Organized Training Routines and Utilization of Injury Prevention Practices in Collegiate Reserve Officers' Training Corps Cadets

by

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INTRODUCTION: In the ROTC population, most musculoskeletal injuries occur during physical training (PT). However, no study has assessed the organized physical training routines among ROTC divisions. Without an assessment of physical training routines, injury prevention practices may be limited. Therefore, the purpose of this study was to investigate the organized training routines and utilization of injury prevention practices among collegiate U.S Military

Reserve Officers' Training Corps Cadets. **METHODS**: This cross-sectional, descriptive study utilized a 23-question survey to assess the organized physical training routines and the utilization of injury prevention practices among 62 collegiate cadets at the University of Pittsburgh and Carnegie Mellon University. Outcomes were compared between groups using Fisher's exact test. Statistical significance was set *a priori* at $\alpha = 0.05$, two-sided. **RESULTS**: Forty-nine

(79.0%) cadets reported that they participate in organized physical training 1-4 hours per week, 54 (87.1%) stated that they their military branch, unit, command leader, or ROTC program promotes injury prevention, and 8 (12.9%) cadets stated their military branch, unit, command leader, or ROTC program does not promote injury prevention. The majority of cadets stated that they consume protein 1-hour following organized training, but carbohydrate consumption is minimal. **CONCLUSION**: ROTC cadets are meeting the minimum American Heart Association physical activity guidelines for adults. This study provides evidence that suggest that some injury prevention practices are not as practical in collegiate ROTC setting, such as the utilization of

neuromuscular injury prevention practices. Enhancing educational components of ROTC training based on the results of this study may assist in optimizing injury prevention and performance in this population.

Table of Contents

List of Tables

List of Figures

1.0 INTRODUCTION

The United States Military requires soldiers to be physically fit for duty. However, musculoskeletal injuries (MKIs) may pose as a significant threat to physical readiness, leading to substantial healthcare costs for the military.[20,46] After acknowledging the cost of training-related musculoskeletal injuries, the military established initiatives and adopted health models in efforts to reduce MSKIs, however, to date, few outcomes of these efforts have been reported.[15,17,25,26,37]

In 2004-2010, The Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Work Group emerged.[27] The Work group consisted of researchers, practitioners, clinicians, epidemiologists, the Centers for Disease Control and Prevention (CDC), and academic institutions.[27] After conducting an expedited systematic literature review, the group provided evidence-based recommendations for injury prevention practices intended for military physical training.[27] The Work Group identified essential components of an effective injury prevention program such as: neuromuscular training, injury surveillance, leadership support, consuming nutrients to restore energy balance within 1 hour following high-intensity activity, and injury prevention education.[12] The U.S Reserve Officers' Training Corps (ROTC) is a division of the military that may benefit from the Work Group's injury prevention recommendations. In the ROTC population, most musculoskeletal injuries occur during physical training (PT). In ROTC research, it has been reported that noncontact mechanisms of injury such as repetitive movements are more common when compared to contact mechanisms of injury during PT.[42] However, no study has assessed the physical training routines among ROTC divisions. Without an assessment of physical training routines, injury prevention practices may be limited.

Another component that may limit injury prevention practices are the barriers to implementing an injury prevention program. A study examined the barriers for exercise-related injury prevention programs in the collegiate ROTC population.[19] The perceived barriers found in the ROTC population were: lack of time, access to equipment, location of the program, and knowledge on how to correctly perform the preventative exercises.[19] The perceived barriers had a large association with intention to not participate in exercise-related injury prevention programs .[19] No military research has assessed physical training routines and the utilization of the Work Group's injury prevention recommendations among collegiate ROTC.

Therefore, the purpose of this study is to investigate the organized workout routines among collegiate U.S Military Reserve Officers' Training Corps cadets. Also, this study aimed to investigate the utilization of The Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Work Group's injury prevention recommendations among the U.S Military Reserve Officer's Training Corps.

1.1 Musculoskeletal Injuries in Military Populations

1.1.1 Defining Musculoskeletal Injury

The musculoskeletal system is a combination of two systems in the body- the muscular and skeletal system. The term, musculoskeletal, serves to highlight the close anatomical and physiological relationship between the two systems. The skeletal system is responsible for supporting the body's structure, movement, protecting the viscera, blood formation, and mineral storage. The muscular system is responsible for, the body's stability, movement, communication

(between muscles and brain), control of body contractions and heat production. The musculoskeletal system is defined as two systems (muscular and skeletal) that work together to support, maintain posture and stability, and responsible for locomotion of the body.[2] Brotto and Bonewald describe the system as a mechanical relationship between the muscular and skeletal systems in which muscle contraction contributes to skeletal growth and adaptations due to changing mechanical forces; muscle load can be recognized on bone as it adjusts its shape and mass to changes in load and load can be recognized through muscle contractions. [11] The musculoskeletal system is made up of ligaments, cartilage, bone, tendon, and skeletal muscle. Those structures can be damaged resulting in a musculoskeletal injury. Although it may be obvious that an injury has occurred, there is controversy on the definition of an injury. Most importantly, an injury must be defined concurrently by the causative crisis and by the resulting pathology.[40] A current theoretical definition of injury refers to damage to the body produced by energy transfers or by the absence of energy that have sudden perceptible effects.[40] Some argue that ‘‘sudden perceptible effects’’ excludes tissue damage due to chronic low energy events. On the other hand, some define injury as tissue damage caused by external forces placed on the body.[44] The operational definition of injury includes all pathologies in the ‘‘Injury and Poisoning’’ chapter (XVII) of the ninth revision of the International Classification of Diseases (ICD) or all those events coded to ICD Supplementary External Causes of Injury and Poisoning (known as E codes).[44]example, all mechanisms and events that cause an injury such as a fall or crash, would be included in would be included in the “Injury and Poisoning” chapter or E codes.[40] This definition is problematic because it has no explanation for exclusion and inclusion criteria. For the purpose of this study, a musculoskeletal injury is defined as acute, chronic, or overuse damage to ligaments, bones, tendons, muscles, or cartilage resulting from external or internal biomechanical forces

placed on the body as well as the absence of forces. This excludes musculoskeletal injury resulting from a laceration, avulsion of the skin, or puncture. This includes but not limited to musculoskeletal injury resulting from a sprain, strain, avulsion fracture, bone fracture, dislocation, impingement, bursitis, capsulitis, or herniation. Pain is not considered an injury.

Now that musculoskeletal injury is defined, the epidemiology of musculoskeletal injuries will be examined as it pertains to military training.

1.1.2 Epidemiology of Musculoskeletal Injuries in Military Populations

Musculoskeletal injuries are a public-health problem in the military.[18] An average rate of lower-extremity overuse injury visits was about 900 per 1000 person-years among the U.S Department of Defense.[25] Nye et al. reported that 12.5% recruits sustained one or more MSKIs and an overall rate of 18.3 musculoskeletal injuries per 1000 person-weeks among 68,000 U.S Air Force recruits between 2012 and 2014.[38] Between 2014-2015, the incidence of musculoskeletal injuries was 49.2 injured U.S Air Force Special Operators per 100 U.S Air Force Special Operators a year.[33] In 2016, the frequency of musculoskeletal injuries among U.S Army Air Assault Division was 29.5 per 100 soldiers per year.[34] Between 2017 and 2018, the rate of musculoskeletal injuries among U.S army soldiers was 29 and 34 MSKIs per 100 soldier-years, respectively.[32] Between 2009-2010 an injury frequency of 0.32 per soldier per year was reported among Navy Special Warfare Personnel.[31] A MSKI rate of 3.2 injuries per 100 person-months among Navy Special Warfare personnel has been previously reported.[4] The most common activities in which musculoskeletal injuries occurred in the military population was running, lifting, and physical fitness activities.[3,31,33,38]

The most common injury types in the military population are ligament sprains, muscle strains, bone stress fractures followed by bone fractures and cartilage tears. Additionally, sprains and stress fractures are more likely to occur in the lower extremity versus the upper extremity.[47] The ankle is the most prevalent joint to be sprained.[13] The tibia, fibula, and femoral neck are the most common bones to suffer a stress fracture.[52] Nevertheless, most of these injuries are said to be preventable.[3,47] Preventable injuries are those musculoskeletal injuries that can be decreased through injury prevention means (e.g. injury prevention training program, injury prevention education) in which the goal is to improve neuromuscular, biomechanical, or physiological characteristics related to musculoskeletal injury risks.[3] The estimated frequency of preventable musculoskeletal injuries is about 12-20 injuries per 100 soldiers per year [34] with sprains and strains being the two most common preventable injuries.[3] A closer look into each military division in regards to MSKIs prevalence may be the first step in mitigating this public-health concern.

A preparatory division in the military, collegiate ROTC, can be a crucial phase in one's military career as it prepares cadets to become military officers. This preparatory period may be the most appropriate time to introduce injury prevention means. This division showed a similar prevalence in musculoskeletal injuries when compared to the overall military population. Between 2012-2013, an incidence rate among cadets enrolled in an Army ROTC program was 60 lower extremity injuries per 100 person-years.[45] A recent 2-year (2017-2019) Army ROTC study reported that 148 of 364 cadets in the most advanced fitness group (Alpha) and cadets in their third year of training (n = 97/364) presented with the most musculoskeletal injuries.[42] Medial tibial stress syndrome, a lower-extremity overuse injury, was found to be most prevalent among cadets who were in their 3rd year of training.[16] The most common activity in which musculoskeletal injuries occurred in the Army ROTC was physical training.[42,45]

1.1.3 Mechanism of Musculoskeletal Injuries in the Military

There are various ways musculoskeletal injury can occur and these events are referred to as the mechanism of injury (MOI). Verrall and Dolman proposed that a mechanism of all musculoskeletal injuries (MOMI) results from an inability of structures to counteract applied forces while the structure is lengthened.[44] In the military population, most musculoskeletal injuries occur during physical training (PT).[34] Running followed by lifting are the most common activities resulting in musculoskeletal injuries. Contact mechanisms of injury are more common than noncontact mechanisms of injury.[3] An example of a contact mechanism is direct trauma such as 1) a kick to the body or 2) tripping and landing directly on a body part. Contact mechanism of injury can occur during combat training or ruck marching. Examples of noncontact mechanism of injury are 1) hyperextension of the lower back or 2) repetitive mechanical loading on the leg. Noncontact mechanisms of injury can occur during lifting or as a result of repetitive long runs. Although contact mechanisms such as the ones previously mentioned are more likely to occur, when examining preventable musculoskeletal injuries, noncontact mechanisms are more frequently seen in this population.[3] These mechanisms include but not limited to overtraining, overexertion, repetitive movements, internal/external forceful loading, gross joint positions such as twisting, and maintaining a static posture for a prolonged amount of time.[21] Sliding and falling are seen frequently during military training courses most likely due to the various terrain encountered on the combat and physical fitness courses.[36] The various terrains encountered during a single course may include rocks, steep hills, slopes, slippery/ wet surfaces, sand, or snow. These environments place significant external forces on cadets' bodies. Next, MOI among ROTC will be reviewed; it is imperative to take a closer look at the collegiate Reserve Officers' Training Corps as they may experience different MOIs in military officer training.

In the ROTC population, most musculoskeletal injuries also occur during physical training (PT). Common activities in which musculoskeletal injuries occur are also during running and ruck marching.[42] Differing from the overall military population, it has been reported that noncontact mechanisms of injury are more common than contact mechanisms of injury.[42] This may be attributed to the less exposure time of contact combat training. These mechanisms include but not limited to repetitive movements, internal/external forceful loading, and gross joint positions such as twisting.[42]

Now that mechanisms of injuries were discussed, the impact of musculoskeletal injuries will be reviewed as it directed influenced by the cause of injury.

1.2 Risk Factors for Injuries in Military Populations

1.2.1 Intrinsic Risk Factors for Musculoskeletal Injury

The most common intrinsic risk factors found in the military population are older age, female sex, and previous injury. Females soldiers who were over the age of 25 had a 61% higher chance of injury, and male soldiers over the age of 25 had a 78% higher chance of injury when compared to 17-18 year old female and male soldiers, respectively.[49] Intrinsic risk factors such as anatomical and biomechanical-related risk factors, high and low body mass index (BMI), muscular strength, and flexibility, can be correlated to sex.[51] Common anatomical and biomechanical differences found in military women that may put them at an increased risk of injury when compared to their male counterparts are narrower femoral notch, lower arches in foot, longer tibial length, thinner cortical bone, narrower bicondylar breadth (knee joints), wider pelvis and greater

hip flexion, knee valgus, and knee flexion during jump-landing tasks.[6,9,10] These anatomical and biomechanical differences are associated with an increased risk for ligamentous injuries of the knee, ankle sprains, stress fractures.[9] Thinner cortices (less percentage of cortical bone) may be the bones response to mechanical loading, in which woman respond by building bone on the endocortical surface while men respond on the subperiosteal surface, thus women have narrower subperiosteal diameters than men.[9] This suggests that women have relatively weaker skeletal bone overall. In this cohort, women were found to have higher bone mineral density (BMD) in the tibia and lower BMD in the femur than men.[9] In female fracture cases, a smaller percentage in cortical bone leads to significantly lower BMD, thus, the bone is less protective against a fracture.[9,10] Consistent with previous literature, female recruits have a higher incidence of stress fractures during basic training and those stress fractures are likely to occur in the femur and pelvis compared to male recruits.[29] Additionally, females who have a history of amenorrhea have higher increased risk for stress fractures.[9,10]

High body fat percentage may predispose one to injury. When compared to male counterparts, women on average have higher body fat percentages and less muscle mass, which leads to less muscular strength per unit of body mass.[9,23]

On average, muscular strength and flexibility differ between men and women. Lower muscular strength was found in female's lower and upper extremity. Possible advantages found in female soldiers are greater range of motion in the shoulder, hip, and knee.[6] Similar differences have been found among ROTC. In a ROTC study implementing the Functional Movement Screen (FMS), females had significantly better functional movement scores on the in-line lunge and active straight leg raise.[24] Both movements require flexibility of the knee and hip joints as well as stability of the back and core to control the movements. Male counterparts performed better on the trunk

stability push up which also requires stability of the core and back, but it relies less on flexibility and more on upper body strength, hence the higher scores produced by the men.[24] These sex differences should be taken into consideration when planning an injury prevention program. For example, when examining the cohort in this study, males may benefit more from a program that emphasized lower-extremity flexibility to improve flexibility of the hip and knee complexes. Female soldiers may benefit more from a program that emphasizes strength and stability of the trunk and upper body.

