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An Exploratory Study of Military Management Practices, Physical activity, and the Prevalence of Shin Splints in ROTC Cadets

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ABSTRACT

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Medial Tibial Stress Syndrome (MTSS, Shin splints) is very common in military personnel accounting for up to 35% of incidences, which is almost twice the incidence seen in the average active individual. Each year there is in increase number of injuries in Army recruits. Though Army Reserve Officer Training Corps (ROTC) programs are known for commissioning approximately 60% of 2nd Lieutenants and 40% of generals on active Army duty, no research has been done examining MTSS occurrences in relation to military management practices. Therefore, the purpose of this study is to explore the relationship between military management practices and the prevalence of shin splints in Army ROTC cadets. The study consisted of 63 Army ROTC cadets. The data was explored by addressing frequencies, descriptive statistics, crosstabs and correlations of the data. MTSS incidences had a significant relationship with days missed, endurance training, ROTC classification and ROTC club participation.

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DEDICATION

To my parents for always believing in me and teaching me that the sky is the limit.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Every year an increased number of military recruits sustain injuries during their training. Due to the increase of injuries, the government spends around $31,000 per recruit a year on surgeries, and medical treatment (Bornstein et al., 2018; Niebuhr, Powers, Li, & Millikan, 2015). The injuries sustained during training have been "characterized as the most significant medical impediment to military readiness" (Bornstein et al., 2018, p. 5; Hauret, Jones, Bullock, Canham-Chervak, & Canada, 2010). Injuries can be caused by a variety of conditions such as age, gender, height, weight and Body Mass Index (BMI) just to name a few (Starkey & Brown, 2015; Yang et al., 2012). However, when looking at military populations such as Army Reserve Officers' Training, these injuries can be caused by mismanagement from the physical fitness council and military leaders.

The sport medicine field, in conjunction with coaches and administrative staff, researches and theorizes about mismanagement in sport leading to injuries (Courson et al., 2014). Each year, approximately 209,000 injuries occur in individuals from universities across the country (Courson et al., 2014). In order to help prevent these injuries, a mutual understanding and responsibility for sports safety is contingent on the cooperation of athletic trainers, coaches, participants, and all others associated with the team. Communication between all parties is essential to ensuring that injuries are managed and treated correctly. However, management decisions can also affect activity-related injuries, such as facility maintenance (Mccall, Fanchini, & Coutts, 2017). In particular for the military, management decisions have played a key role in Physical Training for recruits (Bornstein et al., 2018). By exploring this topic from a

management perspective, researchers can continue to build the bridge between management and medicine for the benefit of participants, including military recruits.

Though sport management and sport medicine are separate disciplines, it is necessary to explore their relationship to ensure quality care for those in the military. While the sport medicine field researches sport injury prevention, and the sport management field researches the management of teams and sport-related organizations , there is a disconnect between the two (Pedersen & Thibault, 2014; Starkey & Brown, 2015). This is especially true in physical activity and fitness management in the armed forces. When dealing with the armed forces, most military leaders are fixated on having high passing rates rather than proper management of injuries. Though management practices may be different, comparing sport medicine and those in the military, the armed forces participate in physical activity beyond the nature seen in sports. However, despite being within the realm of physical activity and management, the broadly defined sport management literature neglects this area, with few exceptions (Hong, 2012). Therefore, it is imperative that these two disciplines work together to improve the physical welfare of those in the armed forces.

Armed forces management literature focuses their research on statistics, building better soldiers and preparing them for battle (Knapik & East, 2014).The top priority is to ensure soldiers will be ready when going out into combat, not on their physical well-being. Whereas, sport medicine injury literature has found that in order for someone to perform to the best of their ability they must be in good shape and injury free (Psaila & Ranson, 2017). The management of physical activity in the armed forces preparation programs, with its primary goal of combat-ready individuals, could benefit from a sport management and medicine perspective. Application of that research may improve injury rates.

There is one key issue in application of current sport management and medicine research to armed forces physical activity management. The day to day functioning of the armed forces is starkly different than most sport research settings. The physical fitness council and military leaders are tasked with ensuring that all recruits meet the minimum standard needed for things such as the physical fitness test, swim test and other required fitness activities. This desire for minimum requirements fails to address physical well-being, something more commonly addressed in sport settings by trainers and coaches (Starkey & Brown, 2015). These military leaders neglect to consider that this push for meeting these minimum standards can affect the number of injured personnel. In fact, the reason behind why fitness tests are administered has not changed for 100 years (Knapik & East, 2014). In 1920, the Chairman of the Athletic Division of Commission of Training Camp Activities described the physical fitness test as a way to "motivate physical training, provide commanders with an evaluation of physical capability of soldiers, and examine the effectiveness of fitness programs" (Raycroft, 1920, pp. 142–143). In the list of reasons, Raycroft neglects to discuss the physical well-being of cadets/soldiers. This gap between army minimum standards and the importance of keeping the body safe can lead to continued increase of injuries.

Injuries can be classified as either acute or chronic. Compared to acute injuries that occur immediately, chronic injuries are commonly seen due to overuse or repetition of activities. Chronic injuries are often directly related to the management of physical activities. These injuries are most commonly seen due to a repetitive stressor such as running or other similar physical activity (Chéron, Le Scanff, & Leboeuf-Yde, 2017). Individuals who are involved in repetitious activities daily, such as army personnel, have a greater occurrence of overuse injuries. For individuals looking to join the military, ROTC programs were created in order to provide

leadership skills and military training needed at universities across the country (Scott, Simon, Van Der Pol, & Docherty, 2015). However, unlike in many sport programs, the physical activity is not shaped by the coach or other team-specific professional but directed uniformly across all ROTC programs. Thus, any management changes to reduce overuse injuries, truly are management issues.

For the purposes of this study, one specific overuse injury was considered. While analyzing all overuse injuries would help the armed forces reduce their cost per cadet, Medial Tibial Stress Syndrome (MTSS, Shin splints) is one of the most common in military personnel only second to sprains (Andersen, Grimshaw, Kelso, & Bentley, 2016; Hamstra-Wright, Bliven, & Bay, 2015). MTSS accounts for up to 35% of incidences, which is almost twice the incidence rate for the average individual (Hamstra-Wright et al., 2015; Winkelmann, Anderson, Games, & Eberman, 2016). Due to limited theoretical development of military ROTC practices and physical activity, the purpose of this study was to explore ROTC military practices, recruit activity, and the prevalence of shin splints. The study considered military practices such as frequency of physical training, club involvement, exercises type and exercise volume, within the context of an ROTC program.

CHAPTER 2

LITERATURE REVIEW

Injuries in the military have increased immensely over the past few years, costing the government billions of dollars (Bornstein et al., 2018; Niebuhr et al., 2015). Due to this, various actions have been made by military upper management to help resolve the issue. In February, the Department of Defense issued a new policy to remove service members who have been non-deployable for more than 12 months for a variety of factors including injuries (Cronk, 2018). However, these leaders have not examined how service members could be non-deployable due to injuries related to military training. Injuries can be caused by many factors, all of which would prevent combat readiness. One of the most common injuries seen in military personnel is medial tibial stress syndrome (MTSS), an overuse injury accounting for 13.6% of incidences in active individuals (Hamstra-Wright et al., 2015). Acute injuries are uncontrollable injuries which happen instantaneously, contrarily, overuse injuries occur over time and can be controlled if caught early. Many studies have investigated uncontrollable factors such as terrain, foot shape, body mass index and body structure; however, there is limited research into how certain management practices such as physical training (PT), running volume, and required exercises relate to the prevalence of MTSS in Army ROTC cadets. The following literature will expand upon common practices seen in the military, research MTSS and overuse injuries, examine common injuries seen in the military, including MTSS and the gaps in the literature constituting completion of this study.

Military Practices

Military practices can have a substantial influence on injuries sustained by soldiers. Distinctive practices vary across branches; however, the goal remains the same, which is to prepare service members for combat. This training can be seen in the traditional Army ROTC (AROTC) programs. AROTC programs first began in 1916 with the National Defense Act was signed by President Woodrow Wilson. During World War I, it was important to properly train soldiers in order to build leaders and prepare cadets to enlist in the military. AROTC programs house more than 20,000 cadets. Approximately 60% of 2nd Lieutenants on active Army duty come from these programs (Scott et al., 2015). Almost 40% of Generals seen in the Army were commissioned through the ROTC programs (Scott et al., 2015). In order to build these leaders for the physical burden of combat, ROTC programs consist of a series of rigorous exercises and drills. At times, this training can be physically demanding in order to ensure readiness when entering the field. In the average ROTC program, cadets participate in physical training, ruck marching, an endurance activity involving carrying weight in a ruck sack over a specific distance, and field training (Scott et al., 2015). Physical training consists of things such as endurance runs, conditioning drills, agility and strength training. Ruck marching is done to help simulate combat situations, along with field training incorporating activities such as land navigation, rope bridges, repelling and patrolling. Additionally, AROTC programs require cadets to take an Army Physical Fitness Test (APFT) which includes a two-minute push up test, a two-minute sit up test and a timed two-mile run which is based on both age and gender. Collectively, AROTC training can lead to an increase of injuries in service members (Scott et al., 2015).

