U.S. Army Center for Health Promotion and Preventive Medicine

USCHPPM

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THE VICTORY FITNESS PROGRAM: INFLUENCE OF THE US ARMY'S EMERGING PHYSICAL READINESS TRAINING DOCTRINE ON FITNESS AND INJURIES IN BASIC COMBAT TRAINING

With

The US Army Physical Fitness School
Ft Benning GA

The 1st and 4th US Army Training Brigades
Ft Jackson, SC

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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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13. ABSTRACT *(Maximum 200 words)*
The Victory Fitness (VF) Program examined fitness and injury outcomes during the initial "toughening phase" of Physical Readiness Training (PRT). PRT is the US Army's emerging physical training doctrine. A Basic Combat Training (BCT) battalion which implemented PRT (VF battalion, n=1284) was compared to a battalion which used traditional BCT physical training (the Control battalion, n=1275) during the 9-week BCT cycle. PRT exercises included precision calisthenics, dumbbell drills, movement drills, 30-second run/30-second walk (interval training), ability group runs, and flexibility training. On the first administration of the Army Physical Fitness Test (APFT) taken for record, the VF group had a greater proportion of trainees passing than the Control Group (men: 85% vs. 81%, $p=0.04$; women: 80% vs. 70%, $p<0.01$). After all administrations of the record APFT, the VF group had fewer APFT failures than the Control group among the women (1.6% vs. 4.6%, $p<0.01$) but not the men (1.6% vs. 2.8%, $p=0.18$). On push-up raw scores, Control men and women improved more than the VF men ($p<0.01$) and women ($p<0.01$), although the VF group scores exceeded minimum BCT passing values. On sit-up raw scores there were no differences between the VF and Control men ($p=0.21$) but the VF women improved more than the Control women ($p<0.01$). There were no differences in improvements in 2-mile run times between the VF and Control men ($p=0.15$) or women ($p=0.54$). Battalion differences in injury rates were examined using Cox regression (a survival analysis technique), which controlled for initial differences in demographics, fitness, and training-related variables. The relative risk of an injury of any type was 37% higher in the Control men ($p=0.02$) and 35% higher in the Control women ($p<0.01$), compared to the VF men and women. The relative risk of an overuse injury was 57% higher in the Control men ($p<0.01$) and 45% higher in the Control women ($p<0.01$), compared to the VF men and women. There were no differences between the VF and Control groups for traumatic injuries ($p=0.84$ and $p=0.70$ for men and women, respectively). The VF Program reduced overuse injuries while allowing a higher success rate on the APFT.

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Overuse, trauma, stretching, flexibility, warm-up, calisthenics, dumbbell drills, interval training, movement drills, medicine ball, intrinsic motivation, discharges, newstarts, running, road marching

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EPIDEMIOLOGICAL CONSULTATION REPORT NUMBER 12-MA-5762-01 THE VICTORY FITNESS PROGRAM: INFLUENCE OF THE US ARMY'S EMERGING PHYSICAL READINESS TRAINING DOCTRINE ON FITNESS AND INJURIES IN BASIC COMBAT TRAINING

EXECUTIVE SUMMARY

1. INTRODUCTION. Recently, the US Army Physical Fitness School (USAPFS) proposed major modifications to the US Army's physical readiness training doctrine. This new doctrine is called Physical Readiness Training (PRT) and it consists of two training phases: toughening and conditioning. The toughening phase is designed to increase fitness and teach soldiers fundamental training skills with emphasis on the correct execution of the exercises and a gradual increase in the amount of exercise. Soldiers build muscular strength, cardiovascular endurance, and mobility as they progress. The conditioning phase is designed to develop a high level of physical readiness appropriate to the soldier's duty position. Activities that directly support the unit mission and the Mission Essential Task List (METL) are integrated into the PRT program in this second phase. This paper reports the results of a program that examined fitness and injury outcomes during implementation of the toughening phase of PRT in Basic Combat Training (BCT). The program was called Victory Fitness.