Intrinsic risk factors can be linked to one another, forming a "chain" of risk factors. For instance, let's examine the following risk factors: low muscle endurance, low and high flexibility, and low and high BMI. If a cadet has low muscle endurance, he or she may likely have a higher BMI because a) the cadet does not engage in much endurance training which can lead to higher fat masses or b) the cadet engages in more strength training, increasing the percentage of muscle mass. Unfortunately, the BMI does not take muscle mass into account. Someone with increased muscle mass will have a high BMI and be considered overweight, even if he or she is not actually overweight. The cadet with a higher BMI may have lower flexibility due to inactivity and a cadet with a lower BMI may have higher flexibility as a result of overactivity.[24]

After examining intrinsic risk factors, extrinsic risk factors will be reviewed as these factors can also influence the likelihood of musculoskeletal injury.

1.2.2 Extrinsic Risk Factors for Musculoskeletal Injury

The most frequent extrinsic risk factors found in the military are smoking, high running volume, and history of low physical (prior to joining military). Extrinsic risk factors that are related to physical training include running, foot marching, load carriage, obstacle courses, high amount

of weekly exercise, moving and lifting heavy objects, and hiking.[27,28,53] Cadets have high exposure to running, foot marching, and load carriage and less exposure to obstacle courses, however obstacle courses have high injury rates.[27] Occupational risk factors arise from the military occupational specialty (MOS) job duties and physical demand level.[22] For example, a Motor Transport Operator (MOS 88M) has high physical demands that include but not limited to lifting over 100 pounds occasionally and constantly lifting 50 pounds.[22] Soldiers in MOS 88M are more at risk for sustaining a MSKI when compared to soldiers in less physical demanding job such as a Legal Specialist (71D) who occasionally lift up to 20 pounds.[22] Injury risk factors may also be detected during physical fitness assessments. For example, Army soldiers must complete a physical fitness assessment called the Army Physical Fitness Test (APFT) periodically. The test consist of endurance and strength activities- pushups, sit-ups (amount of repetitions completed in 2 min) and a timed 2 mile run.[8] If a soldier performs poorly on the assessment, it may be indicative of low fitness levels which increases the risk for injury. Another extrinsic risk factor found in the military include the condition of running or training shoes.[53] If a running shoe is in moderate to poor conditions such as worn down heels or midsoles, the shoe will not provide the support it is intended to such as motion control. The shoe type is just as important as the condition of the shoe. For example, a foot with an excessive supinated gait would benefit more from neutral cushioned shoes to provide more shock absorption.[43] Additionally, different arch types such as high and low arches benefit from different shoe types. Low arches benefit from motion control running shoes and high-arched feet benefit from cushioned running shoes.[14] In all, running in the appropriate shoe may be able to alter the mechanics that are associated with injury and reduce injury risks. Now that extrinsic risk factors were discussed, injury prevention strategies are examined as they can help mitigate extrinsic risk factors.

1.3 Injury Prevention Strategies in Military Populations

1.3.1 Injury Prevention Recommendations

The Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Work Group recommended six injury prevention strategies in efforts to reduce musculoskeletal injury in the military population.[12] Those six strategies were leadership support, injury prevention education, injury surveillance and evaluation, consuming nutrients to restore energy balance within 1 hour following high-intensity activity, prevention of overtraining, and neuromuscular training.[12]

1) ***Leadership support***. Leadership is an important role in the military. The practices and beliefs of the leader can greatly influence his or her subordinates. When leaders are held accountable, the rate of success improves. Good leadership bares awareness and supervision. Leadership has been shown to enable a 35% reduction in injury prevalence in the military population.[50] Leadership support is deemed to be an essential component to any successful injury prevention program.[8,17] **2)** ***Injury prevention education***. Education is an important foundation to any regime. Educational counseling was utilized to increase servicemen's knowledge and awareness of MSKIs during various training environments.[39] Various education supplements have been found such as guidance booklets with information on activities that pose a high risk for injury (e.g. training on uneven surfaces, lifting heavy objects, and injury prevention videos).[39,50] Injury prevention videos were found ineffective in reducing injures.[50] When in conjunction with another injury prevention intervention (e.g. neuromuscular training), injury educational programs have been shown to reduce 30% of injuries in Army initial entry trainees.[8] While it was difficult to precisely measure the effectiveness of education alone on injury rates, providing information on

evidence-based prevention strategies is crucial to the support of military commanders in their responsibility to uphold the service members' safety.[8] Therefore, education was deemed an essential component of any successful injury prevention program.[17] **3) *Injury surveillance and evaluation***. Military commanders could influence their service members' injury rates by simply evaluating their current state of injuries, the mechanism of injuries, setting goals for success, and monitoring their improvements.[8] This is only possible if surveillance of injuries and physical activity are conducted routinely. It is said that a unit's injury rates should be a measurement of physical training program success, similar to the evaluation of traditionally fitness' test scores.[8] High injury rates are seen during physical training, especially in the new recruit population, which indicates a need to revise that program.[8] Routine reporting of injury data by command leaders may influence greater command accountability for unit physical performance and musculoskeletal health.[8] Thus, the surveillance and reporting of injuries is a key component to any successful injury prevention program.[8,17] **4) *Consuming nutrients to restore energy balance within 1 hour following high-intensity activity***. The depletion of the body's glycogen storage and muscle fatigue is a result of sustained physical activity and intermittent, high-intensity exercise.[8] Previous research stated that consuming a combination of carbohydrates and protein within 1 hour following strenuous exercise initiates the repair process of the damaged muscles that were used during the activity and begins the replenishment of muscle glycogen storage.[8] Additionally, negative energy balance has been identified as a risk factor for stress fractures in active-duty women.[8] Nutritional deficiency increases the risk for sustaining a stress fracture. Thus, a well-balanced and nourished diet is recommended for any injury prevention program. **5)*Prevent overtraining***. Soft tissue, such as muscles, tendons, and cartilage need breaks in between exercise sets and exercise days in order to recover and build.[8] The structures are strengthened during this recovery time. If the subsequent

recovery does not take place, the rate of breakdown surpasses the body's ability to recover resulting in overuse injuries.[8] Studies found that reducing running frequency, duration, and distance decreased lower extremity injury rates.[52] A study found a 34% reduction in injury rates among subjects who completed lower physical activity volume.[50] There are ways to mitigate overtraining. Periodization training is a type of training that manipulates training variable, when done correctly, it should optimize performance, minimize injury, and prevent overtraining.[8] Interval training is another type of that can mitigate overtraining. Interval training is a type of an intermittent training in which multiple bouts of high intensity running is combined with periods of recovery (e.g. shuttle runs, and hill/stair running). Intervals incorporate a progressive work to recovery ratio.[8] Interval training minimizes repetitive load on the lower extremities while also training the cardiovascular system.[8] Military studies that examined the effects interval training and decreased total running mileage found better fitness improvements as compared to long, slow sustained running.[8] In efforts to reduce injuries and optimize fitness of marine recruits, the San Diego MCRD conducted a training intervention trial.[28] The intervention included decreased running miles, gradual progression of exercise and military hiking, and emphasis early training aerobics before progressing to anaerobic activities and strength conditioning.[28] The outcomes of this intervention were significant reductions in all overuse type injuries, a 55% decrease in lower extremity stress fractures, which resulted in 370 fewer stress fractures annually with savings of over $4.5 million at the San Diego MCRD.[28] Military physical training that balances physical overload and recovery time for rebuilding may facilitate the greatest protection for the service member.[8] Thus, the prevention of overtraining is recommended for injury prevention programs. **6) *Neuromuscular training***. Neuromuscular, proprioception, and agility activities are found to be beneficial in the military population.[52] A neuromuscular training program was designed to improve cadets' posture

control and agility, as well as to enhance the stability of the trunk, knee and ankle.[39] A neuromuscular training program may focus on proper technique, such as posture, core stability or positioning of the, ankle knees, and hips.[39] Neuromuscular, proprioceptive, and agility physical training sessions may reduce injury risks for other reasons than stability, posture, and movement control: 1) performing these interventions routinely during a training period reduces the exposure to running activities, which can reduce lower extremity injury risks; and 2) These type of drills place mechanical stresses on the body that are more evenly distributed and occur in various planes of motion (unlike linear running, which mainly stress in the lower extremity in one plane), thereby reducing injury risk.[8] Core strength and stabilization exercises can translate to and is crucial for many of the movements required during more complex combat activities and this may improve military occupational task performance and possibly reduce injuries.[8] Thus, neuromuscular training is recommended for any injury prevention program.

1.4 Training Programs in Military Populations

1.4.1 Physical Training in ROTC

Aerobic training. ROTC cadets must train, like any other branch in the military, in order to meet the demands of their prospective job. Physical training is mandatory during the academic year. A component of physical training from all branches of the ROTC is aerobic fitness training. Aerobic training can also be referred to as endurance training. Army ROTC aerobic and endurance training can consist of, but is not limited to, lower and upper body muscular endurance training, ruck marches, timed laps, plyometric jumping, squats, push-ups, sit-ups, core exercises, and

lunges; running miles on various settings such as predetermined paths, stadium runs, and uphill.[39] The average distance ran during a session was 2-3 miles.[39]

Anaerobic training. Another component to physical training is anaerobic training. The Army ROTC incorporates short distance sprinting (40-60 yards) and sub-maximal shuttle runs.[39]

*Physical assessments***.** Both aerobic and anaerobic training is intended to improve scores on the Army Physical Fitness Test (APFT) which consist of timed push-ups, sit ups, and a 2-mile run and possibly the Occupational Physical Assessment Test which includes standing long jump, seated power row, strength deadlift, and an interval aerobic run.[39] An 8 week training program that enhanced pre-existing exercises of an Army ROTC PT program consisted of high intensity, functional movements with kettle bells, medicine balls, and ruck sacks, lower intensity and longer duration aerobic exercise, mobility exercises, sprints and core exercises, moderate intensity circuits and, long duration aerobic components, significantly improved scores on the APFT.[5] The other branches of ROTC (Air Force, Navy, and Marines) may have similar physical training regimes as their physical fitness test have similar components. The Air Force Physical Fitness Test consist of body composition assessments, timed pushups, sit-ups, and a 1.5-mile run.[35] For Navy ROTC (NROTC) students going into the Navy, physical training is mandatory at least 3 times per week. For NROTC students going into the Marine Corps, physical training is required 5 days a week**.**[7] Throughout the ROTC, physical fitness assessments are conducted every pre-determined month, in which students compete against other students in their branch. It is estimated that in a typical week of physical training, cadets complete 1.0±0.8 running days of varying distances, 0.2±0.4 days of strength/power workouts and 1.2±0.7 days core strength/endurance exercise, which has been shown to improve scores on the APFT and OPFT.[50] Scores on physical fitness

tests serve as an integral component of the ranking system within the battalion. The higher the score, the higher the rank.

Considerations. The ROTC may consider encouraging cadets to participate in light to moderate training/exercising over the summer break (about 3 months) as a discontinuation in training can significantly decrease V02 max among male and female cadets.[30] No studies evaluated the muscular strength and anerobic fitness following summer break, but similar outcomes are expected after cessation of strength and anaerobic training. A decline in strength, aerobic, and anerobic fitness can increase the risk of a musculoskeletal injury.

1.5 DEFINITION OF THE PROBLEM

There is limited amount of research in the ROTC population. There is little research on training-related injury risk among ROTC and it is not known if ROTC cadets are utilizing injury prevention practices.

1.6 STUDY PURPOSE

The purpose of this study was to investigate the organized physical training routines and utilization of the Work Group's injury prevention recommendations among collegiate ROTC cadets. This study also investigated if there are differences in survey responses among the various ROTC branches (Army ROTC vs Air Force vs Navy ROTC). The study also examined if there were within-subject differences among survey responses. The survey inquired about their specific

organized physical training routine and training factors, as well as activities that follow the Work Group's recommendations during organized physical training.

1.7 SPECIFIC AIMS

Specific Aim 1: To investigate a difference between academic classes (within the same ROTC branch) among training routine and injury prevention survey responses

Hypothesis 1: Training routine and injury prevention responses will vary among class levels

Specific Aim 2: To investigate a difference between sex among training routine and injury prevention responses

Hypothesis 2: Training routine and injury prevention responses will not vary among sex

Specific Aim 3: To investigate a difference between Air Force, Army, Navy, and Marine ROTC branches among training routines and injury prevention survey responses

Hypothesis 3: Training routine responses will show that Army ROTC cadets participate in physical training more days a week when compared to Air Force, Navy, and Marine ROTC cadets and injury prevention responses will vary among all three branches

Specific Aim 4: To investigate the organized physical training routines among collegiate Air Force, Army, Navy, and Marine ROTC cadets

Specific Aim 5: To investigate the utilization of the Joint Services Training Injury Prevention Work Group's injury prevention recommendations among collegiate Air Force, Army, Navy, and Marine ROTC cadets

1.8 STUDY SIGNIFICANCE

The outcomes of this study may help determine if there is a need for implementation of an injury prevention program within this ROTC population. If a need does exist, it paves the way for future research focusing on 1) confirming the fundamental influences behind this need and 2) determining if these influences are replicable. This study may serve as a stepping-stone for improvements in injury prevention, ultimately serving as a helpful tool to improve injury prevention initiatives, program implementation, and decreasing musculoskeletal injury incidence.

2.0 METHODS

2.1 EXPERIMENTAL DESIGN

This cross-sectional, descriptive survey aimed to investigate organized physical training routines and the utilization of The Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Work Group's training-related injury prevention recommendations among collegiate ROTC. This study utilized a survey to address these specific aims.

2.2 SUBJECT RECRUITMENT

Subjects were recruited from the Army ROTC and Air Force ROTC battalions at the University of Pittsburgh and the Navy ROTC battalion at Carnegie Mellon University. Subjects were recruited via email. An email was sent to battalion commanders, explaining the purpose of the study and the primary investigator requested that the battalion commanders forward the email to cadets. Interested participants were given a short survey electronically. The short survey asked: 1) Are you 18 years old or older? 2)Do you currently participate in organized physical training with your ROTC branch? If a participant answered, "no" to either question, the participant's survey was redirected to the thank you page and the participant was not able to answer any further questions related to the study. If a participant answered, "yes" to both questions, the participant continued to the study survey. Participation in the study was voluntary and the cadet could have discontinued the study at any time. A similar cross-sectional study that identified factors

associated with intention to participate in an Exercise-Related Injury Prevention Program within ROTC cadets utilized 28 participants from a single university and potentially a single ROTC branch.[19] This study aimed to include three different ROTC branches from two universities, so 60 participants were determined appropriate for this study.

2.3 SUBJECT CHARACTERIZATION

2.3.1 Exclusion and Inclusion Criteria

To be included in the study, subjects had to be actively participating in organized physical training within the Army ROTC, Air Force ROTC (University of Pittsburgh), or Navy ROTC (Carnegie Mellon University). Subjects had to be at least 18 years of age.

Subjects were excluded if they were under the age of 18. Subjects were excluded if they were not actively participating in organized physical training within their respective branch.

