health and Fitness (H2F). These groups have great programs for use in the military and are accessible for all tactical athletes and family members. Even though these groups exist, areas still need covered in the field of performance nutrition and exercise with the everyday tactical athletes facing obesity in front of them.

While these groups such as the AWC's performing task such as Fitness Testing, Metabolic Analysis, Body Composition testing, and teaching healthy nutrition classes (Omar, Ford, Hartzell, & Hoover, 2018) nothing in the form of performance nutrition is educated on unless it is within individual appointments. The inclusion of educational materials at the unit level discussing the forces of body reactions with bioenergetics and training in a fasted state, as

well as how to properly fuel their body before exercise and combat-related tasks; is much needed to give tactical athletes an advantage in combating obesity.

The Project

The overall intent of this project is to provide an educational overview for tactical athletes no matter their status. This is to ensure the smooth and safe delivery of accurate information flow to the tactical athletes, and this is so training programs from the individual to the unit can be designed without complications and hindrance to anyone when attempting to reach their health and fitness goals. Looking back, three areas within the individual tactical athlete need addressing: 1. Individualized Nutrition Needs, 2. Bioenergetics and Fuel Usage, and 3. Metabolic Flexibility and Nutritional Periodization.

Understanding Nutritional Needs

First, every individual has specific jobs that stress the body. To fully understand the individual's body type and how they burn calories through the day, an excellent place to start is with their resting metabolic rate (RMR), which is part of the daily energy expenditure. Individualization with body composition, gender activities being performed throughout the day, external conditions and the tactical athlete's age are all factors that affect the RMR. There are multiple calculations to gain this number, although using more updated and scientific approaches such as a Metabolic Analysis by a FitMate Med via Army Wellness Centers (Omar, Ford, Hartzell, & Hoover, 2018) can serve to get the most accurate measurement of the number for tactical athletes. If this is not available, using the Harris-Benedict Equation to measure Basal Energy Expenditure (BEE) (Table 8) can serve as an excellent tool for estimation.

Table 8.

Harris Benedict Equation: BEE basal energy expenditure

Men	BEE = 66.5 + 13.75 x Weight (kg) + 5.003 x Height (cm) – 6.775 x Age
Women	BEE = 655.1 + 9.563 x kg + 1.850 x cm – 4.676 x Age

Note. BEE basal energy expenditure. Alvar, B.A., Sell, K., Deuster, P.A. (2017). NSCA's Essentials of Strength and Conditioning. *National Strength and Conditioning Association. Human Kinetics.* Champaign IL. p.72.

When using the FitMate or other equations, it is vital for the individual to gain an estimation of the tactical athlete's physical activity. This is discussed as four areas ranging from sedentary, low active, active and very active (Alvar et al. 2018). Each has its own factor that plays a part in the FitMate calculations. The understanding of physical activity and lifestyle characteristics is related mainly to how the individual expends energy through the day. With tactical athletes wanting to always be on the verge of increasing performance, the understanding of the total energy expenditure is crucial to their energy intake programming. This way tactical athletes can prepare for the road ahead per se, and develop performance foods for the operational tasks in their training and combat-related missions.

The first step in the equation is always to understand the athlete and to be able to find an adequate number of calories for the individual to intake. This is vital in the role of losing and gaining weight for the athlete. While this seems like a great place for athletes to begin, there are many more factors that go into the design of programming, that are laid out behind the scenes. It is also vital as to gain a baseline understanding of the energy required to balance out their day, as tactical scenarios run long; this way adequate energy intake is obtained. The next area tactical athletes need to understand is the bioenergetic mechanisms and contributions of anaerobic and aerobic actions.