Injuries sustained during initial military training (IMT) have had a considerable impact on the United States Army, accounting for more than 80% of medical discharges among first

year recruits (Molloy, Feltwell, Scott, & Niebuhr, 2012; Niebuhr et al., 2015). Due to this high discharge rate, injuries sustained during IMT have been identified as the most significant medical impediment to military readiness (Molloy et al., 2012). A study by Molloy et al. (2012), analyzed the various injuries and interventions used precisely for recruits heading to basic training. The researchers discovered overuse injuries account for 70-80% of the occurrences seen with IMT. While reviewing physical fitness trends and injury risk factors, the goal was to provide an argument for reconstructing pre-enlistment fitness screenings and fitness programs for those who do not meet requirements. The authors researched physical attributes such as aerobic endurance, muscle endurance, body composition, flexibility, mobility and balance. Out of all the attributes listed, low fitness levels had the greatest association with overuse injuries seen. The military answered these statistics with the Army Physical Readiness Program, a system designed to prepare the body before strenuous activity; however, injury rates have not changed for those with low fitness levels (Molloy et al., 2012). The authors did not address potential management issues related to military practices and how those could improve injury rates, such as within ROTC programming.

Training regimes play a significant role, both positively and negatively, in injury rates and injury types. It is believed to be difficult to find a balance between physical requirements and staying healthy or uninjured (Bos, Kuijer, & Frings-Dresen, 2002; Warr, Heumann, Dodd, Swan, & Alvar, 2012; Wyss, Roos, Hofstetter, Frey, & Ma¨der, 2014). Therefore, a study by Wyss et al. (2014) investigated PT patterns and incidences of injuries. Patterns such as training load, activity type and duration, monotony (no change in physical demands) and periodization are considered to play a role in the incidence of injuries. The study consisted of 1,676 army recruits from 12 different Swiss training schools and focused on rescue and infantry techniques.

Technology has allowed researches to track certain changes in the body, therefore body sensors were worn to check heart rate accelerations associated with fatigue, rest and overexertion, all extreme measures in the body which could lead to injury. The results of the study, saw approximately 54% of recruits visited the medical center at least once during their time at training due to an injury of some kind. Of these visits to the medical center, 36% were overuse injuries. Additionally, increased distance on foot, low monotony, and fewer rest periods were the leading risk factors when looking at injuries (Wyss et al., 2014). It is unknown if these results can be generalized to Army ROTC recruits, due the differing management structures of Swiss training schools and US university-based ROTC programs.

Military practices can include a variation of activities such as running and ruck marching. Ruck marching is an endurance activity "common to military basic training allowing soldiers to be adequately prepared to carry equipment needed for missions" (Poel, 2016, p. 2). This can add great stress to the body and increase the number of injuries seen in military personnel. As a result of ruck marching being identified as the 2nd leading cause of injury to infantry soldiers, Schuh-Renner et al. (2017) completed a study addressing the incidences of injuries seen with ruck marching. The authors examined ruck marching in relation to physical training and the risk factors associated with increased mileage during rucking. It can be seen that 23% of all injuries reported were associated with running. Additionally, the average participant reported rucking 5 times a month, carrying up to 44 pounds over 7.4 miles per session. Individuals who engage in ruck marching, are identified as having a high prevalence of injuries compared to those who do not (Schuh-Renner et al., 2017). This opens the door for future research to look at specific injuries such as MTSS.

In a similar study, Mala, Szivak & Kraemer (2015) examined ways to help improve performance of carrying heavy loads during high intensity combat-related task. They found that ruck marching, like many other combat situations, requires muscular strength and aerobic endurance, so it is vital for training focus to on these aspects (Mala, Szivak, & Kraemer, 2015). The importance of this can be seen in tasks such as using hand grenades, moving under fire and performing combative missions all while carrying a heavy load. This poses a problem because most physical training still only emphasizes strength and power as seen in the traditional APFT, verses focusing on all elements needed for combat, which can lead to an increased number of soldiers not being physically ready for combat (Mala et al., 2015).

Military practices encompass a wide array of activities, and each activity can have both a positive or negative effect on the body. The studies above have looked at the relationship of training factors and injuries in Army soldiers. However, no studies have looked at these factors in relation to AROTC cadets, despite their importance in training future military leaders.

Chronic Injuries

A chronic injury is defined as a "repeated micro-trauma, no single identifiable cause, gradual onset and one in which activity exceeds tissue tolerance" (Chéron et al., 2017, p. 2). Medial Tibial Stress Syndrome (MTSS) is one of the most frequently reported injuries in active individuals accounting for up to 13.6% of injuries in runners (Hamstra-Wright et al., 2015; Lopes, Hespanhol, Yeung, & Costa, 2012). MTSS is an exercise-induced injury which causes a tender and painful area in the distal two-third of the posterior medial edge of tibia; the pain is relieved with rest, but it reappears with exercise (Sobhani et al., 2015). In the past, the signs and symptoms of MTSS have been clearly defined, however the cause of the injury still remains

unknown. Previous research linked factors such as BMI, height, weight, ankle range of motion and hip movement as risk factors of MTSS (Hamstra-Wright et al., 2015; Psaila & Ranson, 2017). While it is beneficial for researchers to consider many different potential factors influencing MTSS rates, a focus on activity programming may benefit managers in physical activity programming, such as the military ROTC programs, hoping to change their participants' injury rate.

Chéron et al., (2017) examined different injury occurrences in relation to participants involvement in a specific sport or activity. During the study, the most common sites for overuse injuries were the knee, tibia (shin bone), thigh and the groin. Additionally, injuries such as shin splints and stress fractures were more common in young adults, which is a similar population seen with Army ROTC programs. These injuries can commonly be caused by the activities done in these sports and programs (Chéron et al., 2017). In sports, the training techniques and activity individuals participate in can affect the type of injuries they experience. However, no further research was done into how these specific sports correlated to the injuries sustained.

In order to find the difference between overuse injuries at diverse levels, Roos et al. (2017) analyzed the different overuse injuries among both high school and collegiate sports. The study consisted of 3,569 overuse injuries in college athletes and 3168 in high school athletes. The most common injury occurrence was seen with non-contact running sports, such as an ROTC program. Participants reported 70% of injuries occurring in the lower body, 20% of those were in the lower leg/shin with 5.6% of those specifically from shin splints (Roos et al., 2015). It is important to look at how different injuries can be sustained based on contrasting levels of activities such as seen in the high school verses the collegiate setting. While the results of this study are important when looking at overuse injuries in sports, due to the fact that these same

injuries were not examined in ROTC populations, knowing how an ROTC participant would be affected is unknown.

When looking at the existence of overuse injuries, research indicates training elements are a significant cause of these injuries. Ristolainen et al. (2014) examined training related risk factors for overuse injuries in endurance sports. The researchers measured factors such as training volume, intensity, how long the subjects have been training, and information about their rest periods which can play an extensive role in overuse injuries. Regarding overuse injuries, the amount of rest days the athlete had was a direct correlation to the occurrence of overuse injuries. Additionally, the most common injury site was the shin accounting for 24.7% of injuries seen. Winters, Veldt, Bakker, and Moen (2013) did a similar study directed at intrinsic factors commonly seen with MTSS. The aim of the study was to properly identify risk factors, to initiate a future prevention protocol. They inspected aspects such as hip internal rotation and external rotation, ankle plantarflexion and dorsiflexion, and maximum calf girth just to name a few. The most closely associated variables to MTSS were reduced hip abduction, ankle plantarflexion and increased subtalar eversion (Winters et al., 2013). In the above literature, MTSS is a commonly seen overuse injury for active individuals. Though it is important to know what inherent factors are associated with overuse injuries and specifically MTSS, most of these factors are non-controllable and vary across each person. However, for managers, focusing on controllable variables is fundamental to organizational change, including reducing overuse injuries in AROTC cadets. By analyzing management practices, such as frequency of PT or miles run, it can be easier for military physical activity managers (i.e. ROTC Cadre) to modify these factors in order to reduce and eventually prevent overuse injuries such as MTSS from occurring.

In the sports medicine literature, researches have acknowledged many risk factors associated with MTSS and overuse injuries. Many non-controllable elements have a great influence on the incidence of these injuries seen across both sport and recreation activity. Although, many risk factors are taken into account, many do not take into account what can be controlled from a management standpoint.

Injuries in the Military

Military service members have an increased risk of injuries due to the demands placed on them in both training and combat. Injuries in the military account for 1.8 million medical visits, affecting more than 800,000 service personnel per year (Jones, Canham-Chervak, & Sleet, 2010). As a result, military personnel have used approximately 25 million limited duty days because of injuries. When dealing with military personnel, it is important to not only decrease the number of injuries, but to also decrease the amount of days missed because of these injuries. Focusing on this steady increase of injuries, it is vital to analyze what training practices could have been avoided if proper management practices were used.