2.4 INSTRUMENTATION

2.4.1 Survey

The survey was developed in Qualtrics, a survey tool used by the University of Pittsburgh that assists in the creation of surveys and survey questions. The survey questions were derived from the Work Group's Injury Prevention Recommendations. Six injury strategies were deemed by the work group to have sufficient scientific evidence for implementation in all four military

branches. Those strategies include leadership support, injury prevention education, injury surveillance and evaluation, prevent overtraining, and neuromuscular training. The primary investigator of this study did not inquire about the utilization of injury surveillance and evaluation. Injury surveillance and evaluation would be the responsibility of ROTC command leaders, not the ROTC cadets. This study was geared towards ROTC cadets; thus, injury surveillance and evaluation were excluded from the survey. Additionally, leadership support embodies all injury prevention recommendations; thus, leadership support was not assessed independently. In this study, the cadets were asked to complete a 23-question survey. Three questions pertained to the cadets' demographic information: class level, branch affiliation, and sex. Six questions inquired about the cadets' organized physical training routines. Four questions aimed to assess the utilization of the Work Group's neuromuscular training recommendations. Five questions aimed to assess the utilization of the Work Group's injury prevention education recommendations. Two questions aimed to assess the utilization of the Work Group's preventative overtraining recommendations. Three questions aimed to assess the utilization of the Work Group's recommendation regarding the consumption of nutrients to restore energy balance within 1 hour following high-intensity activity. Examples of questions included: "Has your military branch, unit, command leader, or ROTC program ever provided you with any injury prevention educational materials (e.g. pamphlets, videos)?" and "How often do you participate in organized strength training per week?"

2.5 PROCEDURES

2.5.1 Data Collection

All survey data was collected online via Qualtrics. Cadets were able to remotely access the form electronically with a mobile device, explaining the purpose of the study and the request for voluntary participation. The cadets were informed that they can voluntarily withdraw from the study at any point in time. The survey was administered to the cadets electronically (remotely). The survey consisted of 23 questions, which took no more than 15 minutes to complete. All data was automatically recorded on Qualtrics after cadets submitted the survey, which was then sorted by the primary investigator.

2.6 DATA REDUCTION

Data from the survey was manually entered into the Qualtrics Online Survey Services. The results from each question were generated by Qualtrics and the primary investigator organized the results into graphs to better view. The questions primarily asked about the cadets' demographics, their organized physical training routine, and the utilization of the Work Group's injury prevention recommendations.

2.7 DATA ANALYSIS

All survey data was entered into the Qualtrics Core XM Online Survey Services software (Qualtrics, Provo, UT, 2019). Qualtrics automatically generates the recorded responses. The responses will be categorized by division affiliation, class level, and preventative utilization which will be represented in tables and figures. 82 surveys were recorded in Qualtrics. Two surveys did not consent to the study's terms and conditions and 18 incomplete surveys were excluded from the results. The primary investigator analyzed 62 surveys for this study.

2.8 STATISTICAL ANALYSIS

Descriptive statistics in thesis mean standard deviation median interquartile range, and proportion, as appropriate was calculated for all variables. Outcomes related to organized physical training, as well as the utilization of Joint Services Training Injury Prevention Work Group's injury prevention recommendations, were described as absolute frequencies in parathesis counts and relative frequencies in parathesis proportions.

Outcomes were compared between groups (sexes, class levels, and branches) using Fisher's exact test. Statistical significance was set *a priori* at $\alpha = 0.05$, two-sided. Statistical analyses were conducted using IBM SPSS Statistics, version 28 (IBM Corporation; Armonk, NY).

3.0 Results

3.1 Survey Data

Table 1 displays the characteristics (branch, sex, academic class) of the ROTC cadets and midshipmen. The **ROTC branches**- Army, Navy, Air Force, and Marines are labeled across the top of the chart. **Sex**-male and female and **academic year**-freshman, sophomore, junior, senior is labeled in the left column and the **totals** column is located on the right. Of the 62 subjects, 27 (43.5%) stated that they serve in the Army, 18 (29.0%) stated that they serve in the Navy, 14 (22.6%) stated that they serve in the Air Force, and 3 (4.8%) stated that they serve in the Marines. Out of 62 subjects, 36 (58%) males and 26 (41.9%) females participated in the survey. Out of the 36 males, 16 (44.4%) stated that they are in the Army, 11 (30.6%) in the Navy, 14 (22.6%) in the Air Force, and 3 (4.8%) in the Marines. Out of the 26 females, 11 (42.3%) stated that they are in the Army, 7 (26.9%) in the Navy, 7 (26.9%) in the Air Force, and 1 (3.8%) in the Marines. Out of the 62 subjects, 18 freshmen, 13 sophomores, 20 juniors, and 11 seniors participated in the survey. Out of the 18 freshmen, 7 (38.9%) stated that they are in the Army, 5 (27.8%) in the Navy, 4 (22.2%) in the Air Force, 2 (11.1%) in the Marines. Out of the 13 sophomores, 4 (30.8%) stated that they are in the Army, 5 (38.5 %) in the Navy, and 4 (30.8%) in the Air Force. Out of the 20 juniors, 12 (60%) stated that they are in the Army, 5 (25%) in the Navy, 2 (10%) in the Air Force, and 1 (20%) in the Marines. Out of the 11 seniors, 4 (36.4%) stated that they are in the Army, 3 (27.3%) in the Navy, and 4 (36.3%) in the Air Force.

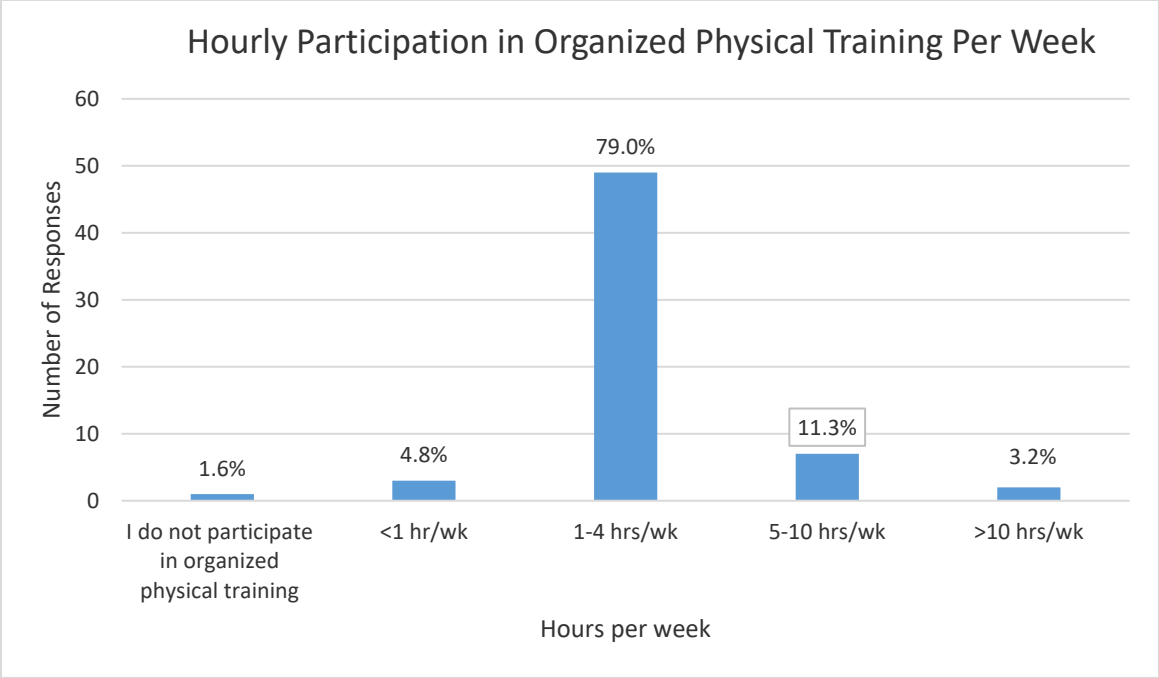
Table 1 Subject Characteristics of 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	ARMY	NAVY	AIR FORCE	MARINES	TOTAL
ROTC Branch	27/62= 43.5%	18/62= 29.0%	14/62= 22.6%	3/62= 4.8%	62
Sex					
Males	16/36= 44.4%	11/36=30.6%	7/36= 19.4%	2/36= 5.6%	36
Females	11/26= 42.3%	7/26= 26.9%	7/26= 26.9%	1/26= 3.8%	26
Academic Class					
Freshman	7/18= 38.9%	5/18= 27.8%	4/18= 22.2%	2/18= 11.1%	18
Sophomore	4/13= 30.8%	5/13= 38.5%	4/13= 30.8%	0/13	13
Junior	12/20= 60%	5/20= 25%	2/20= 10%	1/20= 5%	20
Senior	4/11= 36.4%	3/11= 27.3%	4/11= 36.3%	0/11	11

3.1.1 Organized physical training routines among collegiate Air Force, Army, Navy, and Marine ROTC cadets

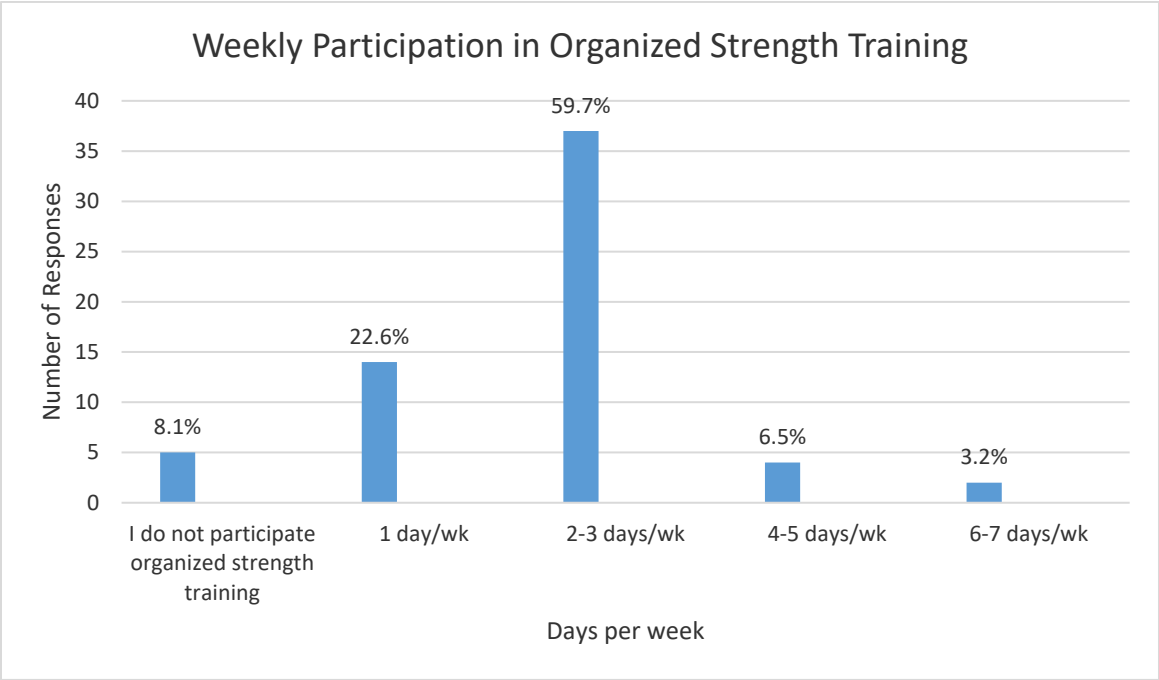
The amount of time ROTC cadets participate in organized physical training per week is shown in Figure 1. In response to weekly participation in organized physical training, 1 (1.6%) ROTC cadet reported that they do not participate in organized physical training, 3 (4.8%) cadets reported that they participate in organized physical training less than 1 hour per week, 49 (79.0%) cadets reported that they participate in organized physical training 1-4 hours per week, 7 (11.3%) cadets reported that they participate in organized physical training 5-10 hours per week, 2 (3.2%) cadets reported that they participate in organized physical training more than 10 hours per week.

Figure 1 Hourly Participation in Organized Physical Training Per Week Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University



The number of days ROTC cadets participate in organized strength training per week is shown in Figure 2. In response to organized strength training, 5 (8.1%) cadets reported that they do not participate in organized strength training, 14 (22.6%) cadets reported that they participate in organized strength training 1 day per week, 37 (59.7%) cadets reported that they participate in organized strength training 2-3 days per week, 4 (6.5%) cadets reported that they participated in organized strength training 4-5 days, 2 (3.2%) cadets reported that they participate in organized strength training 6-7 days per week.

Figure 2 Weekly Participation in Organized Strength Training Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University



Activities performed during organized strength training are shown in Table 2. In response to organized strength physical training activities, powerlifting was selected 7 times, free weight-lifting was selected 29 times, machine lifting was selected 10 times, calisthenics was selected 49 times, and "other" was selected once.

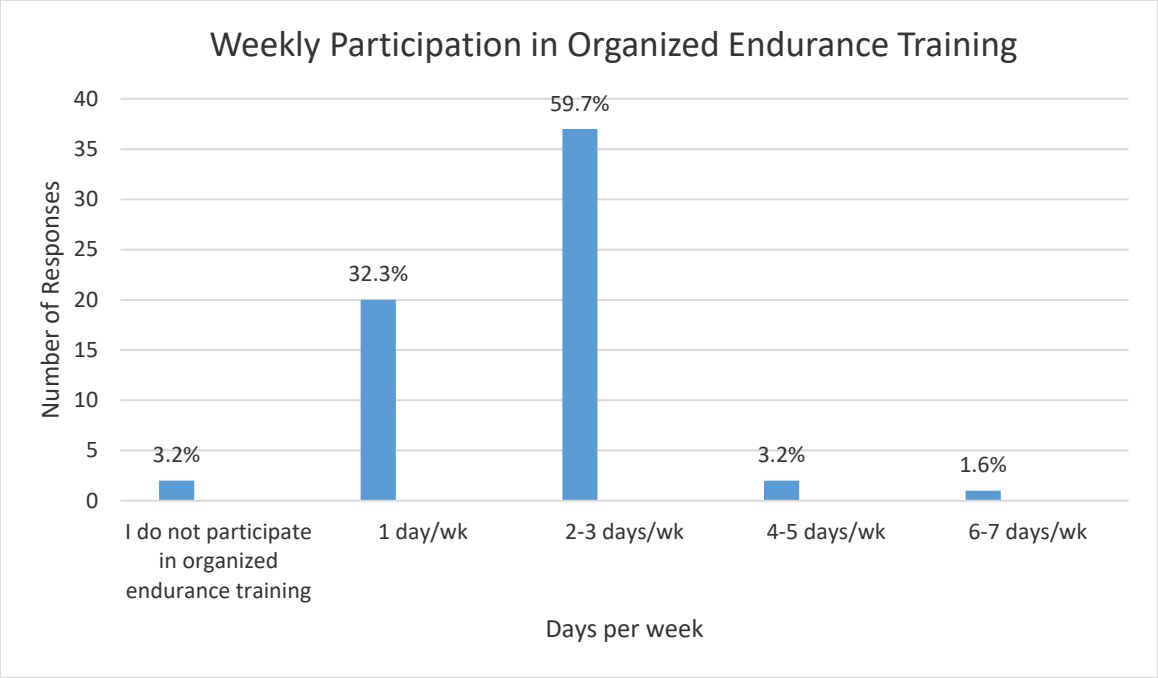
Table 2 Types of Organized Strength Training Activities Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

Activity	Count
Powerlifting	7 (7.3%)
Free weight lifting	29 (30.2%)
Machine lifting	10 (10.4%)
Calisthenics	49 (51.0%)
Other	1 (1.0%)

Total 96 *Numbers do not add up to 62 as participants could choose >1 option

The number of days ROTC cadets participate in organized endurance training per week is shown in Figure 3. In response to organized endurance training, 2 (3.2%) cadets reported that they do not participate in organized endurance training, 20 (32.3%) cadets reported that they participate in organized endurance training 1 day per week, 37 (59.7%) cadets stated that they participated in organized 2-3 days per week, 2 (3.2%) cadets reported that they participated in 4-5 days per week, 1 (1.6%) cadet reported that they participated in organized endurance training 6-7 days per week.