Bioenergetics and Fuel Usage

Looking at the energy pathways in the human body, Haff (2016) notes that efficient and productive programs for training tactical athletes must be designed with the focus on the understanding of how energy is made available, according to specific types of exercise and how energy transfer can be modified or altered to work for and or against the individual training. The body works with three systems, Phosphagen Glycolysis and Oxidative (Haff, 2016, p.44). The two most common terms relating to these systems are anaerobic (without Oxygen) and aerobic (with Oxygen) processes. These energy systems entirely focus on the production of Adenosine Triphosphate (ATP). ATP is the primary fuel source that transfers energy between the pathways of Endergonic (Anabolic) and Exergonic (Catabolic) processes inside the body. The metabolism is the end result of the endergonic and exergonic reactions and goes to show the importance of understanding the nutritional needs of the individual as if one wants to change their body composition by either growing muscle or losing weight. The connection has to be made of how much is being expended and how much needs are taken in (Haff et al. 2016 & Alvar et al. 2017). This number becomes essential when determining the macronutrients composition within the diets. It is also imperative to understand the expenditure versus intake when deciding if fad diets are right for the individual.

Exercise sessions in the military last anywhere from 30 minutes to 60 minutes like programming, as far as the actual training is concerned an overview of a basic Army PRT session is outlined in Appendix One. Within these training sessions, each style of training such as explosive power, high-intensity intermittent training or long intensity steady state training can be seen. Each of these intensities has a primary energy system used for the events. Looking ta the

new training system the Army is implementing, specific exercises were mentioned earlier along with their associated primary energy systems. To fully understand the energy systems, one must fully break down the five components (Phosphagen, Fast Glycolysis, Slow Glycolysis, Oxidations of Carbohydrates and Oxidations of Fats and Proteins), which is an extension of the three main energy systems (Haff, 2016).

Phosphagen and Fast Glycolysis. In the phosphagen and fast glycolysis systems, the exercise activities are usually high in intensity as well as lasting only up to about six seconds in duration for the initial phosphagen and up to 30 seconds for the fast glycolysis. Examples of these systems include; Maximum Repetition Deadlifts, Squats, Power Cleans and other maximum lifts in combat scenarios such as throws in hand to hand combat or assisting individuals on a roof or over a wall in the initial phase being the phosphagen system. In the fast glycolysis side of the system, this can be seen as a 100-meter sprint or 5-10 repetitions in weight training. In this system, the rate of ATP production compared to the others is the fastest, but its capacity is the least (Haff, 2016, p.54). With the capacity being the least other forms of exercise are warranted to produce great results and storage potential of ATP for later use.

Slow Glycolysis. In the slow glycolysis phase of training, the energy requirements are from the 30-second mark until the two-minute marker. These intensity rates as high on the scale and has a rate in the middle of the chain for APT production and capacity. Examples of this would include a 400-meter dash, and litter carries that require long movements out of harm's way and movement under direct fire (Haff, 2016, p.54-55).

Oxidative (Carbohydrates, Proteins, and Fats). The last is the oxidative system, and this energy system requires low to moderate intensities, has the slowest rate of ATP production,

although with the longer duration of the exercise the capacity of ATP will fill more as the exercise will produce more over a given period. The use of all energy systems is required for optimal training.

Once the training individuals conduct daily is briefly looked over, professionals can assist in determining the activity factor and discuss the methods for training according to the caloric intake, as well as basing the training of the carbohydrate and fat fueling according to exercise modes. These two factors give trainers, and other professionals a basis of how the individual should proceed (Haff, 2016, p.54-55). A brief overview of Fueling is required to fully bridge the gap and wrap all the parts together to assist the individual training of the tactical athlete fully.

Fueling for each energy system is based off the maximum heart rate and training zones associated with each. Looking back on the previous three energy systems, the phosphagen system being high intensities will increase the heart rate at rapid rates, it will also need proper fueling to accommodate for the energy used. With the moderate to low activities such as the glycolytic energy system and the oxidative energy system, the body will need proper calories for the fueling process. According to Birrer, O'Connor, and Kane (2016) the body has specific energy requirements for fuel based on heart rate training zones. Looking at individuals that are training in high intensities such as HIFT and other popularized training programs currently trending, these individuals' bodies will be primarily fueled on Carbohydrates. With the low-intensity training such as marathon running the body primarily fuels off fats. This is due to the percentage of max heart rate for the individual. Looking at Figure 3. *Carbohydrate and Fat usage at specific percentages.,* it is shown at what rates the individual transfers from fats to

carbohydrates during an exercise session. The stored glycogen plays a significant role in this process.