2. METHODS. This program had three major phases: 1) train-the-trainers, 2) pilot, and 3) test. The train-the-trainers phase involved a 32-hour block of instruction to drill sergeants on how to conduct the exercises involved in the program. The pilot phase involved an entire 9-week BCT cycle in which the drill sergeants administered the PRT program to the trainees. Program modifications were made based on observation and drill sergeant feedback. The test phase involved two battalions: a Victory Fitness (VF) group that performed the new PRT program and a Control group that conducted a traditional BCT physical training program. The PRT program involved precision calisthenics, dumbbell drills, movement drills, 30 second run/30 second walk (interval training), ability group runs, and flexibility training. Both battalions were observed daily to assure compliance with their respective programs.

a. During the test phase, fitness outcomes were obtained from the Army Physical Fitness Test (APFT). The APFT consisted of the maximum number of push-ups completed in 2 minutes, the maximum number of sit-ups completed in 2 minutes, and a 2-mile run for time. Battalion training personnel identified a) trainees passing the APFT on the initial test (given 3-5 days after arrival at BCT), b) trainees passing the first "record" APFT (given in the 7th week of training), and c) trainees who ultimately failed the APFT after all retakes (retakes given between the 7th and 9th week of training). APFT raw scores were obtained from unit records. Each battalion kept a record of their formation running mileage. Training schedules provided the number of physical training sessions.

b. Injury outcomes during the test phase were obtained by screening individual medical records. For each visit to a medical care provider, extracted information included the date of visit, diagnosis, body part injured, disposition (final outcome of the visit), and days of limited duty (if any).

c. Additional demographic and training data were obtained from unit records. These data included race, marital status, rank, educational level, service component, trainees who were discharged or newstarted, and trainees who came from the Fitness Assessment Program (FAP). FAP personnel were those who failed the Reception Station Physical Fitness Test (given prior to BCT) and physically trained in a special unit for 3 days to 3 weeks to achieve a minimum level of physical fitness before entering BCT. Age, height, and weight were obtained from the physical examination in the medical records.

3. RESULTS. There were 1284 trainees in the VF group (769 men and 515 women) and 1296 trainees in the Control group (645 men and 651 women). Estimated formation running was 17±2 miles and 37±6 miles in the VF and Control group, respectively ($p<0.01$). The number of physical training sessions was 34±2 in both groups ($p=0.78$).

a. There were no significant differences between battalions ($p>0.34$) on the proportion of men or women passing the initial APFT. On the first administration of the final APFT, the VF group had a greater proportion of trainees passing than the Control group (men: 85% vs 81%, $p=0.04$; women: 80% vs 70%, $p<0.01$). After all administrations of the final APFT, the VF group had fewer APFT failures than the Control group, among the women (1.6% vs 4.6%, $p<0.01$) but not the men (1.6% vs 2.8%, $p=0.18$). On push-up raw scores, Control men and women improved more than the VF men ($p<0.01$) and women ($p<0.01$). On sit-up raw scores, there were no differences between the VF and Control men ($p=0.21$). The VF women improved more than the Control women ($p<0.01$) after adjustment for difference in initial scores. There were no differences in improvements in 2-mile run times between the VF and Control men ($p=0.15$) or women ($p=0.54$) after adjustment for differences in initial 2-mile run times.

b. Analysis of demographic variables, fitness measures and training data indicated that there were significant differences between battalions for marital status, service component, age, sit-up performance, two-mile run times, the proportion of trainees from the FAP, and the proportion of trainees who were discharged. Cox regression (a survival analysis technique) was used to control for these battalion differences while examining differences in injury rates between battalions. After adjustment, the relative risk of an injury of any type was 37% higher in the Control men ($p=0.02$) and 35% higher in the Control women ($p<0.01$), compared to the VF men and women. For overuse injuries, the relative risk of injury was 57% higher in the Control men ($p<0.01$) and 45%

higher in the Control women ($p<0.01$), compared to the VF men and women. There were no differences between the VF and Control groups for traumatic injuries ($p=0.84$ and $p=0.70$ for men and women, respectively). For lower extremity overuse injuries, Control men had a 65% higher injury risk ($p=0.01$) while Control women had a 30% higher injury risk ($p=0.03$), relative to the VF men and women.

c. Historical comparisons between the 2 battalions were made using an injury surveillance system that tracked BCT sick call visits. For 4 BCT cycles prior to the pilot and study phases, differences between the VF and Control battalions in male lower extremity injury sick call rates varied between 6% and 17%, compared to 48% during the test phase. Female lower extremity injury sick call rates varied 5 to 20%, compared to 31% during the test phase.