Figure 3 Weekly Participation in Organized Endurance Training Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University



Activities performed during organized endurance training are shown in Table 3. In response to organized endurance training activities, running was the most popular activity receiving a total of 58 responses. Swimming was selected 12 times, walking was selected 6 times, plyometrics was selected 9 times, endurance weightlifting was selected 12 times, jump roping was selected 3 times, endurance calisthenics was selected 34 times, and ruck marching was selected 22 times.

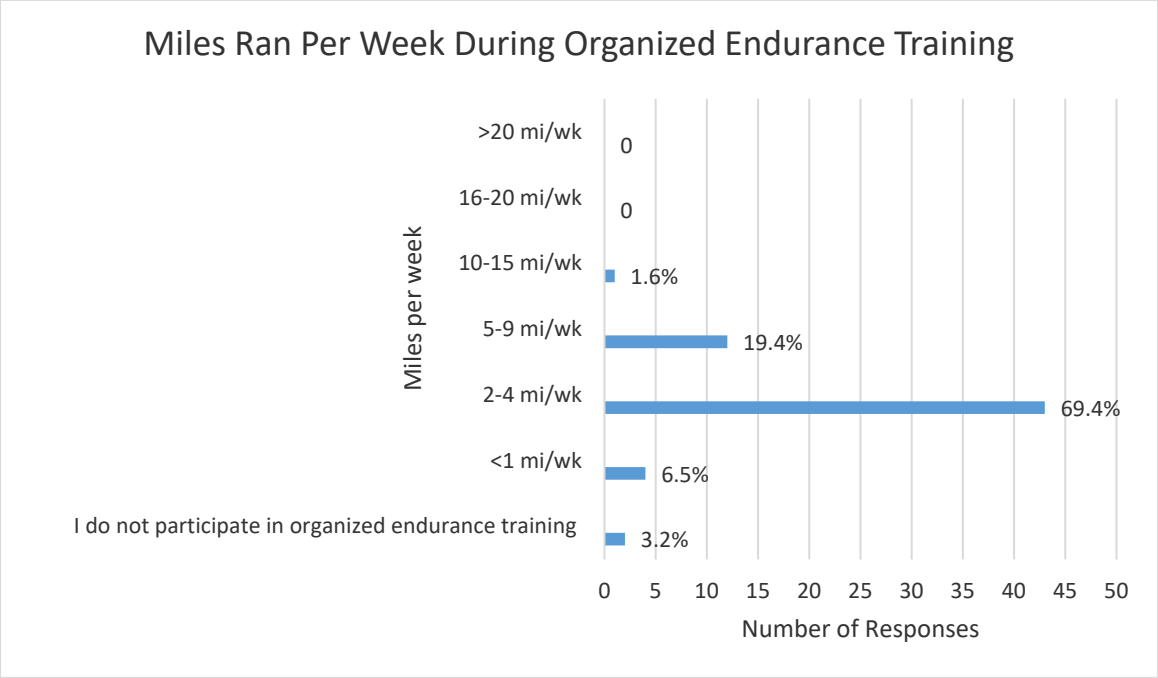
Table 3 Types of Organized Endurance Training Activities Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

Activity	Count
Swimming	12 (7.7%)
Walking	6 (3.8%)
Running	58 (37.2%)
Plyometrics	9 (5.8%)
Endurance Weightlifting	12 (7.7%)
Jump Roping	3 (1.9%)
Endurance Calisthenics	34 (21.8%)
Ruck Marching	22 (14.1%)
Other	0

Total 156 * Numbers do not add up to 62 as participants could choose >1 option

Figure 4 shows the distance (miles) ROTC cadets run per week during organized endurance training. In response to miles ran per week during organized endurance training, 2 (3.2%) cadets reported that they do not participate in organized endurance training, 4 (6.5%) cadets reported that they run less than 1 mile per week, 43 (69.4%) cadets reported that they run 2-4 miles per week, 12 (19.4%) cadets reported that they run 5-9 miles per week, 1 (1.6%) cadet reported that they run 10-15 miles per week. No cadets reported running 16-20 miles or more than 20 miles per week.

Figure 4 Amount of Miles Ran Per Week During Organized Endurance Training Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University



3.1.1.1 The utilization of the Joint Services Training Injury Prevention Work Group's injury prevention recommendations among collegiate Air Force, Army, Navy, and Marine ROTC cadet

Figure 5 shows the responses to the neuromuscular injury prevention questions. In response to the neuromuscular injury prevention questions, 42 (67.7%) reported that they participated in stabilization training organized by their military branch, unit, command leader, or ROTC branch and 20 (32.3%) cadets stated that they have never participated in stabilization training organized by their military branch, unit, command leader, or ROTC branch. 26 (41.9%) cadets reported that they participated in neuromuscular or proprioception training organized by their military branch, unit, command leader, or ROTC program and 36 (58.1%) cadets reported that they have not

participated in any neuromuscular or proprioception training organized by their military branch, unit, command leader. 30 (48.4%) cadets reported that they participated in agility training organized by their military branch, unit, command leader, or ROTC program. 31(50.0%) cadets reported that they have never participated in any agility training organized by their military branch, unit, command leader, or ROTC program and 1 participate (1.6%) preferred not to answer the question. 11 (17.7%) cadets reported that they received a postural assessment under the direction of their military branch, unit, command leader, or ROTC program, 50 (80.6%) cadets reported that they have never received a postural assessment under the direction of their military branch, unit, command leader, or ROTC program and 1 (1.6%) preferred not to answer the question.

Figure 5 Neuromuscular Injury Prevention Survey Responses Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

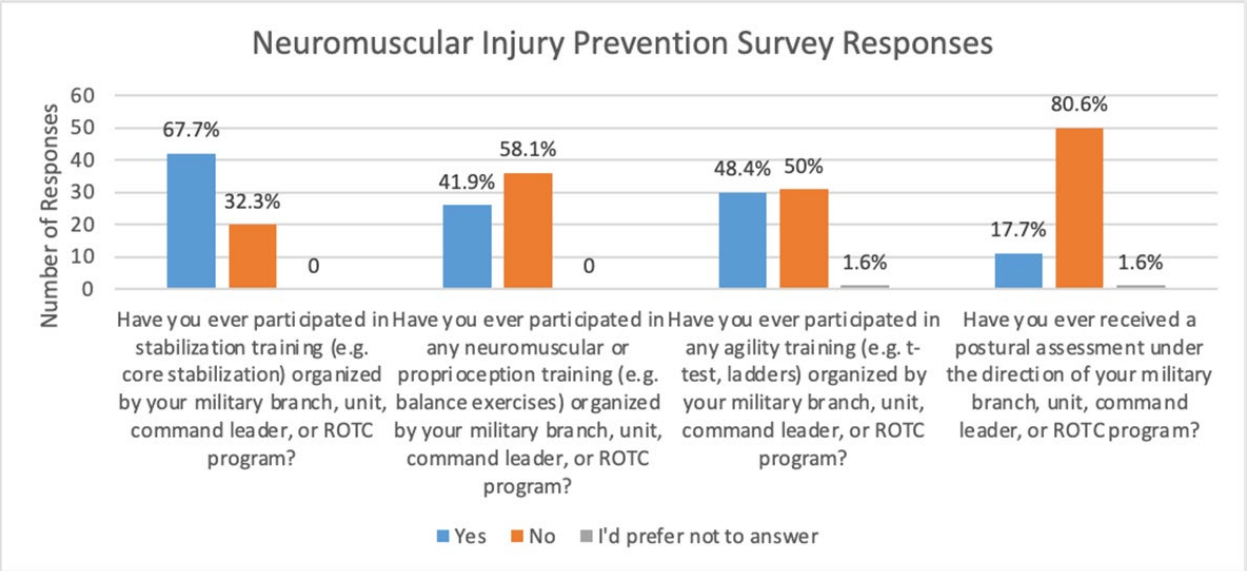


Figure 6 shows the responses to the injury prevention education questions. In response to the injury prevention education survey responses, 54 (87.1%) stated that they their military branch,

unit, command leader, or ROTC program promotes injury prevention and 8 (12.9%) cadets stated their military branch, unit, command leader, or ROTC program does not promote injury prevention. 48 (77.4%) cadets reported that their military branch, unit, command leader, or ROTC program informed them of techniques to prevent injuries during organized strength training, 13 (21.0%) cadets reported that they have not been informed them of techniques to prevent injuries during organized strength training, and 1 (1.6%) preferred not to answer the question. 48 (77.4%) cadets reported that their military branch, unit, command leader, or ROTC program informed them of techniques to prevent injuries during organized endurance training, 13 (21.0%) cadets reported that they have not been informed them of techniques to prevent injuries during organized endurance training, and 1 (1.6%) preferred not to answer the question. 15 (24.2%) cadets reported that their military branch, unit, command leader, or ROTC program provided them with injury prevention educational materials and 47 (75.8%) cadets reported that their military branch, unit, command leader, or ROTC program never provided any injury prevention educational materials. 6 (9.7%) cadets reported that they attended an injury prevention course or lecture under the direction of their military branch, unit, command leader, or ROTC program and 56 (90.3%) cadets reported that they have not attended an injury prevention course or lecture under the direction of their military branch, unit, command leader, or ROTC program.

Figure 6 Injury Prevention Education Survey Responses Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

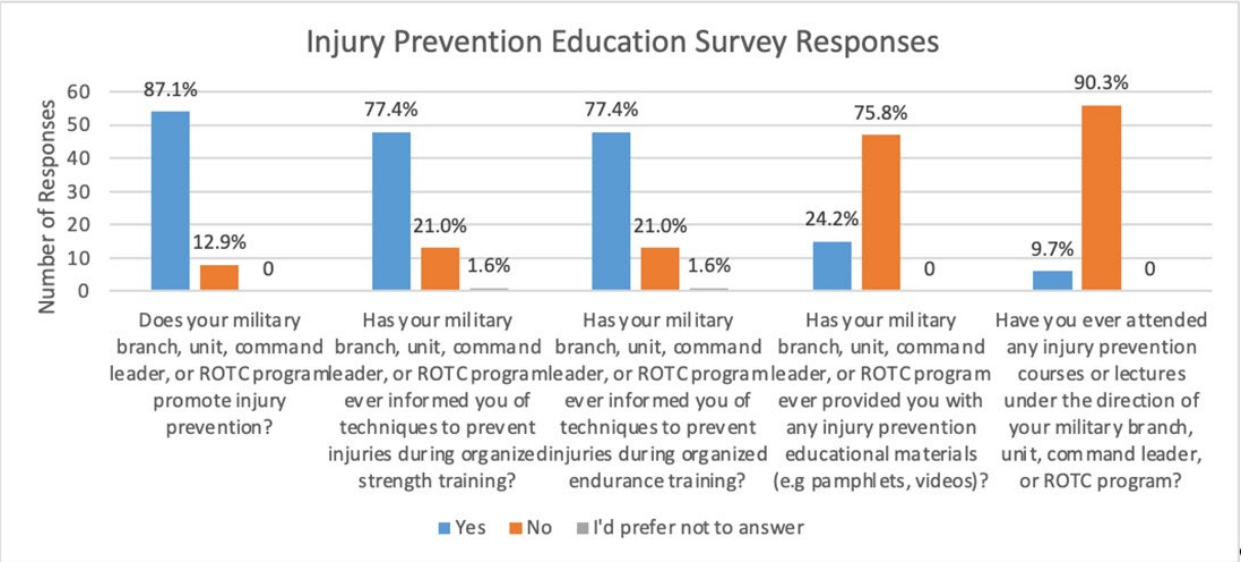


Figure 7 shows the responses to the overtraining injury prevention question regarding the number of miles ran during organized physical training. In response to the overtraining injury prevention responses, 8 (12.9%) cadets reported that their military branch, unit, command leader, ROTC program instructed them to reduce the amount of miles ran during organized training in order to reduce the likelihood of injury and 53 (85.4%) cadets reported that their military branch, unit, command leader, ROTC program never instructed them to reduce the amount of miles ran during organized training in order to reduce the likelihood of injury and 1 (1.6%) cadet preferred not to answer.

Figure 7 Overtraining Injury Prevention Survey Responses Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

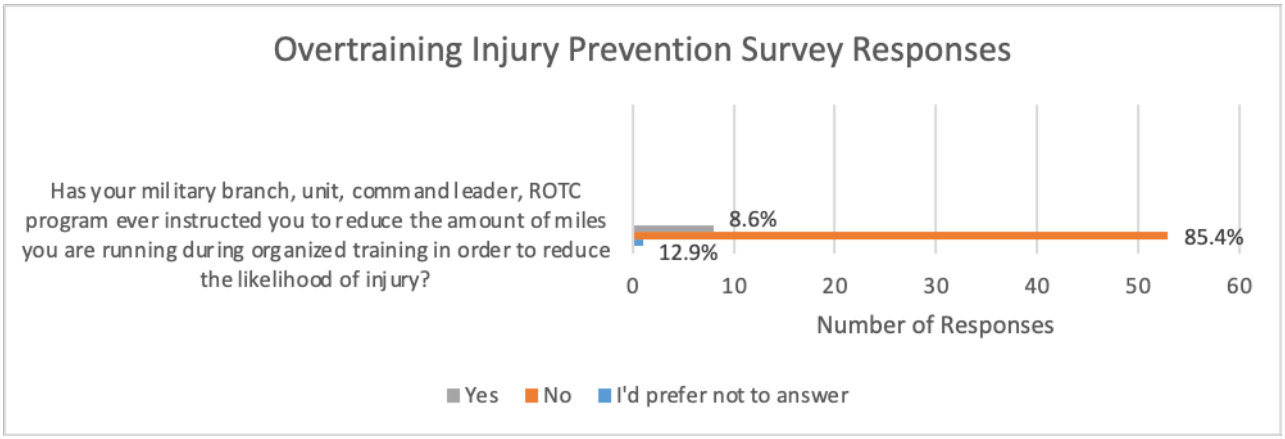


Figure 8 shows the responses to the overtraining injury prevention question regarding stress fractures. In response to the overtraining injury prevention responses, 2 (3.2%) stated that have had a stress fracture once, 1 (1.6%) stated that they have had a stress fracture more than once, 58 (93.5%) cadets stated that they have never had a stress fracture during their time in collegiate ROTC and 1 (1.6%) preferred not to answer.