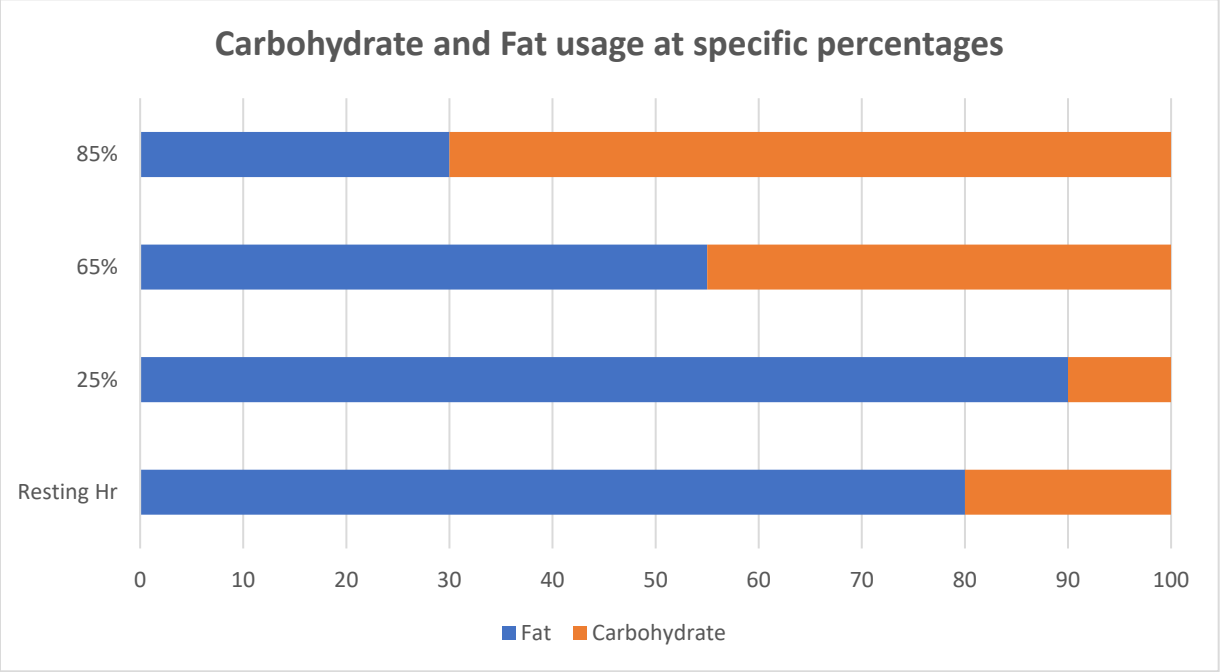

Figure 3. *Carbohydrate and Fat usage at specific percentages. Adapted from,* Birrer, R., O'Connor, F.B., and Kane, S. (2016). Musculoskeletal and Sports Medicine for the Primary Care Practitioner. *Sports Nutrition and the Athlete*. Taylor and Francis Group.

The process of stored glycogen being used relies on the amounts of ingested carbohydrates. Looking back on specialized diets as Intermittent Fasting (IF), and explicitly speaking of popularized diets in the military such as Time-Restricted Feeding (TRF) could significantly impact the stored glycogen levels depending on the training time and the number of calories ingested. Bridging the gap between the diets and training statuses presented earlier in the review of literature, it is easily put together that the individuals that place themselves on a restricted diet while also performing high levels of intense training can easily not have enough readily available carbohydrates for the task at hand. Kersick (2017) discussed when prolonged exercise (> 60 – 90