Musculoskeletal injuries in service personnel is growing each year, causing a threat to combat readiness. Many of the injuries seen in service personnel are a direct result of physical training (Cameron & Owens, 2014; Copley, Burnham, Shim, & Kemp, 2010; Lauder, Baker, Smith, & Lincoln, 2000). Comparing musculoskeletal injuries between the general population and military personnel shows a system in which both management and sports medicine research can work together (Cameron & Owens, 2014). Looking at both management and sports medicine elements open doors for better treatment and prevention of injuries. This article reviews musculoskeletal injuries within military population and how the sports medicine model can be

used to help care for these injuries. When comparing sport medicine and military injuries, it is vital to look at various attributes and how they relate to factors such as physical training or military deployment. Although training practices and occurrences may be different, injuries in military members are similar to those seen in the traditional sports medicine setting. Therefore, when looking at injuries in service personnel, it is vital to incorporate sports medicine in the process. For years, military practices have been handled with the primary goal to prepare individuals for combat. However, in doing so, there is little consideration for the physical wellbeing of service personnel. Cameron and Owens (2014) concluded it would be beneficial to incorporate the sports medicine model into military training. By integrating this model, military management can find a way to ensure readiness of all personnel, while keeping them physically healthy.

Basic military training is a demanding process with the goal of preparing service personnel for combat (Leggat & Smith, 2007). Each year new medical advances are made, yet the amount of injuries seen continues to increase. During basic training, 26% of recruits drop out due to inability to cope because of injuries (Psaila & Ranson, 2017). Psaila and Ranson (2017) explored injury prevention strategies in an attempt to reduce injury risk and premature discharge rates. The study was designed to determine if there were certain factors which allowed them to diagnose injuries early to prevent soldiers from chronic or reoccurring injuries. The authors specifically examined lower leg ankle and foot injuries looking at things such as failure to process through training, trainee wastage and financial burdens. Psaila and Ranson (2017) conducted an initial medical screening which consisted of body mass index, foot posture, fitness level, foot and ankle ability measurement and a list of additional generic medical questions. In the results, out of the 45 injuries reported, 35 of those were some sort of injury to the lower leg,

ankle or foot. Out of these reported injuries, the most commonly seen injury was MTSS. However, out of all the risk factors studied, the only one that aligned with the proposed hypothesis was fitness level, indicating rates of increased injuries for those who are not physically fit. (Psaila & Ranson, 2017). Basic military training is a core place for injuries in military service personnel. Examining the factors in which these injuries occur can be valuable to decreasing injury occurrences. An earlier section reviewed Cameron and Owens' (2014) study on injuries in the military compared to those seen in sports medicine. Though completely different studies, they both show the relevance of sport medicine and management disciplines working together. Knowing the risk factors associated with military injuries and knowing how these factors correlate to the general population shows great promise to preventing the increase of injuries seen in the military.

Army ROTC cadets account for the largest number of soldiers commissioned in the US Army. Over 40% of army generals and 60% lieutenants come from an ROTC program (Scott et al., 2015). During training, strength and endurance are stressed; however, this emphasis can lead to a wide variety of injuries. Though injuries can occur in a range of areas, 37%-87% of injuries occur in the lower extremity (Heir & Glomsaker, 1996; Scott et al., 2015). To test this theory, Scott et al. (2015), attempted to identify the risk factors associated with lower extremity injuries in ROTC cadets. The authors examined different activities they believed contributed to injuries, such as ROTC year, PT scores, BMI, sex, previous injury, boots and frequency. The cadets were categorized into to the year in which they were in the program such as MS1 for freshmen and MS4 for seniors. Out of the 195 cadets in the study, 41 sustained a lower extremity injury during training. Of these injuries, there was a maximum of 120 days missed from training. The participant's year in the program and PT exposures had the greatest effect on injuries. The

first-year cadets were more likely to see injury than the 4th year cadet. In this study, Scott et al. (2015) analyzed many factors, most of which cannot be changed. However, the results show that PT exposure (frequency), a variable which can be changed, was one of the most significant factors seen with injuries. Therefore, further research is needed to explore these changeable factors.

Discharge rates due to injuries have continued to increase over the last few years (Swedler, Knapik, Williams, Grier, & Jones, 2011). In 2007, about 4% of recruits were discharged from basic training, costing the army up to $57 million in lost (Swedler et al., 2011). Several factors have been associated with decreased military readiness; however, training injuries are one of the most common (Knapik et al., 2001; Pope, Herbert, Kirwan, & Graham, 1999; Reis, Trone, Macera, & Rauh, 2007; Snoddy & Henderson, 1994; Swedler et al., 2011). Despite classification, training injuries can be seen among all subgroups. Schwartz, Libenson, Astman & Haim (2014) identified the occurrence and types of orthopedic injuries seen in infantry and non-infantry units. The aim of the study was to help reduce injuries and loss training time. The study consisted of 18,651 soldiers (11,242 infantry and 7,904 non-infantry). Of these soldiers, 641 (379 infantry and 262 non-infantry) were discharged due to medical reasons, with orthopedic injuries accounting for 43% of those discharged Additionally, 90% of these injuries reported were overuse injuries (Schwartz et al., 2014). This study shows great similarities to ROTC club involvement in the current study. The aim is to look at smaller subgroups with the same purpose, but different training techniques, to see how specific injuries correlate.

Researchers have attributed many factors to the occurrence of injuries in military personnel. Many have addressed ways to prevent injuries all together, however, most methods are unrealistic. The intrinsic factors studied addressed individual issues, however, they do not

address management issues. Therefore, further research should be elicited to look at specific military practices and the occurrence of specific military injuries.

MTSS in the Military

Entering military training, such as basic military training and Army ROTC programs, the nature of physical stress placed on the lower leg increases leading to a higher risk of injuries (Sobhani et al., 2015; Winkelmann et al., 2016). There are many injuries seen in military populations; however, 20% of injuries are found in the lower leg (Roos et al., 2015). Medial Tibial Stress Syndrome (MTSS) is common in military persons, accounting for up 35% of incidences, which is almost twice the occurrence rate for the average active individual (Hamstra-Wright et al., 2015; Winkelmann et al., 2016). There are many factors related to MTSS in service personnel. For example, Hamstra-Wright et al. (2015), concluded that individuals with a high BMI, navicular drop (measure of arch height), and ankle plantarflexion were more likely to have MTSS. The lower leg is made to sustain only a certain amount of stress, and when it reaches its limits injuries such as MTSS can occur. Interventions to address these injuries can be made, however addressing training techniques and practices could be equally, if not more effective to addressing these injuries.

When looking at MTSS, intrinsic and extrinsic factors play a major role of occurrences. Additionally, when looking at the association between fitness level, smoking habits, foot pressure and the existence of MTSS, 7.9% of service personnel had incidences of MTSS (Sharma, Golby, Greeves, & Spears, 2011). The researchers found increased tobacco use decreased physical fitness, therefore leading to greater incidences of injuries. Additionally, low fitness levels were typically seen in novice individuals entering programs for the first time such

as seen in basic military training and 1st year ROTC cadets. Because a majority of ROTC programs include novice individuals who are new to physical activity, it is critical to examine these occurrences of MTSS in ROTC populations

Medial Tibial Stress Syndrome has a high occurrence in military personnel (Hamstra-Wright et al., 2015). It has been shown to cause issues with combat readiness, missed participation days, finances and discharge of members. Yet little research has been done from military management to address this issue. Though sport management and sport medicine literature have separate goals, working cohesively will hopefully result in a decrease in injuries. Research studies have shown MTSS as one of the most common injuries seen in active individuals (Moen et al., 2012). It also shows military persons having twice the occurrence rate of active individuals when looking at MTSS (Hamstra-Wright et al., 2015; Winkelmann et al., 2016). Yet, few studies have researched MTSS explicitly in military personnel. In the sports medicine literature, researchers have considered the many factors which can potentially cause MTSS. However, reframing the issue as a management issue, the focus can narrow in on programming decisions made by military personnel. These factors include frequency, intensity and types of exercises. Additionally, most studies have investigated enlisted military populations, but few have investigated Army ROTC programs, despite their importance in developing future military leaders. Due to limited theoretical development of military ROTC practices and physical activity, the purpose of this study was to explore ROTC military practices, recruit activity, and the prevalence of shin splints.

CHAPTER 3

METHODS

Due to the mismanagement of injuries, the government spends almost $31,000 a year per military recruit on things such as surgeries and other medical treatment (Bornstein et al., 2018). One of the most common injuries seen is MTSS, accounting for up to 35% of injury incidences in military personnel (Hamstra-Wright et al., 2015). In order to focus on this issue, the current study explored the relationship between military management practices and MTSS. The study used a self-reporting survey that asked questions about physical training and related factors such as exercise type and exercise volume.

Participants and Procedures

After getting approval from the East Tennessee State University Institutional Review Board, participants were recruited. Participants of the study consists of ROTC cadets at a southeast public university. All students in the study were volunteers. Subjects ranged in age from 18-35 years old, and the mean age was 20 years old. In order to be considered for the study, participants had to be at least 18 years old, enrolled in the university and enrolled in the ROTC physical training class. Additionally, participants were either prior enlisted in the United States Army or were getting contracted at the completion of the program.

This is an exploratory, hypothesis generating study. A survey was used to investigate ROTC military practices, recruit activities and MTSS injury rates. In order to avoid biases of completing the survey because of working with researcher daily, the survey was sent to participants from the department executive aid. An example of the email sent out is shown in

Appendix A. The email included an explanation of the study, informed consent form (Appendix B), and the google forms link for access to the survey. Participants were assured that all responses would be confidential, and submissions would be anonymous. The subjects were given three weeks to respond to the survey, after which it would be closed. The survey had a return rate of 92% with 58 participants responding to the survey in its entirety.