Figure 8 Overtraining Injury Prevention Survey Responses Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

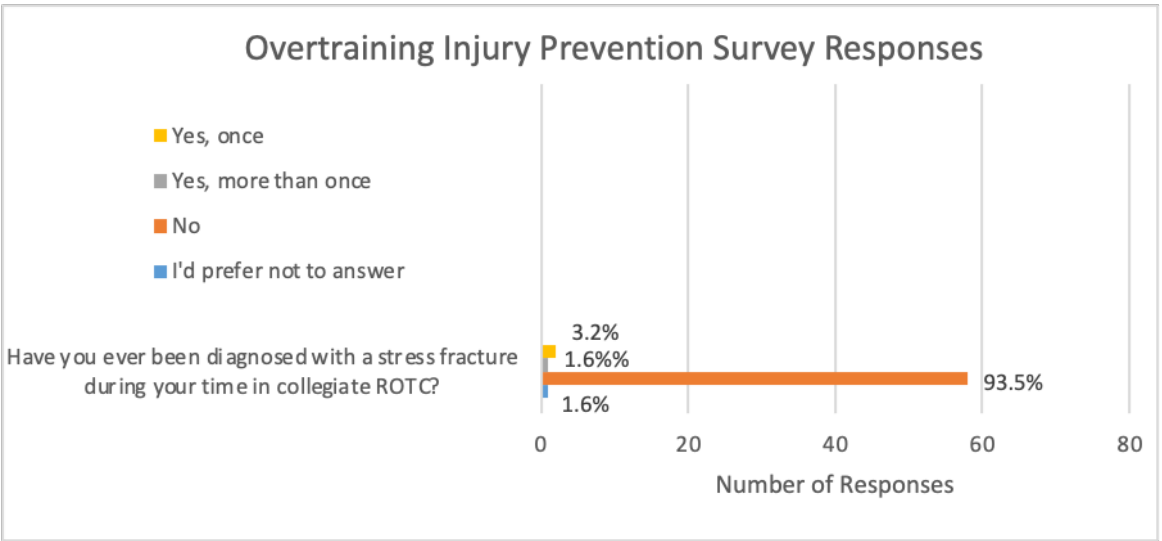


Table 4 shows the protein supplements and high protein foods consumed 1 hour following organized physical training. In response to protein consumption in a 1-hour window following organized training sessions, protein shake was selected 19 times, protein powder was selected 25 times, food high in protein was selected 19 times, and no consumption of protein supplements or foods high in protein was selected 16 times. The most popular response for high protein foods were eggs (12) followed by white meats (4), red meats (4), milk (3), yogurt, and cliff bars.

Table 4 Types of Protein Supplements/Drinks or Foods High in Protein Consumed in a 1-Hour Window Following Organized Training Sessions Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

Item	Count
Protein shake	19 (24.1%)
Protein powder	25 (31.6%)
Protein pills or tablets	0
Other protein supplement	0
Food high in protein	19 (24.1%)
I do not consume any protein supplements or foods high in protein within a 1-hour window following organized training sessions	16 (20.3%)

Total 79 * Numbers do not add up to 62 as participants could choose >1 option

Table 5 shows the carbohydrate supplements and high carbohydrate foods consumed 1 hour following organized physical training. In response to carbohydrate consumption in a 1-hour window following organized training sessions, carbohydrate powder was selected once, healthy foods high in carbohydrates was selected 22 times, and no consumption of carbohydrate supplements or healthy foods high in carbohydrates was selected 36 times. The most popular response for foods high in carbohydrates was bread (12) followed by oatmeal/oats (6), fruits (4), granola bars, and potatoes.

Table 5 Types of Carbohydrate Supplements/Drinks or Foods High in Carbohydrates Consumed in a 1-Hour Window Following Organized Training Sessions Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

Item	Count
Carbohydrate powder	1 (1.3%)
Other carbohydrate supplement	0
Healthy foods high in carbohydrates	22 (27.8%)
I do not consume any carbohydrate supplements or foods high in carbohydrates within a 1-hour window following organized training sessions	36 (45.6%)

Total 79 * Numbers do not add up to 62 as participants could choose >1 option

3.1.1.2 Training routine and injury prevention responses by sex among collegiate ROTC cadets

When looking at the amount of time spent during organized physical training among female and male collegiate ROTC cadets, most women and men spend 1-4 hours in organized physical training per week (Table 6). Of the 26 women, 21 women (80.8%) stated that they participate in organized physical training 1-4 hours per week; 2 [women (7.7%)] stated that they participate in organized physical training less than 1 hour per week, and 2 [women (7.7%)] stated that they participate in organized physical training 5-10 hours a per week. One female respondent (3.8%) stated that she does not participate in organized physical training. Of the 36 men, 27 (75.0%) stated that they participate in organized physical training 1-4 hours per week. Six male respondents (16.7%) stated that they participate in organized physical training 5-10 hours per week, and 2 men (5.6%) stated that they participate in organized physical training more than 10 hours per week; One male respondent (2.8%) stated that he participates in organized physical training less than 1

hour per week. These differences in organized physical training participation were not statistically significant between sexes (Fisher's exact test p=0.375).

Table 6 Participation in Organized Physical Training by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	I do not participate in organized physical training	Yes, < 1 hour/week	Yes, 1-4 hours/ week	Yes, 5-10 hours/week	Yes, > 10 hours/week
Female	1/26 = 3.8%	2/26 = 7.7%	21/26 = 80.8%	2/26= 7.7%	0
Male	0/36 = 0.0%	1/36 = 2.8%	27/36 = 75.0%	6/36 = 16.7%	2/36= 5.6%

When looking at the number of days per week collegiate female and male ROTC cadets participate in organized strength training, most women and men participate in strength training 2-3 days per week (Table 7). Five respondents stated that they did not participate in organized strength training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 57 respondents. Of the 23 women, 18 women (78.3%) stated that they participate in organized strength training 2-3 days per week; 5 [women (21.7%)] stated that they participate in organized strength training 1 day per week. Of the 34 men, 19 (55.9%) stated that they participate in organized strength training 2-3 days per week. Nine male respondents (26.5%) stated that they participate in organized strength training 1 day per week, 4 male respondents (11.8%) stated that they participate in organized strength training 4-5 days per week, and 2 men (5.9%) stated that they participate in organized strength training 6-7 days per week. These differences in organized strength training participation were not statistically significant between sexes (Fisher's exact test p=0.179).

Table 7 Weekly Participation in Organized Strength Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Female	5/23 = 21.7%	18/23 = 78.3%	0	0
Male	9/34 = 26.5%	19/34 = 55.9%	4/34 = 11.8%	2/ 34 = 5.9%

When looking at the number of days per week collegiate female and male ROTC cadets participate in organized endurance training, most women and men participate in endurance training 2-3 days per week (Table 8). Two respondents stated that they did not participate in organized endurance training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 60 respondents. Of the 25 women, 16 women (64.0%) stated that they participate in organized endurance training 2-3 days per week; 8 [women (32.0%)] stated that they participate in organized endurance training 1 day per week; One female respondent (4.0%) stated that she participates in organized endurance training 6-7 days per week. Of the 35 men, 21 (60.0%) stated that they participate in organized endurance training 2-3 days per week. Twelve male respondents (34.3%) stated that they participate in organized endurance training 1 day per week, 2 male respondents (5.7%) stated that they participate in organized endurance training 4-5 days per week. These differences in organized endurance training participation were not statistically significant between sexes (Fisher's exact test p=0.549).

Table 8 Weekly Participation in Organized Endurance Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Female	8/25 = 32.0%	16/25 = 64.0%	0	1/25 = 4.0%
Male	12/35= 34.3%	21/35 = 60.0%	2/35 = 5.7%	0

When looking at the number of miles female and male ROTC cadets run per week during organized endurance training, most women and men participate run 2-4 miles per week (Table 9). Two respondents stated that they did not participate in organized endurance training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 60 respondents. Of the 25 women, 16 women (64.0%) stated that they run 2-4 miles per week; 5 [women (20.0%)] stated that they run 5-9 miles week; Three female respondents (12.0%) stated that they run less than one mile per week; One female respondent (4.0%) stated that they run 10-15 miles per week. Of the 35 men, 27 (77.1%) stated that they run 2-4 miles per week; 7 [men (20.0%)] stated that they run 5-9 miles per week; One male respondent (2.9%) stated that they run less than one mile per week. These differences in miles ran during endurance training were not statistically significant between sexes (Fisher's exact test p=0.329).

Table 9 Number of Miles Ran Per Week During Organized Endurance Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	< 1 miles/week	2-4 miles/week	5-9 miles/week	10-15 miles/week
Female	3/25 = 12.0%	16/25 = 64.0%	5/25 = 20.0%	1/25 = 4.0%
Male	1/35 = 2.9%	27/35 = 77.1%	7/35 = 20.0%	0

When looking at cadet's participation in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program, 19 woman (73.1%) and 23 men (63.9%) stated that they have participated in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program (Table 10). These differences in stabilization training participation were not statistically significant between sexes (Fisher's exact test p=0.314).

Table 10 Number of Cadets that Participate in Strength Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	19/26 = 73.1%	7/26= 26.9%
Male	23/36 = 63.9%	13/36 = 36.1%

When looking at cadet's participation in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program, 12 woman (46.2%) and 12 men (38.9%) stated that they have participated in neuromuscular training organized by their perspective military branch, unit, command leader, or ROTC program (Table 11). These differences in neuromuscular training participation were not statistically significant between sexes (Fisher's exact test p=0.377).

Table 11 Number of Cadets that Participated in Neuromuscular Training by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	12/26 = 46.2%	14/26 = 53.8%
Male	14/36 = 38.9%	22/36 = 61.1%

When looking at cadet's participation in agility training organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not to answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 12). Twelve woman (46.2%) and 18 men (51.4%) stated that they have participated in agility training organized by their perspective military branch, unit, command leader, or ROTC program. These differences in agility training participation were not statistically significant between sexes (Fisher's exact test p=0.441).

Table 12 Number of Cadets that Participated in Agility Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	12/26 = 46.2%	1426 = 53.8%
Male	18/35 = 51.4%	17/35 = 48.6%

When looking at cadet's participation in a postural assessment organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not to answer." The respondent was excluded from the following results. The primary

investigator analyzed the remaining 61 respondents (Table 13). Five woman (19.2%) and 6 men (17.1%) stated that they have participated in a postural assessment organized by their perspective military branch, unit, command leader, or ROTC program. These differences in postural assessment participation were not statistically significant between sexes (Fisher's exact test p=0.546).

Table 13 Number of Cadets that Participated in Postural Assessments by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	5/26 = 19.2%	21/26 = 80.8%
Male	6/35 = 17.1%	29/35 = 82.9%

When asked if their perspective military branch, unit, command leader, or ROTC program promoted injury prevention, 21 (80.8%) female cadets and 33 (91.7%) male cadets stated that their military branch, unit, command leader, or ROTC program promotes injury prevention (Table 14). These differences in injury prevention promotion responses were not statistically significant between sexes (Fisher's exact test p=0.189).

Table 14 Number of Cadets that Stated that Their Military Branch, Unit, Command Leader, or ROTC Program Promotes Injury Prevention by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	21/26 = 80.8%	5/26 = 19.2%
Male	33/36 = 91.7%	3/36 = 8.3%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of injury prevention techniques during organized strength training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 15). Twenty-one (80.8%) female cadets and 27 (77.1%) male cadets stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention techniques during organized strength training. These differences in strength training injury prevention responses were not statistically significant between sexes (Fisher's exact test p=0.493).

Table 15 Number of Cadets Informed of Injury Prevention Techniques During Organized Strength Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	21/26 = 80.8%	5/26 = 19.2%
Male	27/35 = 77.1%	8/35 = 22.9%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of techniques to prevent injuries during organized endurance training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 16). Twenty (76.9%) female cadets and 28 (80.0%) male cadets stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention techniques during organized endurance training. These differences in endurance training injury prevention responses were not statistically significant between sexes (Fisher's exact test p=0.507).

Table 16 Number of Cadets Informed of Injury Prevention Techniques During Organized Endurance Training by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	20/26 = 76.9%	6/26 = 23.1%
Male	28/35 = 80.0%	7/35 = 20.0%

When asked if their perspective military branch, unit, command leader, or ROTC ever provided them with educational injury prevention material such as pamphlets or videos, 3 (11.5%) female cadets and 13 (36.1%) male cadets stated that their military branch, unit, command leader, or ROTC program provided them with educational injury prevention material (Table 17). These differences in injury prevention education material responses were statistically significant between sexes (Fisher's exact test p=0.04).

Table 17 Number of Cadets Provided with Injury Prevention Educational Materials by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	3/26 = 11.5%	23/26 = 88.5%
Male	13/36 = 36.1%	23/36 = 63.9%

When asked if they ever attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program, 1 (3.8%) female cadet and 5 (13.9%) male cadets stated that they have attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program (Table 18). These differences in injury prevention responses were not statistically significant between sexes (Fisher's exact test p=0.387).

Table 18 Number of Cadets that Attended an Injury Prevention Course or Lecture by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	1/26 = 3.8%	25/26 = 96.2%
Male	5/36 = 13.9%	31/36 = 86.1%

When asked if their military branch, unit, command leader, or ROTC program ever instructed them to reduce the number of miles they are running during organized training in order to reduce the likelihood of injury, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 19). Three (11.5%) female respondents and 5 (14.3%) male respondents stated

that their military branch, unit, command leader, or ROTC program instructed them to reduce the number of miles they are running during organized training in order to reduce the likelihood of injury. These differences in injury prevention responses were not statistically significant between sexes (Fisher's exact test p=1.00).

Table 19 Number of Cadets Informed to Reduce the Number of Miles Ran During Organized Endurance Training in Order to Reduce the Likelihood of Injury by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	3/26 = 11.5%	23/26 = 88.5%
Male	5/35 = 14.3%	30/35 = 85.7%

When asked if they have ever sustained a stress fracture during their time in collegiate ROTC, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 20). Two (7.7%) female respondents stated that they sustained a stress fracture once and 1 (2.9%) male respondent stated that he sustained a stress fracture more than once. These differences in stress fracture responses were not statistically significant between sexes (Fisher's exact test p=0.178).