min) of moderate to high intensity occurs in tactical athletes, the high intensity being anywhere from 65% to 80% of the individuals VO2max; the body will begin to rely heavily upon carbohydrate stores in the form of glycogen. Haff (2016) mentions that the body can only facilitate 300g to 400g of glycogen to be stored in the skeletal muscle, and upwards of 100g for available storage in the liver (p.57). The facilitation of timing meals can genuinely assist in this area. Although when TRF is the key factor in the tactical athlete's diet, timing cannot be reached appropriately, thus, limiting the ability to reach any goals the individual wants to achieve. While there are studies out there that note fat mass (FM) can be lost with TRF and resistance training such as Moro et al. (2016) this study conducted the training from 4:00 – 6:00 PM, directly in the middle of the feeding zone of the 16:8 (Fast:Fed) TRF cycle. While this study produced significant results, the study did not show a comparison to the military side, as these tactical athletes have to train in the mornings with their units. Some tactical athletes have the luxury of training on their own as previously discussed, although for the majority and those primarily targeted for this project such as individuals labeled as obese or over body fat, they have to adhere to the training standards set forth for them with the branch of service, as well as the timing of training. It should also be noted that performance can take a hit due to the fasted training, this was concluded by Burke and King (2012) because skeletal muscle glycogen was noted to be impaired and fueling before exercise was lacking.

The key takes away from fueling the body is the comparison of specific diets as it relates to the overall goal the individual has. To combine the brief discussion of nutritional needs, bioenergetics, and fuel usage, this would be the optimal discussion when programming for tactical athletes. An understanding has to be made at the unit and individual level in all military branches to be able to assist the tactical athletes in their journey. Looking forward, metabolic

flexibility, based on tactical athletes daily lives and expenditure levels previously discussed is a program that needs addressing in the military. This would generate a greater understanding of how to properly fuel the body and ultimately lose weight while increasing performance over time.

Nutritional Periodization and Metabolic Flexibility

When discussing the role of nutritional periodization and metabolic flexibility, it has been stated from Weller (2016) that an understanding of adaptability and flexibility has to be noted from the tactical athlete. This way the individual can begin to learn how to adjust his or her fuel usage to the appropriate point by previous training adaptations (p.22). When the term metabolic flexibility comes up most do not understand the concept of the discussion, Goodpastor and Sparks (2017) described this as the ability of individuals such as tactical athletes to adapt to changes in their metabolic or energy demands. (p.1). This concept appears vital in the area of tactical training, as the tactical athlete will have many different stressors placed on them. Understanding how to properly allow their body to make this switch could assist them in times where they are following special diets. Thus far in the project, IF and TRF have been presented as something tactical athletes should shy away from. While this is a thought, if individuals have not had specific training on how to properly adjust their diet accordingly, the individual may result in decreased performance. So, this is saying that IF and TRF may not be a bad thing if properly conducted with timing and intensities! Although for this style diet to work the individual tactical athlete has to understand his or her time management and be able to schedule their days according to the training the units of the tactical athletes have in their future.

With these fad diets, there are good examples laid out as to when it may be a good idea to use them. In the military, training and combat are never consistent; this is to keep the tactical athletes on their toes as well as the prevent stagnation in the units. Incorporating new and improved training programs is a job in its self in the military. So, why not think outside the box and randomize training while coupling nutrition to receive the best effect? So far it has been shown that the body composition does not improve with high intensities in a fasted state (Horwitz et al., 1997). It has also been shown that feeding before training, as well as the intensity of training effects the Excess Post-exercise Oxygen Consumption (EPOC). It is creating a longer duration of fat burning potential throughout the day (Gieske et al. 2018 & Haff, 2016). Haff (2016) discussed EPOC to be an invaluable item with training that sometimes gets overlooked. This phenomenon, EPOC, is thought of as basically returning the body to a pre-exercise state by replenishing the body with oxygen, resynthesizing ATP and increasing temperature, circulation and ventilation (p.58). EPOC is triggered by an oxygen deficit whether by low-intensity steady state training or in a high-intensity state.