4. DISCUSSION.

a. The lower rate of overuse injury in the VF group may be partly explained by the lower formation running mileage and greater variety of exercises. Studies of runners and basic trainees have shown an association between higher running mileage and higher injury rates. The greater variety of exercises administered in the VF group may have allowed more recovery time between exercises contributing to the reduction in overuse injury rates.

b. The actual push-up and sit-up training volume in the two groups was not recorded but observations suggest the volume was lower in the VF group. Previous studies have shown that practice on a test will result in the greatest improvement on that test; however, exercises that improve the muscular strength or endurance of muscle groups involved in a test can also improve test performance. The dumbbell and calisthenic drills exercised some of the same muscle groups involved in the push-up and sit-up tests and may have aided in improving performance on these APFT events. Previous studies support the concept that much lower volumes of running can result in speed improvements similar to the speed improvements seen with greater volumes of running.

5. SUMMARY. The VF battalion had more favorable injury and fitness outcomes than the Control battalion. The VF battalion had a lower rate of overuse injuries, than the Control battalion but there were no group differences in traumatic injuries. A greater proportion of individuals in the VF group passed the APFT on the first record test and fewer VF individuals failed the APFT after all retakes. On APFT raw scores, there were no differences between battalions on 2-mile run improvements after correction for the slower initial run times of the VF group. The VF women improved more on sit ups than the Control women but there were no group differences among the men. The VF group had lower push-up raw scores compared to the Control group but the VF group still passed the APFT at a higher rate because the scores exceeded minimal passing values. The Victory Fitness Program reduced overuse injuries while allowing higher APFT success.

6. RECOMMENDATIONS. Implement the PRT Program throughout US Army Training and Doctrine Command (TRADOC) for BCT. Teach PRT for BCT in drill sergeant's school to institutional the concepts. Test PRT in AIT using a design similar to that of the present study. Study injury rates and fitness levels in a cohort of trainees that uses the PRT Program in both BCT and AIT. Study implementation of the PRT program in an operational Army unit.

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1. REFERENCES. Appendix A contains the references used in this report.

2. INTRODUCTION.

a. Physical training has long been a job requirement for soldiers in the US Army. The Army's policy for physical training, outlined in Army Regulation 350-41 (AR 350-41) (17) states that commanders and supervisors will conduct exercise periods with sufficient intensity, frequency, and duration to maintain adequate cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition. All personnel in the active Army, the Army Reserve National Guard and US Army Reserve are required to participate in year round collective or individual physical fitness training programs. Active Army personnel, full-time Guardsmen, and full-time Reservists are required to participate in vigorous physical fitness training 3 to 5 times per week during the unit's normal duty-day.

b. Specific guidance for developing physical training programs is described in Army Field Manual (FM) 21-20 (12). This guidance is based on generally accepted principles of physical training (1, 41, 93, 97) which have been adapted for military operations based on the experiences of soldiers who have served at the US Army Physical Fitness School (USAPFS) and soldiers and consultants those who have reviewed the manual for accuracy and adherence to the principles of exercise.

c. Recently, the USAFPS proposed major modifications to FM 21-20 (renumbered to FM 3-25.20) and developed a new training model called Physical Readiness Training (PRT) (16). The PRT program integrates training elements resurrected from previous US Army training manuals (3, 8, 18) but also incorporates procedures and principles derived from epidemiological (65, 67) and physiological studies (82, 97) designed to reduce injuries and increase functional fitness. The historical roots of PRT are described in Appendix B.

d. The new PRT program consists of two phases: toughening and conditioning. The toughening phase is designed to increase fitness and teach soldiers fundamental exercise skills. Training exercises include calisthenics, dumbbell drills, movement drills, interval training, running, and other exercises designed to assist soldiers in performing essential skills such as jumping, landing, lunging, bending, reaching, and lifting. The emphasis during this toughening phase is on the correct execution of the exercises and a gradual

increase in the amount of exercise so that soldiers build muscular and cardiovascular endurance as they progress.

e. The toughening phase prepares new soldiers to enter the conditioning phase. The conditioning phase is designed to develop a high level of physical readiness appropriate to the soldier's duty position. Activities become more physically demanding by the addition of more advanced calisthenic and dumbbell drills and the addition of guerilla exercises and circuit training. Activities that directly support the unit mission and the Mission Essential Task List (METL) are integrated into the PRT program.

f. This paper describes a project that tested the toughening phase of the PRT in Basic Combat Training (BCT). The project was nicknamed the "Victory Fitness Program" and was anticipated to reduce training injuries while making new soldiers more physically capable. Outcome measures used to evaluate program efficacy included assessments of both injuries and physical fitness. The Victory Fitness Program was a joint effort between the 4th and 1st Training Brigades at Fort Jackson, South Carolina, the USAPFS, and the US Army Center for Health Promotion and Preventive Medicine (USACHPPM).