Measures and Variables

Due to the exploratory nature of the current study, all variables were considered. Variables were used to explore potential differences and identify potential hypotheses related to injury rates among ROTC participants. Due to this being an exploratory study, variables were not separated and were therefore examined overall related to MTSS occurrences.

School year and ROTC level. In the ROTC program, MS (Military Science) level refers to the level in which cadets are in the program. MS1 refers to the first year in the program and MS4 refers to the fourth year in the program. In traditional ROTC programs, aside from students who decide to enroll late after their freshmen year, the MS class is a direct reflection of the year in which the cadet is in their education. Scott, Simon, Van Der Pol, & Docherty (2015) saw that the younger the cadet was in the ROTC program, the more likely they were to sustain an injury. Due to this it was important to know both classifications of school year and ROTC level. Two multiple choice questions were asked in which participants were to pick the choice most closely related to their classification. School year was categorized as 1=freshmen; 2=sophomore;3= junior; 4=senior; 5=graduate student. MS class categorized as 1=MS1; 2=MS2; 3=MS3 and 4=MS4.

Pain scale. To better understand the pain participants felt during MTSS injuries, the Numerical Rating Scale was used. This method is widely used in medical settings due to its familiarity and easy administration (Hjermstad et al., 2011). Participants were asked to rate pain on a scale of 1-10 with 1 being "not bad at all" and 10 being "the worst pain you've ever felt" (1=1; 2=3; 3=4; 4=5; 5=6; 6=7; 7=8; 8=9; and 9=10). When injured, people tend to catastrophize pain, therefore, this scale gives a baseline understanding of the severity of pain actually felt (Sullivan, Tripp, Rodgers, & Stanish, 2000).

ROTC and Club involvement. Club involvement is a key part of any Army ROTC program. Army ROTC programs can be found at universities across the country, with clubs that allow cadets to engage in areas of interest outside of required physical training. Every university varies; however, most programs have a run club, a rifle club and a ranger club. Along with required ROTC activities, researchers and practitioners interested in reducing injury rates should take into account the multitude of ROTC activities in which a cadet can be involved.. The first question was a binary yes or no question asking about club involvement with 0= no and 1=yes. It was followed by a select all that apply question to choose all, if any, ROTC clubs involved in. The options were 1=run club; 2=ranger challenge; 3= pershing rifles or 4=n/a. These were combined to add an additional variable, number of clubs involved in, which was simply counted frequency.

Exercise type. In 2010, the Army updated the Physical Readiness training guide, which documents types of exercises programs could incorporate in physical training (Appendix C). It includes a list of exercises and programs to incorporate into physical training. This question consisted of a 'select all that apply' question, which listed different types of exercises done based

on the manual. The options were categorized as 1=running/endurance; 2=abs; 3=climbing; 4=rucking; 5=weights; 6=agility; 7=circuit; 8=pushups/sit-up drills; 9=warmup; and 10=strength.

Physical Training frequency. The frequency, or the number of times per week involving physical activity, can be a major factor in injuries sustained. Scott et al. (2015) found the more military personnel are involved in Physical Training (PT), the greater likelihood of sustaining injuries. Therefore, frequency of Physical Training was included in this study. This question involved a single select multiple choice question listing how many times they participated in PT a week. Participants were asked to choose a level of frequency (0 times per week; 1-2 times per week, 2-3 times per week, 4-5 times per week, +5 times per week).

Resistance and endurance training frequency. To get an idea of the ratio in which participants engage in resistance training verses endurance training, these frequencies were included in the study. The Army PRT Handbook illustrates a breakdown of the frequency of resistance training and endurance training based on the time of year and the phase in which they are in training (United states Army, 2010, pp. 51–57). The question was based off the 7 days in the week. The answers scaled off both the average 3 days of PT per week for PT and the additional days for any involvement in ROTC clubs. The measures were 1=0; 2=1-2; 3=2-3; 4=4-5 and 5=5+.

Number of miles inside and outside of PT. Researchers have found that a key factor related to military injuries was running. Soldiers who ran 3 times or more a week and more than 4 miles per session have a higher incidence of injuries (Schuh-Renner et al., 2017). Examining how many miles are run during PT in relation to other activities done poses as a vital element when considering MTSS occurrences. Furthermore, though all outside factors cannot be accounted for, it is essential to take into consideration outside running activities, which could

also relate to MTSS. The question consisted of a drop-down option ranging from 1 mile to a total of 12 miles per week.

Medial Tibial Stress Syndrome. For the purposes of the study, participants were asked about previous MTSS injuries, as well as current. They were asked about history of MTSS to take into consideration their previous injury history. The questions were measured in binary form where options were categorized as 0=no, 1=yes or 3=n/a for MTSS before ROTC and 0=no, 1=yes or 3=n/a for MTSS since joining ROTC.

Participation and days missed. The most significant cause of soldiers not being ready for combat are injuries sustained during training (Cameron & Owens, 2014). These injuries can further lead to lead to missed training days preventing soldiers from being ready. Therefore, it is vital to consider at missed days by cadets. The participation question was binary, which elicited a "yes" or "no" answer inquiring if the condition ever prevented participation. It was followed by a carry forward question of the amount of days missed. The options ranged from 1 day to 30+ days missed.

Demographic Variables

Demographic variables were also considered, specifically age, gender and race. Age has been researched in relation to injuries sustained, however, it was contingent on experience level and not based on actual years (Scott et al., 2015). Some evidence has shown that women have a higher injury rate, however this was not investigated in patients with MTSS. Additionally, being that 77.2% of participants were white males, these variables were not examined at in relation to MTSS.

Data Analysis

Exploratory or non-hypothesis generating studies are created to discover elements with no theoretical ideas and no definite expected results (Waters, 2007). This type of research is commonly used to have a more thorough understanding of a subject with little research before attempting to qualify the data. As previously addressed, though there is general research on injury trends in military populations, little research has been done explicitly examining AROTC military management practices and MTSS. Due to the unique nature of ROTC programs in the United States, yet important to military readiness, exploration into overuse injuries and military management could provide testable hypotheses that will help reduce injuries. MTSS was the focus of this study simply due to its prevalence and to limit survey length. Therefore, an exploratory design was used for the purpose of better understanding these two variables. This design was used to further define issues, problem areas, areas of interest and explore patterns of associations that could be used for future research.

The variables being explored include ROTC club, club participation, pain scale, school year, ROTC level, frequency of physical training, frequency of endurance training, frequency of resistance training, days missed, miles inside PT, miles outside PT, exercise type, participation, presence of MTSS and MTSS since ROTC. Due to the nature of this study, data was analyzed by addressing frequencies, descriptive statistics, crosstabs and correlations of the data. Data is expressed in percentages and mean variations. The relationship between variables were accessed and determined by using Statistical Package for the Social Sciences (SPSS) software.

CHAPTER 4
RESULTS

Data from the survey was transferred to a Google drive excel sheet in order to categorize each response. In order to ensure correct transference, both the prime investigator and faculty advisor reviewed responses and compared for consistency. Due to limited theoretical development of military ROTC practices and physical activity, the purpose of this study was to explore ROTC military practices, recruit activity, and occurrences of medial tibial stress syndrome (MTSS). Participants in the study consisted of members of an Army ROTC program at a Southeast university. Out of the 63 cadets in the program, 58 of them completed the survey. The study consisted of 78.9% male participants and 21.1% female participants. The participants' ages ranged from 18-35 with the mean age being 20 years old (SD = 3.068). Of the participants, 31.6% were from the MS1 class, 21.1% from the MS2 class, 24.6% from the MS3 class and 22.8% from the MS4 class. Reviewing club participation, 71.9% of subjects were involved in at least one ROTC club with 41.1% in run club, 30.4% in ranger challenge and 28.6% in pershing rifles. As depicted in Table 1, most cadets participated in at least one ROTC sponsored club. Additionally, when looking at miles ran inside and outside PT, though both categories have a maximum amount of 12 miles ran per week, the averages differed. The average amount of miles ran inside PT was 7.22, whereas the average amount of miles ran outside PT was 3.55.

MTSS occurrences varied across each category, specifically when exploring the occurrence of MTSS before and after participating in ROTC activities. Of the 58 participants in the study, 56.1% of the participants have an incidence of MTSS since joining the ROTC program. Of those participants, 54% of those cases have had a previous occurrence of MTSS prior to joining the ROTC program.

Table 1
Descriptive Data of ROTC Cadets

	Mean	Std. Deviation	N
What year are you in school?	2.53	1.241	57
Club Participation Total	.97	.794	58
Running/endurance	.72	.451	58
Ruck marching	.41	.497	58
Weightlifting	.31	.467	58
Circuit training	.28	.451	58
Warmup/cooldown	.53	.503	58
Times/Wk. PT	2.98	.935	57
ResistTrain/Wk	1.70	.925	57
EndurTrain/Wk	2.20	.980	56
Miles/Wk in PT	7.22	2.492	58
Miles/Wk outside PT	3.55	2.969	58
Days Missed	.65	.991	57
Gender?	1.21	.411	57
How old are you?	20.69	3.068	58
What is your race?	1.58	1.238	57
Shin Splints ROTC	.6154	.49125	52

MTSS occurrences

Table 2 takes a magnified look at the MTSS occurrence across MS (ROTC classification) class. The highest occurrence of MTSS came from the MS3 class with 19.2%, followed by the MS1 class with 15.7% of incidences. Likewise, these are the largest represented classes in the ROTC program. Of the classes, the lowest occurrence of MTSS is seen with MS2 cadets with 8.7% of incidences.