Table 20 Frequency of Stress Fractures Sustained During Collegiate ROTC by Sex Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes, once	Yes, more than once	No
Female	2/26 =7.70%	0	24/26 = 92.0%
Male	0	1/35 = 2.9%	34/35 = 97.1%

When looking at food, drink, or supplement consumption within a 1-hour window following organized training for nutrient replacement placement among collegiate ROTC cadets, 19 (73.1%) women and 32 (88.9%) men stated that they consume food, drinks, or supplements within a 1 hour window following organized training for nutrient replacement placement (Table 21). These differences in nutrient replacement responses were not statistically significant between sexes (Fisher's exact test p=0.177).

Table 21 Number of Cadets that Consume Food, Drink, or a Supplement Within a 1-hour Window Following Organized Training for Nutrient Replacement Placement by Sex Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Female	19/26 =73.1%	7/26 = 26.9%
Male	32/36 = 88.9%	4/36 = 11.1%

3.1.1.3 Training routine and injury prevention responses by branch among collegiate ROTC cadets

When looking at the number of days per week collegiate ROTC participate in organized strength training, most cadets participate in strength training 2-3 days per week. Five respondents

stated that they did not participate in organized strength training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 57 respondents (Table 22). Of the 13 Air Force cadets, 12 respondents (92.3%) stated that they participate in organized strength training 2-3 days per week; One respondent (7.7%) stated that they participate in organized strength training 1 day per week. Of the 27 Army cadets, 20 (74.1%) stated that they participate in organized strength training 2-3 days per week, one (11.1%) respondent stated that they participate in organized strength training 1 day per week, 2 army respondents (7.4%) stated that they participate in organized strength training 4-5 days per week, and 2 army respondents (7.4%) stated that they participate in organized strength training 6-7 days per week. Of the 2 Marine midshipmen, 1 (50%) stated that they participate in organized strength training 1 day per week and 1 (50%) respondent stated that they participate in organized strength training 2-3 days per week. Of the 15 Navy midshipmen, 9 (60.0%) stated that they participate in organized strength training 1 day per week, 4 (26.7%) stated that they participate in organized strength training 2-3 days per week, and 2 (13.3%) respondents stated that they participate in organized strength training 4-5 days per week. These differences in organized strength training participation were statistically significant between branches (Fisher's exact test p=0.002).

Table 22 Weekly Participation in Organized Strength Training by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Air Force	1/13 = 7.7%	12/13 = 92.3%	0	0
Army	3/27 = 11.1%	20/27 = 74.1%	2/27 = 7.4%	2/27 = 7.4%
Marines	1/2 = 50%	1/2 = 50%	0	0
Navy	9/15 = 60.0%	4/15 = 26.7 %	2/15 = 13.3%	0

When looking at the number of days per week collegiate ROTC participate in organized endurance training, most cadets participate in endurance training 2-3 days per week. Two respondents stated that they did not participate in organized endurance training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 60 respondents (Table 23). Of the 14 Air Force cadets, 12 respondents (85.7%) stated that they participate in organized endurance training 2-3 days per week; Two respondents (14.3%) stated that they participate in organized endurance training 1 day per week. Of the 27 Army cadets, 19 (70.4%) stated that they participate in organized endurance training 2-3 days per week, 5 (18.5%) respondents stated that they participate in organized endurance training 1 day per week, 2 army cadets (7.4%) stated that they participate in organized endurance training 4-5 days per week, and 1 army cadet (3.7%) stated that they participate in organized endurance training 6-7 days per week. Of the 2 Marine midshipmen, 1 (50%) stated that they participate in organized endurance training 1 day per week and 1 (50%) respondent stated that they participate in organized endurance training 2-3 days per week. Of the 17 Navy midshipmen, 12 (70.6%) stated that they participate in organized endurance training 1 day per week and 5 (29.4%) stated that they participate in organized endurance training 2-3 days per week. These differences in organized endurance training participation were statistically significant between branches (Fisher's exact test p=0.004).

Table 23 Weekly Participation in Organized Endurance Training by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Air Force	2/14 = 14.3%	12/14 = 85.7%	0	0
Army	5/27 = 18.5%	19/27 = 70.4%	2/27 = 7.4 %	1/27 = 3.7%
Marines	1/2 = 50%	1/2 = 50%	0	0
Navy	12/17 = 70.6%	5/17 = 29.4%	0	0

When looking at cadet's participation in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program, 19 (70.4%) Army cadets, 15 (83.3%) Navy midshipmen, 6 (42.9%) Air Force cadets, and 2 (66.7%) Marine midshipmen stated that they have participated in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program (Table 24). These differences in stabilization training participation were not statistically significant between branches (Fisher's exact test p=0.107).

Table 24 Number of Cadets that Participated in Stabilization Training by Branch Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	6/14 = 42.9%	8/14 = 57.1%
Army	19/27 = 70.4%	8/27 = 29.6%
Marines	2/3 = 66.7%	1/3 = 33.3%
Navy	15/18 = 83.3%	3/18 = 16.7%

When looking at cadets' participation in neuromuscular training organized by their respective military branch, unit, command leader, or ROTC program, 11 (61.1%) Navy midshipmen, 10 (37.0%) Army cadets, 4 (28.6%) Air Force cadets, and 1 (33.3%) Marine midshipman stated that they have participated in neuromuscular training organized by their perspective military branch, unit, command leader, or ROTC program (Table 25). These differences in neuromuscular training participation were not statistically significant between branches (Fisher's exact test p=0.244).

Table 25 Number of Cadets that Participated in Neuromuscular Training by Branch Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	4/14 = 28.6%	10/14 = 71.4%
Army	10/27 = 37.0%	17/27 = 63.0%
Marines	1/3 = 33.3%	2/3 = 66.7%
Navy	11/18 = 61.1%	7/18 = 38.9%

When looking at cadet's participation in agility training organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 26). Fourteen (77.8%) Navy midshipmen, 9 (34.6%) Army cadets, 4 (28.6%) Air Force cadets, and 3 (100%) Marine midshipmen stated that they have participated in agility training organized by their perspective military branch, unit, command leader, or ROTC program. These differences in agility training participation were statistically significant between branches (Fisher's exact test p=0.003).

Table 26 Number of Cadets that Participated in Agility Training by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	4/14 = 28.6%	10/14 = 71.4%
Army	9/26 = 34.6%	17/26 = 65.4%
Marines	3/3 = 100.0%	0
Navy	14/18 = 77.8%	4/18 = 22.2%

Table 27 Number of Cadets that Participated in Postural Assessments by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	2/14 = 14.3%	12/14 = 85.7%
Army	5/26 = 19.2%	21/26 = 80.8%
Marines	0	3/3 = 100.0%
Navy	4/18 = 22.2%	14/18 = 77.8%

When looking at cadet's participation in postural assessment organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 27). Five (19.2%) Army cadets, 4 (22.2%) Navy midshipmen, and 2 (14.3%) Air Force cadets stated that they have participated in postural assessment organized by their perspective military branch, unit, command leader, or ROTC program. These differences in postural assessment participation were not statistically significant between branches (Fisher's exact test p=0.953).

When asked if their perspective military branch, unit, command leader, or ROTC program promoted injury prevention, 24 (89.9%) Army cadets, 15 (83.3%) Navy midshipmen, 12 (85.7%) Air Force cadets, and 3 Marine midshipmen stated that their military branch, unit, command leader, or ROTC program promotes injury prevention (Table 28). These differences in injury prevention promotion responses were not statistically significant between branches (Fisher's exact test p=0.928).

Table 28 Number of Cadets that Stated that Their Military Branch, Unit, Command Leader, or ROTC Program Promotes Injury Prevention by Branch Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	12/14 = 85.7%	2/14 = 14.3%
Army	24/27 = 89.9%	3/27 = 11.1%
Marines	3/3 = 100.0%	0
Navy	15/18 = 83.3%	3/18 = 16.7%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of injury prevention techniques during organized strength training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 29). Twenty-two (81.5%) Army cadets, 13 (72.2%) Navy midshipmen, 10 (76.9%) Air Force cadets, and 3 (100.0%) Marine midshipmen stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention techniques during organized strength training. These differences in strength training injury prevention responses were not statistically significant between branches (Fisher's exact test p=0.801).

Table 29 Number of Cadets Informed of Injury Prevention Techniques During Organized Strength Training by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	10/13 = 76.9%	3/13 = 23.1%
Army	22/27 = 81.5%	5/27 = 18.5%
Marines	3/3 = 100.0%	0
Navy	13/18 = 72.2%	5/18 = 27.8%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of injury prevention techniques during organized endurance training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 30). Twenty-one (80.8%) Army cadets, 13 (72.2%) Navy midshipmen, 11 (76.9%) Air Force cadets, and 3 (100.0%)

Marine midshipmen stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention techniques during organized endurance training. These differences in endurance training injury prevention responses were not statistically significant between branches (Fisher's exact test p=0.927).

Table 30 Number of Cadets Informed of Injury Prevention Techniques During Organized Endurance Training by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	11/14 = 78.6%	3/14 = 21.4%
Army	21/26 = 80.8%	5/26 = 19.2%
Marines	3/3 = 100.0%	0
Navy	13/18 = 72.2%	5/18 = 27.8%

When asked if their perspective military branch, unit, command leader, or ROTC program ever provided them with educational injury prevention material such as pamphlets or videos, 9 (11.5%) female Army cadets, 4 (28.6%), Air Force midshipmen, and 3 (16.7%) Navy midshipmen stated that their military branch, unit, command leader, or ROTC program provided them with educational injury prevention material (Table 31). These differences in injury prevention education material responses were not statistically significant between branches (Fisher's exact test p=0.533).

Table 31 Number of Cadets Provided with Injury Prevention Educational Materials by Branch Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	4/14 = 28.6%	10/14 = 71.4%
Army	9/27 = 33.3%	18/27 = 66.7%
Marines	0	3/3 = 100.0%
Navy	3/18 = 16.7%	15/18 = 83.3%

When asked if they ever attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program, 3 (11.1%) Army cadets, 2 (14.3%) Air Force cadets, 1 (5.6%) Navy midshipman stated that they have attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program (Table 32). These differences in injury prevention responses were not statistically significant between branches (Fisher's exact test p=0.819).

Table 32 Number of Cadets that Attended an Injury Prevention Course or Lecture by Branch Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	2/14 = 14.3%	12/14 = 85.7%
Army	3/27 = 11.1%	24/27 = 88.9%
Marines	0	3/3 = 100.0%
Navy	1/18 = 5.60%	17/18 = 94.4%

When asked if their military branch, unit, command leader, or ROTC program ever instructed them to reduce the number of miles they are running during organized training in order to reduce the likelihood of injury, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 33). Five (18.5%) Army cadets and 3 (16.7%) Navy midshipmen stated that their military branch, unit, command leader, or ROTC program instructed them to reduce the number of miles they are running during organized training in order to reduce the likelihood of injury. These differences in injury prevention responses were not statistically significant between branches (Fisher's exact test p=0.365).

Table 33 Number of Cadets Instructed to Reduce the Number of Miles Ran During Organized Endurance Training in Order to Reduce the Likelihood of Injury by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	0	13/13 = 100.0%
Army	5/27 = 18.5%	22/27 = 81.5%
Marines	0	3/3 = 100.0%
Navy	3/18 = 16.7%	15/18 = 83.3%

When asked if they have ever sustained a stress fracture during their time in collegiate ROTC, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents. Two (7.4%) Army cadets stated that they sustained a stress fracture once and 1 (3.7%) Army cadet stated that they sustained a stress fracture more than once (Table 34). These differences in stress fracture responses were not statistically significant between branches (Fisher's exact test p=0.798).

Table 34 Frequency of Stress Fractures Sustained During Collegiate ROTC by Branch Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes, once	Yes, more than once	No
Air Force	0	0	13/13 = 100.0%
Army	2/27 = 7.4%	1/27 = 3.7%	24/27 = 88.9%
Marines	0	0	3/3 = 100.0%
Navy	0	0	18/18 = 100.0%

When looking at food, drink, or supplement consumption within a 1-hour window following organized training for nutrient replacement placement among collegiate ROTC cadets, 19 (73.1%) women and 32 (88.9%) men stated that they consume food, drinks, or supplements within a 1-hour window following organized training for nutrient replacement placement (Table 35). These differences in nutrient replacement responses were not statistically significant between branches (Fisher's exact test p=0.078).

Table 35 Number of Cadets that Consume Food, Drink, or Supplement Within a 1-hour Window Following Organized Training for Nutrient Replacement Placement Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Air Force	12/14 = 85.7%	2/14 = 14.3%
Army	21/27 = 77.8%	6/27 = 22.2%
Marines	1/3 33.3%	2/3 66.7%
Navy	17/18 = 94.4%	1/18 = 5.6%

3.1.1.4 Training routine and injury prevention responses by academic class among collegiate ROTC cadets

When looking at the number of days per week collegiate ROTC cadets participate in organized strength training, five respondents stated that they did not participate in organized strength training. Those respondents were excluded from the following results. The primary investigator analyzed the remaining 57 respondents (Table 36). Five (29.4%) freshmen, 4 juniors (20.0%), 3 (30.0%) seniors, 2 (20.0%) sophomores stated that they participate in organized strength training 1 day per week; 12 freshmen (70.6%), 11 juniors (55.0%), 7 sophomores (70.0%), and 7 (70.0%) seniors participate in organized strength training 2-3 days per week; 1 (10.0%) sophomore and 3 (15.0%) juniors stated that they participate in organized strength training 4-5 days per week; 2 (10.0%) stated that they participate in strength training 6-7 days per week. These differences in organized strength training participation were not statistically significant between academic classes (Fisher's exact test p=0.673).

Table 36 Weekly Participation in Organized Strength Training by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Freshman	5/17 = 29.4%	12/17 = 70.6%	0	0
Sophomore	2/10 = 20.0%	7/10 = 70.0%	1/10 = 10%	0
Junior	4/20 = 20.0%	11/20 = 55.0%	3/20= 15.0%	2/20 = 10.0%
Senior	3/10 = 30.0%	7/10 = 70.0%	0	0

When looking at the number of days per week collegiate ROTC cadets participate in organized endurance training, two respondents stated that they did not participate in organized endurance training. Those respondents were excluded from the following results. The primary

investigator analyzed the remaining 60 respondents (Table 37). Six (31.6%) junior cadets, 5 (29.4%) freshman cadets, 5 (38.5%) sophomore cadets, and 4 (36.4%) senior cadets stated that they participate in organized endurance training 1 day per week; 11 (64.7%) freshmen, 11 (57.9%) juniors, 8 (61.5%) sophomores, and 7 (63.6%) seniors stated that they participate in organized endurance training 2-3 days per week. One (10.5%) junior cadet stated that she participates in organized endurance training 4-5 days per week; 1 (5.9%) freshman cadet stated that they participate in organized endurance training 6-7 days per week. These differences in organized endurance training participation were not statistically significant between academic classes (Fisher's exact test p=0.911).