3. CONCEPTUAL FRAMEWORK.

a. Physical Fitness and Military Physical Readiness.

(1) Physical fitness is defined as "the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies" (124). The major components of physical fitness have classically been defined as muscular strength, muscular endurance, and cardiorespiratory endurance (aerobic capacity). These components can be characterized both behaviorally (by the types of tasks performed) and physiologically (by the types of fuels used to provide energy). Muscle strength is the ability of a muscle group to exert a maximal force in a single voluntary contraction. An example of a strength task is manually lifting a box that contains as much weight as it is possible for an individual to lift. Energy is derived primarily from adenosine triphosphate (ATP) and creatine phosphate (CP) in the active muscles. Muscular endurance is the ability of a muscle group to perform short-term, high-power physical activity; such as manually loading artillery shells at a rate that results in fatigue in several seconds. Energy is derived primarily from glycogen in the active muscle. Cardiorespiratory endurance is the ability to sustain long-term, low-power physical activity. An example is road marching for several hours. Cardiorespiratory endurance depends on the functioning of the circulatory and respiratory systems and energy is primarily derived from carbohydrates and lipids, some located in the active muscles, and some from other parts of other body (32, 54, 59).

(2) Military physical readiness is defined as "the ability to meet the physical demands of any combat or duty station, accomplish the mission and still have a reserve of strength" (16). It involves developing and maintaining a high level of each of the fitness components mentioned above but it also includes the ability to functionally apply this physical capacity to military tasks.

(3) The components of military physical readiness are strength, endurance, and mobility. Absolute muscular strength and muscular endurance are highly related (70, 82) and methods can be utilized that will train both components at the same time (40, 82). Thus, the single concept of "strength" is used as a component of PRT. Endurance is the ability to sustain activity of both short and long term. The endurance concept, as it applies to military performance, is explained in more detail in Appendix C. Mobility is movement proficiency and is the functional application of strength and endurance. Mobility includes agility, balance, coordination, flexibility, posture, stability, speed, and power.

b. Principles of PRT.

(1) The major principles of the PRT program are a) progression, b) variety, and c) precision. Progression is the gradual increase in the total amount of exercise by manipulating the frequency, duration, and intensity of that exercise. Frequency is how often the soldier exercises (times per week), duration is how long the soldier exercises (minutes/session) and intensity is how hard the solider exercises (e.g., heart rate achieved in cardiovascular exercise or resistance overcome in muscle strength/endurance training exercise). Gradually increasing frequency, duration, and/or intensity will improve physical capacity (2, 40, 72, 120) and may minimize the possibility of injury (65, 67).

(2) Variety means performing different types of physical training to enhance each of the major components of physical fitness (32). Different body parts are exercised at different times to improve the strength, endurance, and mobility of each while allowing adequate time for rest and recovery in other body parts. Exercising different fitness components at different times also allows for recovery and adaptations in the different systems that supply the energy for exercise (97). To achieve variety, arrays of different types of exercises are conducted both on the ground and off the ground. On-ground training includes calisthenics, dumbbell drills, running, medicine ball exercises, movement drills, and other activities that make up the largest portion of the program. Off-ground training includes climbing, rappelling, obstacle courses, jumping, landing, and other activities where individuals spend part of their time not in contact with the ground. Variety is important in order to a) improve different components of physical fitness, b) improve muscle groups involved in functional activities, c) avoid boredom in training, and d) to spread the exercise stress across the body to minimize the possibility of injury.

(3) Precision is the quality of movement and is one of the most important principles of the PRT program. Exercises are designed to be performed with emphasis on correct posture and executed in a particular manner to assure that the proper muscle groups are trained and the proper movement patterns developed. Exercises are described in great detail in the emerging PRT program (FM 3-25.20) and adherence to these details is essential for developing the strength, endurance and mobility of specific muscle groups. Precision reduces the likelihood of injury by avoiding hazardous postures and movements.