Table 2
Medial Tibial Stress Syndrome Occurrences Across Classes

MS1	**MS2**	**MS3**	**MS4**
15.7%	8.7%	19.2%	12.2%

Overall days missed

Table 3 is based on the total number of days missed due to MTSS. Previous statistics has shown that 56.1% of participants suffered from MTSS. However, the maximum amount of days

missed was only 4 days, which only occurred in 1.7% of the population. Furthermore, 61.4% of participants with MTSS did not miss any days at all.

Table 3
Frequency of Days Missed

Number of days	Frequency	Percent
0	35	60.3%
1	12	20.7%
2	6	10.3%
3	3	5.2%
4	1	1.7%
Total	57	98.3%

Frequencies

Club frequencies

The breakdown of total club involvement is depicted in Table 4. Run club has the highest participation total with 48.3% of cadets. Comparing the two groups, there is a big gap between run club and ranger challenge participants. Interestingly, there are more individuals not involved in any club than those seen in ranger challenge and pershing rifles.

Table 4
Club Participation Frequency

ROTC Club	Frequency	Percent
0	17	29.3%
1	28	48.3%
2	11	19.0%
3	2	3.4%
Total	58	100%

Endurance training frequency

Endurance training such as running, and ruck marching activities varied. Despite attending PT three times a week, 27.6% of cadets do not participate in any endurance training.

Table 5 illustrated that fewer cadets are involved in endurance training as the frequency increases with only 10.3% pf cadets involved after 4 days a week.

Table 5
Frequency of Endurance Training Per Week

Category of days	Frequency	Percent
1	16	27.6%
2	19	32.8%
3	15	25.9%
4	6	10.3%
Total	56	96.6%

To get a better representation of endurance training, Table 6 shows a breakdown of how many miles were ran inside ROTC. Most cadets ran an average of 6-8 miles per week. There were some outliers who ran more miles than the average cadets reaching up to 12 miles per week and others only running 3 miles per week.

Table 6
Frequency of Miles Ran inside PT

Number of miles	Frequency	Percent
3	2	3.4%
4	6	10.3%
5	9	15.5%
6	8	13.8%
7	8	13.8%
8	8	13.8%
9	6	10.3%
10	5	8.6%
12	6	10.3%
Total	58	100%

Cross Tabulations

MTSS and club participation

Table 7 is based on percentages of MTSS occurrences based on both club membership and MS year. Percentage occurrences are based only on the number of total members in the club.

Run club had a total of 23 members, ranger challenge had a total of 17 members and the no participation group had 15 members. Out of the 3 groups, MS3 cadets had the highest occurrence of MTSS followed by MS1. These are also the largest group of participants with MS3 have 24.6% of cadets and MS1 having 31.6% of cadets. A chi-square test was performed and no relationship was found between MTSS and Ranger challenge participation, $X2$ (3, N = 63) = 4.35, p =.226. A chi-square test was performed and no relationship was found between MTSS and run club participation, $X2$ (3, N = 63) = .332, p =.954.

Table 7
Cross Tabulation MTSS and Club Participation

ROTC club	MS1	MS2	MS3
Run club	13%	8.6%	17.3%
Ranger Challenge	11.7%	5.8%	35.2%
No participation	20%	6.6%	13.3%

MTSS and Overall participation

Those involved in clubs and those who were not involved in clubs had substantial differences in MTSS occurrences. Figure 1 shows these differences in MTSS incidences by both club participation (being a part of a ROTC or not) and ROTC classification. When examining across classes, all of the MTSS occurrences doubled in numbers. However, when highlighting the MS3 class, this number of occurrences quadrupled. Once again across all classes, MS2 cadets still have the lowest occurrence of MTSS. A chi-square test was performed and no relationship was found between MTSS and overall participation, $X2$ (3, N = 63) = 1.33, p =.72.

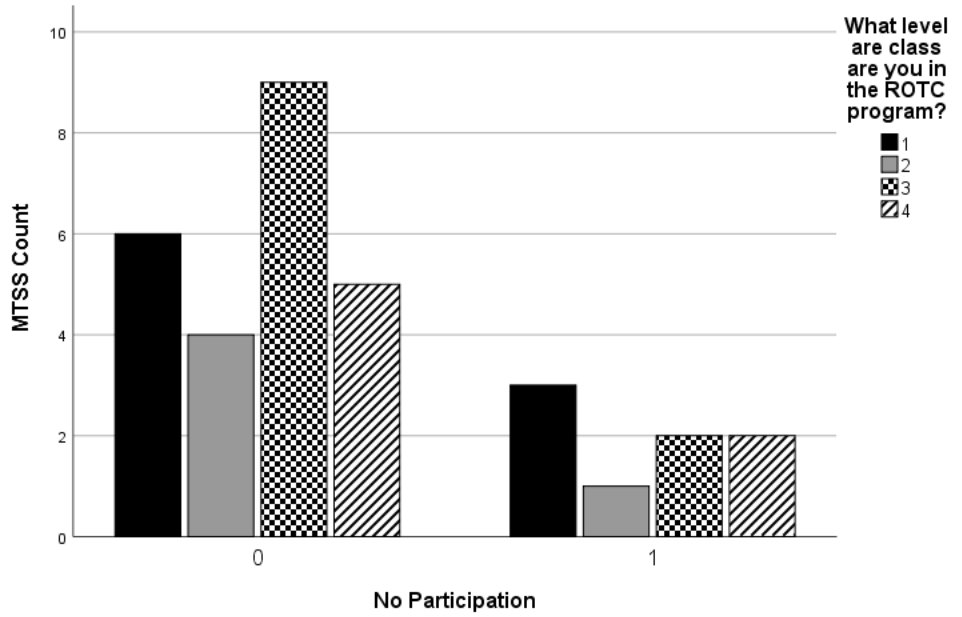

Figure 1. MTSS occurrences based on participation in ROTC clubs and non-ROTC club participation.

MTSS based on PT frequency and ROTC classification

Table 8 examines the occurrence of MTSS based on PT frequency and ROTC classification. Comparing individuals with and without MTSS, MS3 cadets had the biggest jump in incidences. Those with MTSS had occurrences that were 5 times higher than those who did not have MTSS. Additionally, MS3 cadets show higher numbers of participants having MTSS than those who did not have MTSS. However, most MTSS incidences only occurred in MS3 cadets who participated in PT more than 4 days per week. When comparing cadets who have MTSS and those who do not, the frequency of PT was higher in those with MTSS. A chi-square test was performed and no relationship was found between MTSS based on PT frequency and ROTC classification , $X2$ (9, $N = 63$) = 10.21, p =.334.

Table 8

Cross Tabulation MTSS and Frequency of PT Based on ROTC Classification

		Frequency of PT per week				
MTSS	Class	1	2	3	4	Total
0	1	1	2	2	1	6
	2	1	2	1	2	6
	3	0	0	0	2	2
	4	1	0	2	3	6
Total		**3**	**4**	**5**	**8**	**20**
1	1	0	3	6	0	9
	2	0	0	3	2	5
	3	0	1	5	5	11
	4	0	3	1	3	7
Total		**7**	**15**	**10**	**11**	**32**

Correlations

Correlation data in shown in Table 9 for days missed and MTSS since joining ROTC in relation to all other variables. When focusing on days missed, there is a slight positive correlation between the number of miles run outside ($r = .189$, $p < .01$). However, there are negative correlations between days missed and warmup/cool down($r = -.327$, $p < .001$), weightlifting ($r = -.295$, $p < .001$) and circuit training($r = -.294$, $p < .001$) respectively. There are multiple variables that stand out with MTSS occurrences since joining ROTC. First, there is a moderate correlation visible with the frequency of endurance training completed throughout the week. There was also a positive correlation seen with the completion of endurance activities during PT ($r = 0.233$, $p < .01$). There were some negative correlations seen with miles inside PT ($r = -.189$, $p < .001$), circuit training ($r = -.082$, $p < .001$), and weightlifting ($r = -.0$

Table 9
Correlation Matrix

		Running/ endurance	Miles/Wk Inside	Weights	Circuit	Warmup cooldown	PT Freq.	Resist.	Endurance	Miles/Wk outside PT
Days Missed	*Pearson Correlation*	-.051	-1.44	**-.295**	**-.294**	**-.327**	.013	-.116	-.079	**.189**
	Sig. (2-tailed)	.705	.284	.026	.027	.013	.926	.389	.560	.160
	N	57	57	57	57	57	57	57	56	57
MTSS ROTC	*Pearson Correlation*	**.233**	**-.189**	**-.006**	**-.072**	.092	.106	.038	**.308**	.058
	Sig. (2-tailed)	.096	.190	.964	.610	.517	.454	.791	.028	.683
	N	52	52	52	52	52	52	52	51	52

*. Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the .01 level (2-tailed).