EPOC is valuable for tactical athletes to understand, as when training is conducted, it is crucial that it is performed at the appropriate intensities for the state the body is in. Weller (2016) discussed that with metabolic flexibility and nutritional periodization individuals have to train at lower intensities while fasted, compared to; if the tactical athlete is in the postprandial state, they can train at higher intensities (p.25). This is stating that the nutritional intake has to be relative to the timing of training to increase the rate of performance. This is also seen in athletes that participate in Ramadan fasting, Burke, (2010) discussed exercise intensity and duration have to be in relation to any nutritional programming that trainers and athletes set forth. Also, athletes have to be aware of the last meal before the fasting session if they are following the diet and this

meal must be rich in carbohydrates (p.506). Schoenfeld et al. (2014) noted from their study, that body composition noticed no change while either fasted or fed. So, the focus should be placed on performance aspects of their training, and this will eventually equate to a more considerable amount of intensity an individual can produce and overall will elevate the EPOC fat burning potential after that (Haff, 2016), as well as could over time increase their RMR, resulting in more calories burned daily. This would greatly aid the tactical athletes facing body composition programs that are in place by the military branches.

To conclude and wrap the methods together, if tactical athletes understand their nutritional needs, it will assist them in deciding on how many calories to take in throughout the day. With the dietary intake specified for each, this will allow the individual to determine if any fad diets would assist based on the nutritional requirements that are involved in the diet. Lastly, the tactical athlete can use the previous method to determine their intensity or vice versa; if the intensity of exercise and training is already specified, the individual can adjust their calories timing schedule based off the energy system required and intensity associated. So this allows the individual to use the bioenergetics framework and their nutritional intake as a guide to how they will use metabolic flexibility to apply periodization to their programming.

Conclusion

In conclusion, tactical athletes have a fast-paced lifestyle that requires much needed full-time attention on specific aspects of their training. With this, the tactical athlete has to make wise decisions when dealing with his or her nutrition and training as it relates to decreasing body composition and improving performance. This paper concludes that all research questions were answered through reviews and other research presented: Fasted training at low intensities does

improve body composition, while fasted training at high intensities does not directly improve body composition. Performance is not increased with fasted training at high intensities, and lastly, tactical athletes can perform fasted training, although high and low intensities must be varied to accommodate the energy intake for best results. Tactical athletes need a training program that is sustainable and allows for them to enhance their abilities within their programs laid out in the review. These questions provide a framework for future research on total tactical athlete performance improvements associated with alternating nutritional periodization and physical training. It is vital to the tactical athletes to understand the body, how the energy systems work, how to properly feed the body and how sleep and stress truly affect body composition and performance. This paper focused more on the nutritional and physical aspects, although it should not disregard the importance of sleep and stress as it relates to overall fitness. As stated previously, body composition has and will always be a significant factor in how the military assesses its members. Tactical athletes must understand how to properly train and consume foods to maximize their performance. Once this basic understanding is obtained, individuals can progress at much more rapid rates compared to those meddling in diets and training programs with little to no information about the overall effects.

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Appendix

In this appendix, a sample outline of the U.S. Armys' Physical training program will be outlined for an average week for individuals using FM 7-22., (Table 9).

Table 9. Weekly Physical Training Guidance, FM 7-22

Monday	PD, HSD, MMD1, RD
Tuesday	PD, 4C, CD1, CL1, PSD, RD
Wednesday	PD, HSD, MMD1, 30:60's, RD
Thursday	PD, 4C, PSD, RD
Friday	PD, HSD, MMD1, AGR, RD
Saturday	PD, 4C, CD1, CL1, PSD, RD

Note. PD – Preparation Drill, RD – Recovery Drill, PSD – PU/SU Drill, FM – Foot March, STC – Strength Training Circuit, 4C – Four for the Core, CD – Conditioning Drill SR – Shuttle Run, RR – Release Run, HSD – Hip Stability Drill CL – Climbing Drill, AGR – Ability Group Run TR – Terrain Run.