(4) The exercises in the PRT program are designed not only to improve physical capacity of the soldier but also to be "restorative". During the course of the day soldiers develop strength and flexibility imbalances because of the tasks they perform. For example, during basic rifle marksmanship soldiers are working the weapon on one side of the body. On the obstacle course wall climbs, soldiers generally pull themselves over the wall on one side of the body. Thrusting and butt stroking during bayonet practice is usually performed on one side of the body. Road marching with a rucksack results in prolonged cyclic stress on the back muscles. The strength and flexibility imbalances resulting from these and other activities may increase risk of injury (73, 79). Thus, the calisthenic exercises, dumbbell drills, and movement drills are partly designed to assist in restoring a balance in terms of strength and flexibility.

4. BACKGROUND LITERATURE.

a. Injury Incidence and Injury Risk Factors in BCT.

(1) Numerous studies have examined injury incidence and injury risk factors in BCT. Cumulative injury incidence (trainees experiencing one or more injuries) among trainees completing BCT range from 15% to 31% for men and 38% to 67% for women (23, 24, 62, 63, 83, 84, 91, 133). Most of these studies were conducted when BCT was 8 weeks in length. In October 1998, BCT was lengthened to 9 weeks. An investigation during a 9-week BCT cycle reported an injury incidence of 30% among men and 65% among women (31).

(2) The large variation in BCT injury rates may reflect differences in the training environment (extrinsic risk factors) and/or personal differences among trainees (intrinsic risk factors). With regard to the training environment, there are large differences in injury rates among training companies (34, 66, 83). Differences among training battalions are considerably smaller, presumably because companies with both high and low injury rates are contained within a battalion (83). Some of the injury rate differences among companies may be due to differences in training intensities, especially with regard to physical training (65). Another extrinsic risk factor is the use of older running shoes, which has been shown to result in a higher risk of stress fractures (45). Seasonal variations also appear to occur in BCT with higher overall injury rates in the summer and lower injury rates in the fall (75). Administrative changes in the training environment could also result in variations in injury rates. For

example, at Fort Jackson, South Carolina in October 1997 the number of training requirements necessary for graduation increased from 4 to12; during 1998, the number of requirements further increased to 18. There was also increased command emphasis on reducing injury rates during this time and injury surveillance data were provided to commanders beginning in May 1999.

(3) Intrinsic (personal) differences among trainees also affect injury rates. Intrinsic risk factors for injury include female gender (24, 63, 64, 66, 77, 91), high foot arches (36, 51), excessive (>15°) knee Q-angle (35), genu valgus (35), past ankle sprains (66, 76), lower levels of aerobic fitness (63, 64, 77, 83, 84, 133), high and low extremes of hamstring flexibility (66, 83, 84), lower levels of physical activity prior to entry into service (45, 63, 64, 66, 83, 84), and tobacco use prior to service (66, 81, 83, 84). Less consistently demonstrated intrinsic risk factors (i.e., measured but not always related to injury risk) include lower levels of muscular strength/muscular endurance, higher body fat or body mass index, older age, and white ethnicity (22, 28, 45, 63, 64, 66, 77, 81, 83, 84, 133).

b. Stretching and Injuries.

(1) Stretching can be defined as activity designed to increase the flexibility (range of motion) around a joint. For many years sports medicine professionals recommended stretching prior to physical activity as a method for reducing the risk of injury (19, 68). However, it was not until relatively recently that randomized controlled studies examining the influence of stretching on injuries were conducted. These studies generally show that stretching prior to (104, 106) or both prior to and after physical training (129) does not reduce the risk of injury. The studies that do show an effect of stretching on injuries are either non-randomized trials (58), are confounded with interventions other than stretching (38), or have other major design problems (26). A summary of these studies is shown in Table 1 and a more detailed analysis is available in another publication (80).

(2) Flexibility profiles differ considerably in different sports suggesting different amounts of flexibility are favored in different types of activities (53). In some sports like running, individuals with less flexibility in certain joints actually run more economically (37, 53). Maximal voluntary strength can be reduced by increasing flexibility through stretching (88). Epidemiological data indicate that extremes of flexibility (too much or too little) may not be desirable: studies on basic trainees (66, 83) and collegiate athletes (79) have shown that both high and low levels of flexibility are associated with increased risk of injury. Epidemiological studies of injuries in runners and rowers found either that there was no difference in the likelihood of injury between those who reported stretching and those who did not (95, 132), or that risk of injury was elevated among those who reported stretching (60, 132).