Sub Groups

This section takes a closer view just participants who have MTSS. Figure 2 illustrates the occurrence of MTSS based on PT frequency. When considering the 56.1% of participants that had MTSS, 46.9% of this group participated in PT 4-5 times per week. However, when surveying cadets who participate in PT 5+ times per week, they have slightly lower incidences. MTSS occurrences doubled when cadets went from 2-3 days to 4-5 days per week. Figure 3 looks at the overall occurrence of MTSS based on ROTC clubs. The figure is based only on the participants who have had MTSS since joining the ROTC program. Run Club has the highest rate of MTSS with 40.6% of occurrences. Showing only a slight difference in ranger challenge with 34.3% of MTSS occurrences. There is then only a small difference between ranger challenge MTSS occurrences and those seen in both pershing riffles and those who do not participate in any ROTC clubs.

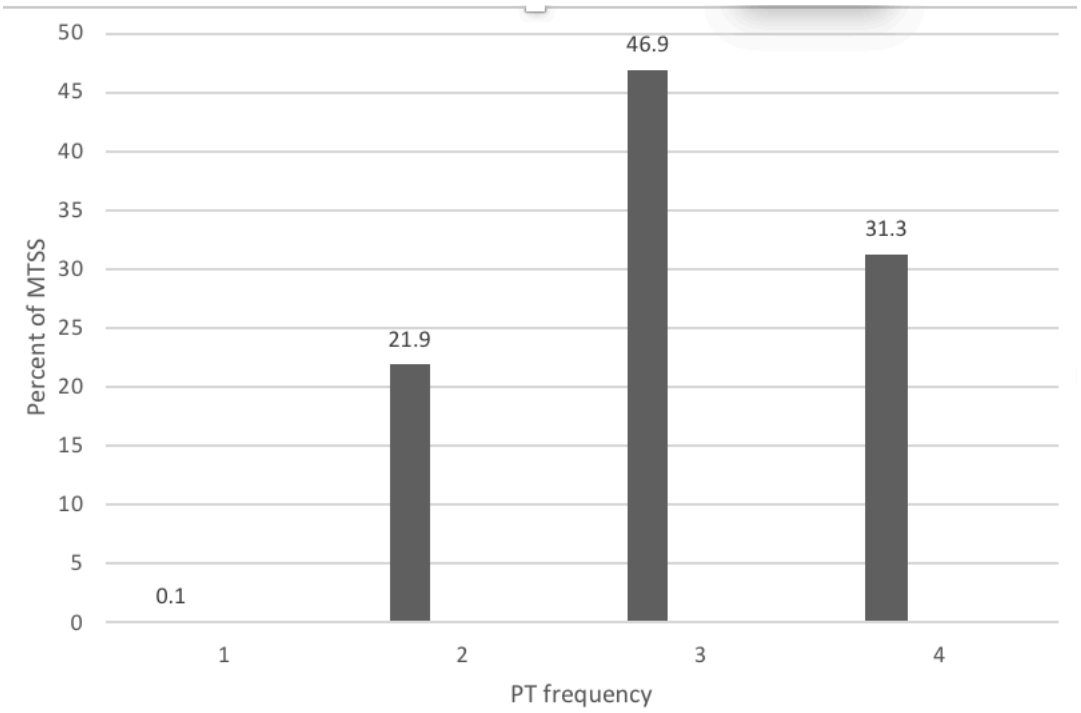

Figure 2. MTSS occurrences based on the frequency of PT participation.

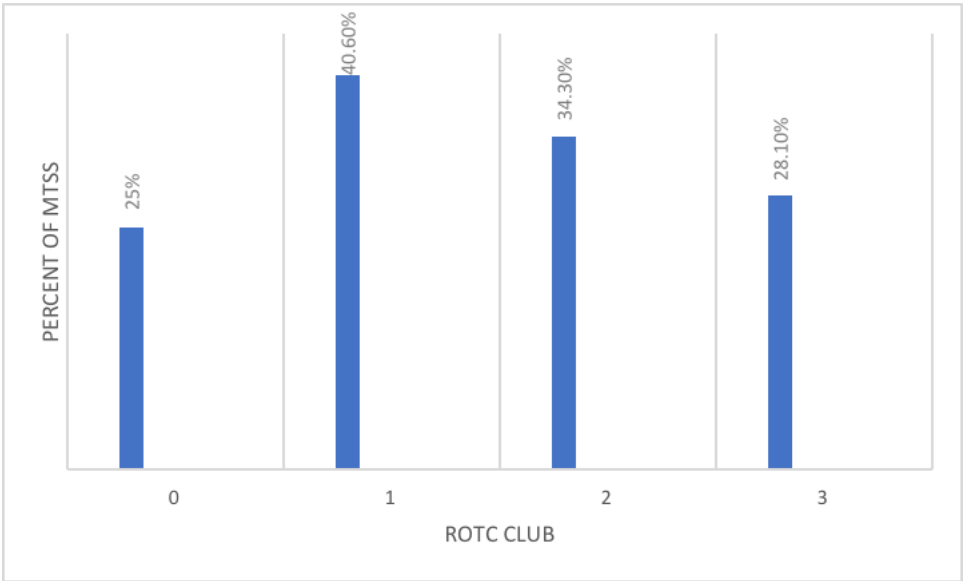

Figure 3. MTSS percentage in ROTC clubs which is based only on the participants that have MTSS since joining the ROTC program.

CHAPTER 5

DISCUSSION

Due to limited theoretical development of military ROTC practices and physical activity, the purpose of this study was to explore ROTC military practices, recruit activity, and the occurrence of MTSS, or commonly called shin splints. This thesis was written to explore these incidences and address the gaps between sports medicine and sport management literature in relation to MTSS occurrences. To our knowledge, this was the first study looking specifically looking at these correlations. Previous literature has researched military personnel as a whole and MTSS, however few have examined AROTC populations and MTSS occurrence based on military management practices.

Scott et al. (2015) found that based on experience levels, MS1 cadets had a higher frequency of injuries. Because they are new to physical training, they suffer a higher incidence of injuries while adjusting to the new demands placed on their bodies. Though the current study consisted of 31% MS1 cadets, they did not have the highest occurrence of MTSS, which did not line with previous research (Scott et al., 2015). Many things can be attributed to this. Cadets are not contracted (sworn in) to the ROTC program until their second year, therefore all PT activities are optional. Once they are contracted into the program, cadets are required to come to PT a minimum of three times a week, make baseline scores on the Army Physical Fitness Test (APFT) and enroll in mandatory lab classes. Additionally, the third year is the most important year for preparing for commissioning as an Army officer. During the MS3 year, cadets earn points for leadership, APFT scores, outside involvement and an array of other factors. These points earned by cadets are compared to cadets from AROTC programs across the nation. They are used to determine a cadet's future in the military, such as rank and job role for the rest of the cadet's

military career. Therefore, the level of commitment and involvement is higher in MS2 and MS3 cadets.

When looking at these factors, MS2 cadets did not follow this pattern as seen with third year cadets. When considering multiple variables such as PT frequency, MTSS occurrences and club involvement, the percentage of MS2 cadets was considerably lower than all other classes. This difference questions why MS2 cadets have a significantly lower occurrence than other classes and why do these occurrences double in their MS3 year. If 3rd year cadets are under great duress to complete comparative points-based rewards which will impact their entire future career, it is understandable they would increase their participation, thus increasing their likelihood of injury. Future researchers should explore this potential issue and test whether cadets are increasing injury rates due to stress regarding their points and future career appointments.

In the current study, cadets who participated in ROTC clubs had a higher incidence of MTSS than those who did not participate. By participating in these clubs, cadets are required to engage in physical activity sometimes 5-6 days a week compared to the average cadet who only has PT three days a week. When researching infantry soldiers in basic military training, 23% of injuries were associate with running, and high endurance frequency was related to higher incidences of injuries (Schuh-Renner et al., 2017). In the current study ranger challenge participants had higher MTSS occurrences than run club. Even though run club had a higher percentage of endurance activities, the ranger challenge had a higher frequency of PT participation. Ranger challenge is a club focused on pushing cadets' activity level further than what is done in the average PT setting. It is often times termed the "varsity sport of Army ROTC". Throughout the semester, cadets train vigorously to compete with teams across the

nation at the Brigade Ranger Challenge Competition. Due to this, cadets are challenged with more than just running. They are tasked with obstacle course, rope bridges, assembling M-16's and land navigation drills, along with ruck marching to each station. The demands required for ranger challenge participation justify why they have a higher incidence of MTSS compared to those in run club. However, as a result of the difference in findings by Schu-Renner (2017), future research should examine specific ranger challenge training and techniques by addressing problem areas to help decrease the incidence of MTSS.

When examining the relationship between PT frequency and MTSS prevalence, there were interesting findings in the results. Cadets who participated in PT 4-5 times per week had higher incidences than those who participated more than five days per week. In initial military training such as with ROTC cadets, the army utilizes phases to help avoid injuries. The training consists of three phases (initial conditioning, toughening and sustaining) to facilitate adaptation over injury. Cadets who have a high frequency of PT participation but no incidence of MTSS may have adapted quickly to this program. They can be categorized in the sustaining phase which is when their body has adapted quickly to the level of training required. Though these phases are helpful to some cadets, they do not account for the entire population. They do not account for some cadets who are previously well-conditioned, and others who adapt faster to conditioning. Those entering ROTC for the first time who are not previously conditioned may take longer to adapt and may develop MTSS during this time. Therefore, future research should address the management of these phases to enable all cadets the opportunity to make it to complete adaptation.