Table 37 Weekly Participation in Organized Endurance Training by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	1 day/week	2-3 days/week	4-5 days/week	6-7 days/week
Freshman	5/17= 29.4%	11/17 = 64.7%	0	1/17 = 5.9%
Sophomore	5/13 = 38.5%	8/13 = 61.5%	0	0
Junior	6/19 = 31.6%	11/19 = 57.9%	2/19 = 10.5%	0
Senior	4/11 = 36.4%	7/11 = 63.6%	0	0

When looking at cadet's participation in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program, 17 (85.0%) junior cadets, 9 (50.0%) freshman cadets, 8 (61.5%) sophomore cadets, 8 (72.7%) senior cadets stated that they have participated in stabilization training organized by their perspective military branch, unit, command leader, or ROTC program (Table 38). These differences in stabilization training participation were not statistically significant between academic classes (Fisher's exact test p=0.128).

Table 38 Number of Cadets that Participated in Stabilization Training by Academic Class Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	9/18 = 50.0%	9/18 = 50.0%
Sophomore	8/13 = 61.5%	5/13 = 38.5%
Junior	17/20 = 85.0%	3/20 15.0%
Senior	8/11 = 72.7%	3/11 = 27.3%

When looking at cadet's participation in neuromuscular training organized by their perspective military branch, unit, command leader, or ROTC program, 9 (50.0%) freshmen, 8 (40.0%) juniors, 5 (45.5%) seniors, and 4 (30.8%) sophomores stated that they have participated in neuromuscular training organized by their perspective military branch, unit, command leader, or ROTC program (Table 39). These differences in neuromuscular training participation were not statistically significant between academic classes (Fisher's exact test p=0.787).

Table 39 Number of Cadets that Participated in Neuromuscular Training by Academic Class Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	9/18 = 50.0%	9/18 = 50.0%
Sophomore	4/13 = 30.8%	9/13 = 69.2%
Junior	8/20 = 40.0%	12/20 = 60.0%
Senior	5/11 = 45.5%	6/11 = 54.5%

When looking at cadet's participation in agility training organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 40). Nine (50.0%) freshmen, 9 (47.4%) juniors, 5 (38.5%) sophomores, and 7 (63.6%) seniors stated that they have participated in agility training organized by their perspective military branch, unit, command leader, or ROTC program. These differences in agility training participation were not statistically significant between academic classes (Fisher's exact test p=0.706).

Table 40 Number of Cadets that Participated in Agility Training by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	9/18 = 50.0%	9/18 = 50.0%
Sophomore	5/13 = 38.5%	8/13 = 61.5%
Junior	9/19 = 47.4%	10/19 = 52.6%
Senior	7/11 = 63.6%	4/11 = 36.4%

When looking at cadet's participation in a postural assessment organized by their perspective military branch, unit, command leader, or ROTC program, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 41). Four (30.8%) sophomores, 3 (16.7%) freshmen, 3 (27.3%) seniors, 1 (5.3%) junior stated that they have participated in a postural assessment organized by their perspective military branch, unit, command leader, or ROTC program. These differences in postural assessment participation were not statistically significant between academic classes (Fisher's exact test p=0.661).

Table 41 Number of Cadets that Participated in Postural Assessments by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	3/18 = 16.7%	15/18 = 83.3%
Sophomore	4/13 = 30.8%	9/13 = 69.2%
Junior	1/19 = 5.3%	18/19 = 94.7%
Senior	3/11 = 27.3%	8/11 = 72.7%

When asked if their perspective military branch, unit, command leader, or ROTC program promoted injury prevention, 17 (94.4%) freshmen, 16 (20%) juniors, 11 (84.6%) sophomores, and 10 (90.9%) seniors stated that their military branch, unit, command leader, or ROTC program promotes injury prevention (Table 42). These differences in injury prevention promotion responses were not statistically significant between academic classes (Fisher's exact test p=0.661).

Table 42 Number of Cadets that Stated that Their Military Branch, Unit, Command Leader, or ROTC Program Promotes Injury Prevention by Academic Class Reported by 62 ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	17/18 = 94.4%	1/18 = 5.6%
Sophomore	11/13 = 84.6%	2/13 = 15.4%
Junior	16/20 = 20%	4/20 = 20.0%
Senior	10/11 = 90.9%	1/11 = 9.1%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of injury prevention techniques during organized strength training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 43). Sixteen (80.0%) junior, 15 (83.3%) freshman, 9 (75.0%) sophomore, and 8 (72.7%) senior cadets stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention techniques during organized strength training. These differences in strength training injury prevention responses were not statistically significant between academic classes (Fisher's exact test p=0.899).

Table 43 Number of Cadets Informed of Injury Prevention Techniques During Organized Strength Training by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	15/18 = 83.3%	3/18 = 16.7%
Sophomore	9/12 = 75.0%	3/12 = 25.0%
Junior	16/20 = 80.0%	4/20 = 20.0%
Senior	8/11 = 72.7%	3/11= 27.3%

When asked if their perspective military branch, unit, command leader, or ROTC ever informed them of techniques to prevent injuries during organized endurance training, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 44). Fourteen (77.8%) freshman, 13 (68.4%) junior, 12 (92.3%), and 9 (81.8%) senior cadets stated that their military branch, unit, command leader, or ROTC program informed them of injury prevention

techniques during organized endurance training. These differences in endurance training injury prevention responses were not statistically significant between academic classes (Fisher's exact test $p=0.466$).

Table 44 Number of Cadets Informed of Injury Prevention Techniques During Organized Endurance Training by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	14/18 = 77.8%	4/18 = 22.2%
Sophomore	12/13 = 92.3%	1/12 = 7.7%
Junior	13/19 = 68.4%	6/19 = 31.6%
Senior	9/11 = 81.8%	2/11 = 18.2%

When asked if their perspective military branch, unit, command leader, or ROTC ever provided them with educational injury prevention material such as pamphlets or videos, 5 (45.5%) senior cadets, 4 (20.0%) junior cadets, 4 (30.8%) sophomore cadets, and 3 (16.7%) freshman cadets stated that their military branch, unit, command leader, or ROTC program provided them with educational injury prevention material (Table 45). These differences in injury prevention education material responses were statistically significant between academic classes (Fisher's exact test p=0.335).

Table 45 Number of Cadets Provided with Injury Prevention Educational Materials by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	3/18 = 16.7%	15/18 = 83.3%
Sophomore	4/13 = 30.8%	9/13 = 69.2%
Junior	4/20 = 20.0%	16/20 = 80.0%
Senior	5/11 = 45.5%	6/11 = 54.5%

When asked if they ever attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program, 2 (15.4%) sophomore cadets, 2 (10.0%) junior cadets, and 2 (18.2%) senior cadets stated that they have attended an injury prevention course or lecture under the direction of their perspective military branch, unit, command leader, or ROTC program (Table 46). These differences in injury prevention responses were not statistically significant between academic classes (Fisher's exact test p=0.271).

Table 46 Number of Cadets that Attended an Injury Prevention Course or Lecture by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	0	18/18 = 100.0%
Sophomore	2/13 = 15.4%	11/13 = 84.6%
Junior	2/20 = 10.0%	18/20 = 90.0%
Senior	2/11 = 18.2%	9/11 = 81.8%

When asked if their military branch, unit, command leader, or ROTC program ever instructed them to reduce the number of miles they are running during organized training in order to reduce the likelihood of injury, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 47). Three (16.7%) freshman cadets, 2 (16.7%) sophomore cadets, 2(18.2%) senior cadets and 1 (5.0%) junior cadet stated that their military branch, unit, command leader, or ROTC program instructed them to reduce the number of miles they are running during organized

training in order to reduce the likelihood of injury. These differences in injury prevention responses were not statistically significant between academic classes (Fisher's exact test p=0.617).

Table 47 Number of Cadets Instructed to Reduce the Number of Miles Ran During Organized Endurance Training in Order to Reduce the Likelihood of Injury by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	3/18 = 16.7%	15/18 = 83.3%
Sophomore	2/12 = 16.7%	10/12 = 83.3%
Junior	1/20 = 5.0%	19/20 95.0%
Senior	2/11 = 18.2%	9/11 = 81.8%

When asked if they have ever sustained a stress fracture during their time in collegiate ROTC, one respondent selected, "I'd prefer not answer." The respondent was excluded from the following results. The primary investigator analyzed the remaining 61 respondents (Table 48). Two (10.0%) junior cadets stated that they sustained a stress fracture once and 1 (5.0%) junior cadet stated that they sustained a stress fracture more than once. These differences in stress fracture responses were not statistically significant between academic classes (Fisher's exact test p=0.535).

Table 48 Frequency of Stress Fractures Sustained During Collegiate ROTC by Academic Class Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes, once	Yes, more than once	No
Freshman	0	0	18/18 = 100.0%
Sophomore	0	0	12/12 = 100.0%
Junior	2/20 = 10.0%	1/20 = 5.0%	17/20 = 85.0%
Senior	0	0	11/11 = 100.0%

When looking at food, drink, or supplement consumption within a 1-hour window following organized training for nutrient replacement placement among collegiate ROTC cadets, 17 (85.0%) junior cadets, 14 (77.8%) freshman cadets, 11 (84.6%) sophomore cadets and 9 (81.8%) senior cadets stated that they consume food, drinks, or supplements within a 1-hour window following organized training for nutrient replacement placement (Table 49). These differences in nutrient replacement responses were not statistically significant between academic classes (Fisher's exact test p=0.967).

Table 49 Number of Cadets that Consume Food, Drink, or a Supplement Within a 1-hour Window Following Organized Training for Nutrient Replacement Placement Reported by ROTC Cadets at the University of Pittsburgh and Carnegie Mellon University

	Yes	No
Freshman	14/18 = 77.8%	4/18 =22.2%
Sophomore	11/13 = 84.6%	2/13 = 15.4%
Junior	17/20 = 85.0%	3/20 = 15.0%
Senior	9/11 = 81.8%	2/11 = 18.2%

4.0 Discussion

Physical training plays an integral role in the physical readiness of a cadet. The Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Group provided evidence-based recommendations for injury prevention practices intended for military physical training. The purpose of this study was to investigate the organized physical training routines and to investigate collegiate ROTC cadets' utilization of the Work Group's injury prevention recommendations. The results found that physical training routines are similar among branches and that cadets, on average, participate in organized physical training 1- 4 hours per week, and have minimum utilization of certain injury prevention recommendations recommended by the Work Group.

4.1 To investigate the organized physical training routines among collegiate Air Force, Army, Navy, and Marine ROTC cadets

The results from this study show that the average amount of time participating in organized physical training per week, does not exceed 4 hours each week. On average, a collegiate ROTC cadet participates in organized physical training 1-4 hours per week. This suggests that cadets receive more than enough time to recover between organized physical training sessions. The majority of these subjects, 59.7%, stated they participate in organized strength training 2-3 days per week and more than half, 51%, of all the subjects that participate in organized strength training stated that they do calisthenic workouts during organized strength training. Calisthenics is a

historically popular exercise format within the U.S Armed Services which likely explains why calisthenics was the most selected strength training activity in this study. Another possible explanation may be low accessibility to weight rooms or gyms. Free weight-lifting was selected 29 times (30.2%), but machine lifting was only selected 10 times (10.4%). It is a possibility that cadets are strength training outside (e.g. field, track) or inside a facility other than a weight room and are using free-weights provided by their ROTC program due to lack of access to weight rooms. The majority of these subjects, 59.7%, stated they participate in organized endurance training 2-3 days per week and running, selected 58 times (37.2%), was the most popular activity for endurance training. It is unknown if organized strength training and organized endurance training take place on the same days or during the same sessions. Since, majority of the subjects, 79.0%, stated that they participate in organized training 1-4 hours per week, it is likely that strength training and endurance training take place during the same sessions. If that is the case, on average, collegiate ROTC cadets or midshipmen are meeting the minimum national exercise guidelines. According to the American Heart Association and the National Academy of Sports Medicine (NASM), adults should participate in moderate-intensity aerobic activity at least 150 minutes per week.[1,41] The American Heart Association recommends adding moderate- to high-intensity muscle-strengthening activity to at least 2 days per week.[1] During organized endurance training, the majority of cadets or midshipmen run 2-4 miles per week. Physical fitness tests require soldiers to run 1.5-3 miles as fast as they can, which may explain why cadets or midshipmen run 2-4 miles during organized endurance training.[48]

4.1.1 To investigate the utilization of the Joint Services Training Injury Prevention Work Group's injury prevention recommendations among collegiate Air Force, Army, Navy, and Marine ROTC cadets

Collegiate ROTC cadets and midshipmen utilize the Joint Services Training Injury Prevention Work Group's injury prevention recommendations, whether they know it or not. The results from this study show that the average ROTC cadet or midshipman utilizes a higher percentage of injury prevention education than neuromuscular training injury prevention techniques. When comparing the most popular injury prevention education survey question to the most popular neuromuscular training injury prevention survey question, 77.4% of subjects answered, "Yes" when asked "Does your military branch, unit, command leader, or ROTC program promote injury prevention" compared to the 67.7% of subjects that answered "Yes" to "Have you ever participated in stabilization training organized by their military branch, unit, command leader, or ROTC program." This suggest that injury prevention education may be a more practical recommendation to adopt and utilize. Although, this is not the case for all injury prevention education techniques. When comparing the least popular injury prevention education survey question to the least popular neuromuscular training injury prevention survey question, 90.3% of subjects answered "No" when asked "Have you ever attended an injury prevention course or lecture under the direction of their military branch, unit, command leader, or ROTC program" compared to the 80.6% of subjects that answered "No" to "Have you ever received a postural assessment under the direction of their military branch, unit, command leader, or ROTC program." The majority of ROTC cadets or midshipmen, 85.4%, are not instructed to reduce the number of miles ran during organized training in order to reduce the likelihood of injury. The majority of subjects stated that they only run 2-4 miles per week which is why majority have never been

instructed to run less in order to reduce the likelihood of injury. The number of miles ran in this population does not put this population at increased risk of overuse injury, thus overuse lower extremity injury incidence is predicted to be low in this population. A U.S. Army study showed that subjects who ran 74 fewer miles during 12 weeks of basic combat training decreased their injury incidence by one fourth.[12] Majority of cadets or midshipmen, 93.5%, stated that they have never been diagnosed with stress fracture during their time in collegiate ROTC. This is consistent with the low mileage ran per week.