Table 1. Studies Examining the Effects of Stretching On Injuries

Study	Sample / Length of Study	Intervention (s)	Groups	Findings
Ekstrand (38)	Soccer Players / 6 months	Warm-up (20 min) 10 min specific warm-up (ball kicking) 10 min contract-relax stretching Cool down (5 min) Shin guards Ankle taping of previous ankle sprains or instability Special rehabilitation program Exclusion of players with knee instability Information on injuries Supervision of program	1.Control 2.Stretching	1.Control – 93 injuries / 90 players 2.Stretching – 23 injuries / 90 players
Van Mechelen et al. (129)	Runners / 16 Weeks	Warm-up (20 min) 6 min of running 3 min of "loosening" exercises 10 min of static stretching 3 bouts of 10 sec, with each muscle group muscle groups included iliopsoas, quadriceps, hamstring, soleus, gastronemius Cool-down – inverse of warm-up (Stretching performed twice each day)	1.Control 2.Stretching	1.Control – 20 injuries / 167 runners 2.Stretching – 24 injuries / 159 runners
Bixler and Jones (26)	5 high-school football teams / Football season	Warm-up and stretching at end of half-time break. Warm-up: run in place (60 sec), jumping jacks (30 sec) Stretching: trunk twist (15sec), hamstring stretch (25 sec), groin stretch (25 sec), quad stretch (25 sec)	1.Two control football teams 2. Three football teams that stretched	1.Control – 2.4 injuries/game; 0.46 3d quarter sprains/strain per game 2.Stretching – 2.4 injuries/game; 0.04 3d quarter strains/sprains per game
Hartig and Henderson (58)	Male Infantry Basic Trainees / 13 weeks	Hamstring stretches 3 times/day 5, 30 sec static stretches each time, each leg	1.Control – Single company of trainees 2.Stretching – single company of trainees	1.Control – 43 injuries / 148 trainees 2.Stretching – 25 injuries / 150 trainees
Pope et al. (104)	Male Australian Army Recruits / 12 weeks	Two 20-sec stretches of two muscle groups (gastronemius and soleus) prior to exercise	1.Control (no stretching but performed 3 min warm-up) 2.Stretching and 3 min warm-up	1.Control – 25 injuries 2.Stretching – 23 injuries
Pope et al. (106)	Male Australian Army Recruits / 12 weeks	One 20sec pre-exercise stretch of each of 6 muscle groups (gastronemius, soleus, hamstrings, quadriceps, hip adductors, and hip flexors) prior to exercise	1.Control (no stretching but performed 4 min warm-up) 2.Streching and 4 min warm-up	1.Control – 5.4 injuries/1000hrs training 2.Stretching – 5.3 injuries/1000hrs training

c. Warm-up and Injuries.

(1) Warm-up can be defined as actions that attempt to increase body temperature by active or passive means before or during participation in sports or exercise. Passive warm-up includes the use of such external devices as hot showers, steam baths, or massage. Active warm-up involves volitional body movements using calisthenics, jogging, stretching, or resistive exercises. A subcategory of active warm-up is task-specific warm-up, which concentrates on movements through ranges of motion that will be used in a specific sport or physical activity (114, 121, 123).

(2) Warm-up results in several favorable physiological changes. The increase in body temperature results in increased speed and force of muscular contractions, increased blood flow, a more rapid dissociation of oxygen from hemoglobin and myoglobin, a more rapid mobilization of energy substrates, reduced muscle viscosity, and increased speed of neural impulses (113, 121) and increased elasticity of connective tissue.

(3) Several studies have been conducted on isolated rabbit muscle that suggest that the warm-up temperature achieved in the muscle should not be excessive. Safran et al. (113) "pretreated" isolated rabbit muscles with a single, electrically induced, 15-sec isometric contraction. Muscle temperature was increased 1°C as a result of this pretreatment. Compared to muscles that had not received this treatment, the pretreated muscles required more force to tear and achieved a greater length prior to tearing. This suggests a moderate increase in muscle temperature may reduce strain-type injuries. Other studies show less favorable effects when muscle temperatures become excessive. Strickler et al. (126) compared an isolated rabbit muscle tested at 25°C to one tested at 39°C. They found that the heated muscle required less force to rupture but achieved greater length prior to rupture. Noonan et al. (101) performed a similar experiment, comparing rabbit muscle at 25°C to one at 40°C. In all cases, the heated muscle required less force to rupture. At faster pulling speeds (10 cm/sec) the heated muscle achieved a greater length before failure, while at slower pulling speeds (1 cm/sec) there was no difference between the hotter and cooler muscle.