Lastly, it is important to address the shoes cadets wear. Cadets wear standard issued boots which are universal across just about all ROTC programs. However, because these are

universal boots, they do not have much individual support. The boots are hard, rigid and have no arch support. Compared to the traditional running shoe, standard issue military boots lack both shock absorption and flexibility (Milgrom et al., 1985; Scott et al., 2015). Despite the major differences between the two types of shoes, in a study of infantry recruits, overuse injuries did not differ between individuals who wore boots and those who wore running shoes (Finestone, Shlamkovitch, Eldad, Karp, & Milgrom, 1992). Additionally, Scott et al. (2015) found that ROTC cadets who wore boots had no overuse injury differences when comparing cadets who did not wear boots. Because of this research, footwear was not a variable considered in the current study.

In the current study over 50% of the population had an occurrence of MTSS since joining ROTC in relationship with various management practices such as the frequency of training and club involvement. As a result, the study supported the idea for the need to explore the relationship between military practices and MTSS in Army ROTC cadets. However, now that we see there is a relationship between the two, this is just a start to collaborations between sport medicine and sport management researchers working together to help decrease these incidences.

Management Implications

The results of the current study showed that further research needs to be done to address MTSS and military management practices. As stated previous, in many cases the primary goal of military management is combat readiness over the physical well-being of its members. Due to over half of the population having an occurrence of MTSS since joining the ROTC program based on both frequency and club involvement, MTSS is seen as more than a medical issue but a management issue. One of the major management implications of the study is the lack of

consistency. In the current study, military leaders change every two to three years. With this constant change, before a cadet's body is able to adjust to one leader and their training tactics, the cadet must immediately adapt to a new system. Despite the fact that most military programs follow the same guidelines, this constant change leads to inabilities in the body to adapt effectively. While the ability to adapt to changes is an important aspect, because of the nature of MTSS and its relationship to inconsistent training or stress on the body among other things, having consistent leadership could help to relieve this problem.

Another implication is the concept of organizational culture. A model that focuses on Edgar Schein's idea of "the values and beliefs that provide norms of expected behaviors that employees might follow" (Hogan & Coote, 2013, p. 1609). In military management, this concept is observed by the implication that extended involvement is required in order to have a successful military career. As previously mentioned, the MS3 year is the most important year for the ROTC cadet. As cadets are preparing for enlistment, it is vital to have a high overall score to ensure ideal placement during active duty. In order to receive this high score, cadets must do more than the average three days of physical training per week. They must be involved in clubs and do additional ROTC work to compete with cadets across the nation. Though, in this case military leaders do not require club involvement, it is almost implied that in order to be successful, you must participate in an ROTC club. A future research collaboration between sport medicine and sport management could be the impact of implied activity expectations on injury rates.

Lastly, it is important to look at the financial burden that occurs with injuries such as MTSS. Due to the extensive financial burden on the government, multiple researches are attempting to address ways to decrease the amount of money spent on injuries (Niebuhr et al.,

2015). Every year, approximately 180,000 Americans apply to serve In the military each year, a number that counters the 4% of soldiers who are discharged (Feeney, 2014; Swedler et al., 2011). Despite injured soldiers being replaced, if the overall management of physical training does not change, new recruits will come in suffering the same injuries, continuously costing the government millions of dollars.

Overall, there are many issues that can be seen with the occurrence of MTSS in ROTC cadets. However, this issue cannot be addressed from just a medical standpoint, but it must also be addressed from a management standpoint. Though it is important for athletic trainers and other medical personnel to address ways to help reduce MTSS occurrences, these efforts will be in vein if organizational change is not seen from the military and those in charge of physical training for cadets.

Limitations

Although the study was carefully planned, there were a few limitations. The sample size limited the type of analysis that could be done. A chi-squared analysis was ran on cross tabulation relations for MTSS and overall participation, MTSS and club participation, and MTSS based on PT frequency and ROTC classification. In all cases no significant relationship was found between any of the variables. However, due to over 50% of the population having occurrences of MTSS since joining ROTC this is an issue that needs to be addressed. Additionally, when doing the chi-squared analysis specifically on MS3 cadets, because the group with MTSS was so much larger than the group without, the assumptions were violated and therefore were deemed insignificant. However, that does not mean that this is not something that should not be addressed. Additionally, over 70% of the participants were white males, making it

impossible to account for both female and other ethnicities. During initial military training, women had a 50% occurrence of injuries compared to men (Bullock, Jones, Gilchrist, & Marshall, 2010). However, in the current study only 21% of participants were female, making it impractical statistically to look at the relationship.

Another limitation was the self-reporting survey. The survey was based solely on the integrity and interpretation of the participants. All answers submitted could have included dishonest or misinterpreted responses. Additionally, participants may not have a full understanding of MTSS, the exercises listed, or the pain felt when the injury occurred. The studies also only included Army ROTC populations at one university. Injury incidences at different universities and branches may vary.

Future Research

The results of this exploratory study opened many doors for future research. Looking at the relationship between MS year, club participation and MTSS, prospective studies should look at causation between these variables. Future research should also address the frequency of PT among MS classes that could potentially lead to MTSS. Due MS2 cadets having a significantly lower occurrence of MTSS than any other class, future research should focus on why there is such a big difference between 2nd year cadets and all other classes.

In order for both the sport management and sport medicine disciplines to benefit, the gap between the two when dealing with injuries should be addressed. Furthermore, researchers should address ways in which the two areas can work together in order to prevent injuries such MTSS from happening. The expectation is this system will travel across branches and eventually

to enlisted military members. In the future, this study should be completed across a larger scale in order to get a significant analysis of the data.

Conclusion

This study was the first to address relationship between military practices and the prevalence of MTSS in AROTC cadets. A great number of studies have researched risk factors associated with MTSS in a variety of populations, however, none have examined this specific population and injury. Many correlations were found between MS class, club involvement and participation frequency when looking at occurrences of MTSS. The results indicate a positive relationship between MTSS and military practices. This study also focused on the exploring the gap between sport managers and sport medicine professionals. This is the first step in understanding the cause of MTSS in AROTC populations, and to addressing ways in which the two disciplines can work together to decrease the incidences.

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APPENDICES

Appendix A: Recruitment Email

Good Morning,

Hello, my name is Jakayla Campbell I am writing to you to request your participation in a brief survey. I am currently conducting a study to focus on shin splints in ROTC cadets and their relationship between current military practices. The study will look at thing such physical training, ruck marching and field training in reference to exercises intensity, frequency, and duration in a survey to see if it is related to the prevalence of shin splints in ROTC cadets.

This study is being done to see if there is a relationship between the two. The survey will only take about 10 minutes, and if you have time I would appreciate it if you participate.

This study is for research purposes and your participation in the survey is completely voluntary. All of your responses provided will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data.

By clicking this link, you will be taken to the Google forms link which will prompt you with an informed consent before you begin.

https://docs.google.com/forms/d/e/1FAIpQLSew9Re8_jHeYq3OImxyKCYxmuugkn1VM4MjXbhIL2ttQY9vig/viewform?usp=sf_link

Thank you in advanced for your help
Jakayla Campbell, ATC, LAT

Appendix B: Informed Consent

Dear Participant:

My name is Jakayla Campbell and I am a Graduate student at East Tennessee State University. I am working on master's Degree in Sport Management. In order to graduate I must complete my research thesis. The name of my research study is Correlation between military practices and the prevalence of shin splints in ROTC cadets

The purpose of this study is to see if there is a positive correlation between exercises intensity, duration and frequency military practices such as physical training, ruck marching and field training, and the prevalence of shin splints. I would like to give a brief survey to ROTC cadets using Google Forms. It should only take about 10 minutes to finish. You will be asked questions about your involvement in your ROTC program. Since this study deals with just information about your past and current injuries, there will be no risk. However, you may also feel better after you have had the chance to express yourself about these specific injuries. This study may benefit you or others by hopefully cutting back on certain military activities that lead to shin splints or finding ways to help prevent the continued increase.
Your confidentiality will be protected as best we can. Since we are using technology no guarantees can be made about the interception of data sent over the Internet by any third parties, just like with emails. We will make every effort to make sure that your name is not linked with your answers. Survey Monkey has security features that will be used in order to keep you identify safe. Specifically, we will disable the collection of IP addresses and use data encryption. Although your rights and privacy will be protected, the East Tennessee State University (ETSU) Institutional Review Board (IRB), Jakayla Campbell and study staff will have certain non-identifying information about the study.

Taking part in this study is voluntary. You may decide not to take part in this study. You can quit at any time. You may put N/A for any questions you do not feel comfortable answering, or you can exit the online survey form if you want to stop completely. If you quit or decide not to take part, the benefits or treatment that you would otherwise get will not be changed.