Nutrient placement plays an important role in injury prevention. The majority, 82.2%, of subjects stated that they consume food, drinks, or supplements within a 1-hour window following organized training for nutrient replacement placement purposes. This suggest that cadets or midshipmen go to the school cafeteria, or elsewhere following training to eat breakfast together or individually. It is recommended to consume a combination of carbohydrates and protein within 1 hour following strenuous exercise in order to initiate positive energy balance and decrease the chances of injury.[12] When the survey inquired about the consumption of protein supplements/drinks or foods high in protein in a 1-hour window following organized training sessions, protein powder received almost one third, 31.6%, of all the responses. “Protein shake” and “foods high in protein” each received one fourth of the responses. On the other hand, carbohydrate consumption in a 1-hour window following organized training was minimal. When the survey inquired about carbohydrate consumption, “I do not consume any carbohydrate supplements or foods high in carbohydrates within a 1-hour window following organized training sessions” received almost half, 45.6%, of all the responses. These results suggest that the repair of muscles damaged during exercise and the replenishment of muscle glycogen stores are not optimized immediately following training in nearly half of the cadets or midshipmen. Cadets or

midshipmen were asked to list the foods high in protein and healthy foods high in carbohydrates that they consume 1-hour (or less) following organized training. Subjects stated that they consume eggs, red meat, yogurt, and milk as a source of protein following training. Subjects stated that they consume bread, oats/oatmeal, and fruits as a source of carbohydrates following training. This demonstrates that subjects are aware of appropriate food items to eat following training. However, some subjects did not list any food items. Again, "protein powder" and "I do not consume carbohydrates in a 1-hour window following training were the most popular protein and carbohydrates survey responses, respectfully. Perhaps, ROTC programs would benefit by having access to a dietitian that can assist in optimizing recovery through diet.

4.1.2 To investigate a difference between sex among training routine and injury prevention responses among ROTC cadets

This study aimed to investigate sex differences among training routine and injury prevention responses. The results revealed that there are no significant differences between women's and men's organized training routines. Some notable differences are that men reported that they participate in organized physical training more than 10 hours per week and participate in organized strength training up to 6-7 days per week and while women reported that they participate in organized physical training up to 5-10 hours per week and participate in organized strength training up to 2-3 days per week. This suggest that women and men may not always trained together. The results revealed that only a few of the injury prevention practices were significantly difference between men and women. A significant difference between sex was found in injury prevention education material responses; 11.5% of female subjects compared to 36.1% of male

subjects stated that their military branch, unit, command leader, or ROTC program provided them with educational injury prevention material.

4.1.3 To investigate a difference between Air Force, Army, Navy, and Marine ROTC branches among training routines and injury prevention survey responses

The primary investigator aimed to investigate branch differences among training routine and injury prevention responses. The results revealed that there are significant differences between the branches' organized training routines. Results revealed that the majority of Army cadets, 74.1%, and the majority of Air Force cadets, 92.3%, participate in organized strength training 2-3 days per week while the majority of Navy midshipmen, 60%, stated that they participate in organized strength training 1 day per week. Results revealed that most Army cadets, 70.4%, and most Air Force cadets, 85.7%, participate in organized endurance training 2-3 days per week while most Navy midshipmen, 70.6%, stated that they participate in organized endurance training 1 day per week. The results revealed that there are significant differences between the branches' injury prevention responses. Results revealed that the majority of Navy midshipmen, 77.8%, participated in agility training organized by their perspective military branch, unit, command leader, or ROTC program compared to Army, 34.6%, and Air Force, 28.6%, cadets.

4.1.4 To investigate a difference between academic class among training routine and injury prevention responses among ROTC cadets

The primary investigator aimed to investigate class differences among training routine and injury prevention responses. The results revealed that there are no significant differences between

the classes' organized training routines or injury prevention responses. However, a notable difference between academic classes is that juniors were the only academic class to report that they have been diagnosed with a stress fracture once and more than once during their time in collegiate ROTC. This is consistent with previous literature that reported that medial tibial stress syndrome, a lower-extremity overuse injury, was found to be most prevalent among cadets who were in their 3rd year (junior year) of training.[16] Left untreated, medial tibial stress syndrome can develop into a stress fracture of the tibia bone.

4.2 Limitations and Future Study Directions

One limitation for this study is that injury prevention and organized training routine survey data was only collected during the 2021-2022 academic year, therefore it may not be representative of utilization during other times of the year. Another limitation is that 18 surveys were excluded from the results due to incompletion. Another issue was the lack of Marine respondents that participated in the Qualtrics survey. A true representation of Marine organized training routines and injury prevention practices were not collected in the Qualtrics survey. Since the Qualtrics survey asked cadets and midshipmen about their military branch, unit, command leader, or ROTC program's injury prevention practices and organized training routines, it is possible that subjects felt obligated to select favorable responses.

This study is a first step in evaluating organized training routines and the use of the Work Group's injury prevention recommendations in collegiate ROTC programs. More research needs to be done to see if more injury prevention practices need to be implemented in collegiate ROTC

programs. This includes a new study that investigates injury incidence among ROTC cadets and midshipmen. Furthermore, the influence that injury prevention staff have in ROTC programs should be investigated. This would assist in the education of cadets/midshipmen and help improve injury prevention practices utilized within the program. Finally, further research into injury prevention practices in these programs could lead the way for the expansion of injury prevention practices into ROTC programs at other colleges and universities.

4.3 Conclusion

This study is first step in determining the use of injury prevention practices among ROTC programs in response to the 2004-2010 Defense Safety Oversight Council's (DSOC) Joint Services Training Injury Prevention Work Group's injury prevention recommendations as well as determining organized training routines in various ROTC programs. This study opens the possibility for more research to be conducted involving injury prevention practices and their effect on injury incidence. With physical training playing a crucial role in a cadets' military readiness, more comprehensive injury prevention practices could impact cadets in unexpected ways. The Work Group has stated clear recommendations for military injury prevention that should be considered when ROTC programs are training cadets for military roles. Guidelines for protein and carbohydrate intake and quality as well as nutrient timing are important for these programs to inform their cadets or midshipmen and should actively promote. ROTC programs can give a distinct advantage to cadets or midshipmen, and their performance and training, if they are being utilized to their fullest potential. This study has found evidence that the ROTC programs at the University of Pittsburgh and Carnegie Mellon University are utilizing injury prevention practices

and that cadets' and midshipmen's participation in organized physical training meets the minimum NASM physical activity guidelines for adults. It must be noted that approximately 88% of participants reported their military branch, unit, command leader, or ROTC program promotes injury prevention. This study provides evidence that suggest that some injury prevention recommendations recommended by the Work Group are not as practical in collegiate ROTC setting as others. For example the consumption of carbohydrates 1-hour following organized training, the utilization of neuromuscular injury prevention practices, some education injury prevention practices (e.g., attending injury prevention courses and providing injury prevention education material) and prevention of overtraining practice (e.g., informing cadets to run less miles in order to reduce the likelihood of injury) are minimally utilized while the consumption of protein 1-hour following organized physical training, some educational injury prevention practices (e.g., informing cadets of proper techniques during physical training and promoting injury prevention) are utilized more. These findings revealed injury prevention practices being utilized within ROTC. Enhancing educational components of ROTC training based on the results of this study may assist in optimizing injury prevention and performance in this population.

Appendix A Qualtrics Survey Document

Organized Physical Training Routines and Injury Prevention Practices in Collegiate ROTC

Please answer the following preliminary questions (2). Participation is anonymous. By clicking next, you are consenting to answer 2 preliminary questions.

How old are you?

- ○ Under 18 years of age
- ○ 18 years of age or older

Do you currently participate in organized physical training with your ROTC branch?

- ○ Yes
- ○ No

Thank you for answering the preliminary questions. You may proceed to the study survey. Please answer each question truthfully and to the best of your ability.
Number of questions: 23
Approximate time to complete: 7 minutes

Instructions: The following 3 questions will inquire about your demographics. Please answer truthfully and to the best of your ability.

Q1 What is your current class rank?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior

Q2 Which ROTC branch do you belong to?

- ○ Army
- ○ Navy
- ○ Marines
- ○ Air Force

Q3 What is your sex?

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other _____

Instructions: The following 6 questions will inquire about your organized training routines. Please answer each question truthfully and to the best of your ability.

Organized physical training routines refer to routines organized by your military branch, unit, or command leader and that take place within your ROTC program.

Q4 Do you currently participate in organized physical training ?

- ○ Yes, < 1 hour/week
- ○ Yes, 1-4 hours/ week
- ○ Yes, 5-10 hours/week
- ○ Yes, > 10 hours/week
- ○ I do not participate in organized physical training

Q5 How often do you participate in organized strength training per week?

- ○ 1 day/week
- ○ 2-3 days/week
- ○ 4-5 days/week
- ○ 6-7 days/week
- ○ I do not participate in organized strength training

Q6 Which best describes the activity/ies during organized strength training? (Select all that apply)

- ☐ Power lifting (e.g. hang cleans)
- ☐ Free weight lifting
- ☐ Machine lifting (e.g leg press machine)
- ☐ Calisthenics (e.g. pull ups)
- ☐ Other. Please specify below: _____

Q7 How often do you participate in organized endurance training per week?

- ○ 1 day/week
- ○ 2-3 days/week
- ○ 4-5 days/week
- ○ 6-7 days/week
- ○ I do not participate in organized endurance training

Q8 Which best describes the activity/ies during organized endurance training? (Select all that apply)

- ☐ Swimming
- ☐ Walking
- ☐ Running
- ☐ Plyometrics
- ☐ Endurance weight lifting (high reps, low sets)
- ☐ Jump roping
- ☐ Endurance calisthenics (high reps) (e.g. pull up, push up)
- ☐ Ruck marching
- ☐ Other. Please specify below: _____

Q9 On average, how many miles do you run/jog per week during organized endurance training?

- ◯ < 1 miles/week
- ◯ 2-4 miles/week
- ◯ 5-9 miles/week
- ◯ 10-15 miles/week
- ◯ 16-20 miles/week
- ◯ >20 miles/week
- ◯ I do not participate in organized endurance training

Instructions: The following 4 questions will inquire about your utilization of stabilization, neuromuscular, proprioception, and agility training, as well as postural assessment. Please answer each question truthfully and to the best of your ability.

Stabilization training- Exercises that are designed to strengthen muscles that support the spine. Muscles that support the spine are abdominal and back muscles. Examples of stabilization exercises include: pelvic tilts, side-lying planks, dead-bugs, and quadruped.

Neuromuscular training- Exercises designed to improve posture control and agility, as well as to enhance the stability of the trunk and lower extremity. Examples of neuromuscular exercises include: core strengthening exercises (e.g. planks), plyometric exercises (e.g. box jumps), and agility exercises.

Proprioception training- Exercises that improve the body's ability to sense movement, action, and position. Examples of proprioception exercises include balance exercises (e.g. cone pick-ups, single leg balancing, reverse lunging).

Agility training- Exercises or drills that improves the body's ability to start (accelerate), stop, or change direction quickly. Agility exercises are performed with a quick burst of movement for a short duration. Examples of agility drills include: t-test and ladder or cone drills.

Q10 Have you ever participated in stabilization training (e.g. core stabilization) organized by your military branch, unit, command leader, or ROTC program?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q11 Have you ever participated in any neuromuscular or proprioception training (e.g. balance exercises) organized by your military branch, unit, command leader, or ROTC program?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q12 Have you ever participated in any agility training (e.g. t-test, ladders) organized by your military branch, unit, command leader, or ROTC program?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q13 During a posture assessment an examiner looks at the patient's posture while the patient is sitting or standing (static posture) or performing a task (dynamic posture). Posture refers to the way in which the body is positioned.

Have you ever received a postural assessment under the direction of your military branch, unit, command leader, or ROTC program?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Instructions The following 5 questions will inquire about your utilization of injury prevention education. Please answer truthfully and to the best of your ability.

Injury prevention is an effort to prevent or reduce injuries before they occur. One can promote injury prevention education by educating someone on injury prevention, demonstrating techniques that help reduce the likelihood of injury, and providing resources that facilitate injury prevention.

Q14 Does your military branch, unit, command leader, or ROTC program promote injury prevention?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q15 Has your military branch, unit, command leader, or ROTC program ever informed you of techniques to prevent injuries during organized strength training?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q16 Has your military branch, unit, command leader, or ROTC program ever informed you of techniques to prevent injuries during organized endurance training?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q17 Has your military branch, unit, command leader, or ROTC program ever provided you with any injury prevention educational materials (e.g pamphlets, videos)?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q18 Have you ever attended any injury prevention courses or lectures under the direction of your military branch, unit, command leader, or ROTC program?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Instructions: The following 2 questions will inquire about overtraining. Please answer truthfully and to the best of your ability.

Q19 Has your military branch, unit, command leader, ROTC program ever instructed you to reduce the amount of miles you are running during organized training in order to reduce the likelihood of injury?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q20 Have you ever been diagnosed with a stress fracture during your time in collegiate ROTC?

- ○ Yes, once
- ○ Yes, more than once
- ○ No
- ○ I'd prefer not to answer

Instructions: The final 3 questions will inquire about your nutrient replacement. Please answer the following questions truthfully and to the best of your ability.

A balance of proteins and carbohydrates can allow for optimal replenishment of energy sources for your muscles. This replenishment can result in a better recovery following physical activity.

Examples of foods high in protein are as follows: meat (red meat and poultry), fish, eggs, dairy products, seeds, nuts, beans, and lentils. Healthy foods high in carbohydrates are as follows: quinoa, oats, fruits (e.g. banana, apples, oranges, grapefruit, blueberries), sweet potatoes, and legumes (e.g. chickpeas, kidney beans).

Q21 Do you consume any foods, drinks, or supplements within a 1 hour window following organized training for nutrient replacement purposes?

- ○ Yes
- ○ No
- ○ I'd prefer not to answer

Q22 Do you consume any protein supplements/drinks or foods high in protein within a 1 hour window following organized training sessions? Choose all that apply

- [ ] Yes, protein powder
- [ ] Yes, protein shakes
- [ ] Yes, protein tablets or pills
- [ ] Yes, other (protein supplement). Please list: _____
- [ ] Yes, I consume food(s) high in protein within 1 hour following organized physical training. List the food item(s): _____
- [ ] I do not consume any protein supplements or foods high in protein within a 1 hour window following organized training sessions
- [ ] I'd prefer not to answer

Q23 Do you consume any carbohydrate supplements or foods high in carbohydrates within a 1 hour window following organized training sessions?

☐ Yes, carbohydrate powder

☐ Yes, other (carbohydrate supplement). Please list: _____

☐ Yes, I consume food(s) high in carbs within 1 hour following organized physical training. List the food item(s): _____

☐ I do not consume any carbohydrate supplements or foods high in carbohydrates within a 1 hour window following organized training sessions

☐ I'd prefer not to answer

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