If you have any research-related questions or problems, you may contact me, Jakayla Campbell at (843) 532-1531. I am working on this project together with our teacher Natalie Smith You may reach her at smithnl4@etsu.edu. Also, you may call the chairperson of the IRB at ETSU at (423) 439-6054 if you have questions about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone who is not with the research team or if you cannot reach the research team, you may call an IRB Coordinator at 423/439-6055 or 423/439-6002.

Sincerely,
Jakayla Campbell

Clicking the AGREE button below indicates

- I have read the above information, I agree to volunteer, and I am at least 18 years old

☐ I AGREE ☐ I DO NOT AGREE

Appendix C: Physical Readiness Training Reference Guide

ABILITY GROUP RUN 1/4-MILE SPLIT TIMES					
Pace/Mile	1/4-Mile Split	Pace/Mile	1/4-Mile Split	Pace/Mile	1/4-Mile Split
6:00	1:30	8:15	2:03	10:30	2:38
6:15	1:34	8:30	2:07	10:45	2:42
6:30	1:37	8:45	2:11	11:00	2:45
6:45	1:42	9:00	2:15	11:15	2:49
7:00	1:45	9:15	2:19	11:30	2:53
7:15	1:48	9:30	2:23	11:45	2:57
7:30	1:52	9:45	2:27	12:00	3:00
7:45	1:56	10:00	2:30	12:15	3:04
8:00	2:00	10:15	2:34	12:30	3:07

RUNNING, ENDURANCE AND MOBILITY ACTIVITIES					
ACTIVITIES	Toughening Phase (BCT/OSUT)	Sustaining Phase (AIT/OSUT)	Sustaining Phase ARFORGEN (Reset)	Sustaining Phase ARFORGEN (Train/Ready)	Sustaining Phase ARFORGEN (Available)
Military Movement Drill 1	1 rep	1 rep	1 rep	1 rep	1 rep
Military Movement Drill 2	N/A	1 rep	1 rep	1 rep	1 rep
30:60s	6-8 reps	6-10 reps w or w/o load	6-10 reps w or w/o load	10-15 reps w or w/o load	10-15 reps w or w/o load
60:120s	6-10 reps	6-10 reps	6-10 reps	6-10 reps	6-10 reps
300-yd Shuttle Run	1 rep	1-2 reps w or w/o load	1-2 reps	1-2 reps w or w/o load	1-2 reps w or w/o load
Hill Repeats	N/A	6-8 reps up or downhill	6-10 reps up or downhill	6-10 reps up or downhill	6-10 reps up or downhill
Ability Group Run	10-30 min	20-30 min	20-30 min	20-30 min	20-30 min
Unit Formation Run	20-30 min	20-30 min	30 min	30 min	30 min
Release Run	20-30 min	20-30 min	30 min	30 min	30 min
Terrain Run	N/A	20 min	20-30 min	20-30 min	20-30 min
Foot March	2-15 Km	2-15 Km	10 Km or less	10-30 Km	10-30 Km

PREPARATION DRILL
1. Bend and Reach (4-count, SLOW)
2. Rear Lunge (4-count, SLOW)
3. High Jumper (4-count, MODERATE)
4. Rower (4-count, SLOW)
5. Squat Bender (4-count, SLOW)
6. Windmill (4-count, SLOW)
7. Forward Lunge (4-count, SLOW)
8. Prone Row (4-count, SLOW)
9. Bent-Leg Body Twist (4-count, SLOW)
10. Push-Up (4-count, MODERATE)

HIP STABILITY DRILL
1. Lateral Leg Raise (4-count, SLOW)
2. Medial Leg Raise (4-count, SLOW)
3. Bent-Leg Lateral Raise (4-count, SLOW)
4. Single-Leg Tuck (4-count, SLOW)
5. Single-Leg Over (20-30 seconds)

MILITARY MOVEMENT DRILL 1
1. Verticals (1 rep = 2 x 25 yards)
2. Laterals (1 rep = 2 x 25 yards)
3. Shuttle Sprint (1 rep = 3 x 25 yards)

MILITARY MOVEMENT DRILL 2
1. Power Skip (1 rep = 2 x 25 yards)
2. Crossovers (1 rep = 2 x 25 yards)
3. Crouch Run (1 rep = 3 x 25 yards)

RECOVERY DRILL
1. Overhead Arm Pull (20-30 seconds)
2. Rear Lunge (20-30 seconds)
3. Extend and Flex (20-30 seconds)
4. Thigh Stretch (20-30 seconds)
5. Single-Leg Over (20-30 seconds)

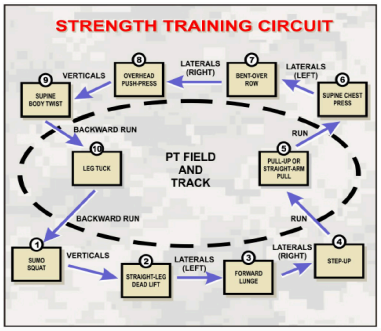
PREPARATION DRILL
1. Bend and Reach (4-count, SLOW)
2. Rear Lunge (4-count, SLOW)
3. High Jumper (4-count, MODERATE)
4. Rower (4-count, SLOW)
5. Squat Bender (4-count, SLOW)
6. Windmill (4-count, SLOW)
7. Forward Lunge (4-count, SLOW)
8. Prone Row (4-count, SLOW)
9. Bent-Leg Body Twist (4-count, SLOW)
10. Push-Up (4-count, MODERATE)

4 FOR THE CORE
1. Bent-Leg Raise (60 seconds)
2. Side Bridge (60 seconds)
3. Back Bridge (60 seconds)
4. Quadraplex (60 seconds)

CONDITIONING DRILL 1
1. Power Jump (4-count, MODERATE)
2. V-Up (4-count, MODERATE)
3. Mountain Climber (4-count, MODERATE)
4. Leg-Tuck and Twist (4-count, MODERATE)
5. Single-Leg Push-Up (4-count, MODERATE)
CONDITIONING DRILL 2
1. Turn and Lunge (4-count, SLOW)
2. Supine Bicycle (4-count, SLOW)
3. Half Jack (4-count, MODERATE)
4. Swimmer (4-count, SLOW)
5. 8-Count Push-Up (8-count, MODERATE)
CONDITIONING DRILL 3
1. "Y" Squat (4-count, SLOW)
2. Single-Leg Dead Lift (4-count, SLOW)
3. Side-To-Side Knee Lifts (4-count, MODERATE)
4. Front Kick Alternate Toe Touch (4-count, MODERATE)
5. Tuck Jump (4-count, SLOW)
6. Straddle-Run Forward and Backward (8-count, MODERATE)
7. Half-Squat Laterals (4-count, MODERATE)
8. Frog Jumps Forward and Backward (4-count, MODERATE)
9. Alternate 1/4 Turn Jump (4-count, MODERATE)
10. Alternate-Staggered Squat Jump (4-count, SLOW)

STRENGTH AND MOBILITY ACTIVITIES					
ACTIVITIES	Toughening Phase (BCT/OSUT)	Sustaining Phase (AIT/OSUT)	Sustaining Phase ARFORGEN (Reset)	Sustaining Phase ARFORGEN (Train/Ready)	Sustaining Phase ARFORGEN (Available)
Conditioning Drill 1	5 reps	5-10 reps	5-10 reps	5-10 reps	5-10 reps
Conditioning Drill 2	5 reps	5-10 reps	5-10 reps	5-10 reps	5-10 reps
Conditioning Drill 3	N/A	5-10 reps	5-10 reps	5-10 reps	5-10 reps
Push-Up & Sit-Up Drill	2 sets @ 30-60 seconds	2-4 sets @ 30-60 seconds	2-4 sets @ 30-60 seconds	2-4 sets @ 30-60 seconds	2-4 sets @ 30-60 seconds
Climbing Drill 1	5 reps	5-10 reps	5-10 reps	5-10 reps	5-10 reps
Climbing Drill 2	N/A	5-10 reps w load	5-10 reps w load	5-10 reps w load	5-10 reps w load
Strength Tng Circuit	2-3 rotations	2-3 rotations	2-3 rotations	2-3 rotations	2-3 rotations
Guerilla Drill	N/A	1-3 reps	1-3 reps	1-3 reps	1-3 reps

CLIMBING DRILL 1
1. Straight-Arm Pull (2-count, MODERATE)
2. Heel Hook (2-count, SLOW)
3. Pull-Up (2-count, MODERATE)
4. Leg Tuck (2-count, SLOW)
5. Alternating Grip Pull-Up (2-count, MODERATE)
CLIMBING DRILL 2
1. Flexed-Arm Hang (5 seconds)
2. Heel Hook (2-count, SLOW)
3. Pull-Up (2-count, MODERATE)
4. Leg Tuck (2-count, SLOW)
5. Alternating Grip Pull-Up (2-count, MODERATE)
GUERRILLA DRILL
1. Shoulder Roll (1 rep = 2 x 25 yards)
2. Lunge Walk (1 rep = 2 x 25 yards)
3. Soldier Carry (1 rep = 2 x 25 yards)
RECOVERY DRILL
1. Overhead Arm Pull (20-30 seconds)
2. Rear Lunge (20-30 seconds)
3. Extend and Flex (20-30 seconds)
4. Thigh Stretch (20-30 seconds)
5. Single-Leg Over (20-30 seconds)



April 2010 GTA 07-08-003

VITA

JAKAYLA CAMPBELL

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