(4) Thus, the literature concerning warm-up suggests that activities that do not raise muscle temperature too high may have favorable physiological effects. However, the influence of warm-up exercise *per se* on injury rates has not been determined.

d. Changes in Fitness during BCT.

(1) Studies that have examined changes in APFT raw scores are shown in Table 2. Women generally have greater relative and absolute changes on each APFT event, except for absolute changes on push-ups. This may be

due to the greater relative training intensity experienced by women in BCT. With few exceptions (e.g., ability group runs, where most individuals in the slower groups are women) men and women train side-by-side in most physical activities during the BCT day. Since women, on average, have lower aerobic capacity, muscular strength, and muscular endurance than men (86, 117, 130), their relative activity intensity will be greater during any given training event.

Table 2. Changes in APFT Raw Scores in Past BCT Studies

Event	Study (Reference Number)	Gender	Initial APFT (reps or min) Mean ±SD	Final APFT (reps or min) Mean ±SD	Absolute Change (reps or min)	Relative Change (%)
Push-Ups	77	Men	33±15	51±14	18	55
		Women	10±9	25±10	15	150
	83	Men	32±14	47±13	15	47
		Women	11±10	25±10	14	127
Sit-Ups	77	Men	40±14	59±10	19	48
		Women	33±15	55±12	22	67
	83	Men	41±13	57±10	16	39
		Women	35±15	54±12	19	54
Two-Mile Run	77	Men	17.2±2.6	14.8±1.3	2.4	14
		Women	21.5±2.8	18.1±1.4	3.4	16
	83	Men	17.5±2.9	14.6±1.6	2.9	17
		Women	21.5±3.0	17.8±1.6	3.7	17

(2) Several studies have examined changes in VO_2max or peak VO_2 during BCT using treadmill-running protocols (102, 119, 131). These studies have reported improvements for men ranging from 3.2% to 8.0% and improvements for women ranging from 6.3% to 6.5%.

(3) Two studies have reported changes in maximal voluntary isometric strength using identical methods and apparatus (86, 119). Isometric upper torso strength increased 0% to 4.2% for men and 2.6% to 9.3% for women. Changes in isometric lower body strength (similar to a leg press with the knee angle at 90 degrees) reported changes of 1.1% and 10.6% for men and 6.8 to 14.0% for women.

5. METHODS.

a. Program Design.

(1) This project involved three major phases: 1) train-the-trainer, 2) pilot, and 3) test. The train-the-trainer phase was conducted from 10 to 14 July, 2000. It involved a 32-hour block of instruction on how to conduct the exercises involved in the project. This was provided by USAPFS personnel to drill sergeants in the 1st Battalion of the 34th Infantry Regiment at Fort Jackson, South

Carolina. The USAPFS training cadre considered feedback from the drill sergeants after each training session and modifications were made to the exercises based on this feedback.

(2) The pilot phase involved an entire BCT cycle in which the drill sergeants implemented the exercises they had been taught during the train-the-trainer session. This pilot phase was conducted from 21 June to 21 September 2000. Trainees were instructed in the exercises and executed them according to the drill sergeant commands. During the pilot phase, personnel from the Fitness School frequently visited, observed training, and had working group sessions with the drill sergeants. Training was modified based on drill sergeant feedback and observations. Representatives from the USACHPPM viewed almost all PRT sessions, provided input to the USAPFS, and assisted drill sergeants when requested. Lessons learned during the pilot phase were implemented during the test phase (the major changes are discussed later). A second training session was given by the USAPFS to the drill sergeants and cadre so that they fully understood the lessons learned from the pilot and the resulting changes in the VF program.

(3) The test phase involved two battalions, the 1st Battalion of the 34th Infantry Regiment (1/34th) and the 2nd Battalion of the 13th Infantry Regiment (2/13th). The 1/34th was the experimental group (referred to hereafter as the VF group or VF battalion) who implemented the Victory Fitness Program. The 2/13th was the Control Group who conducted a traditional BCT physical training program. Both battalions had 5 companies. The test-phase cycles were 28 September 2000 to 30 November 2000 for the VF group and 21 September 2000 to 23 November 2000 for the Control group. Prior to the training, the Control group command staff (battalion commander, battalion executive office, battalion staff, company commanders, and company executive officers) were briefed on the project and told not to alter their physical training from what they would normally do. Physical training was observed in both the VF and Control battalions by the USACHPPM staff during the test phase to assure compliance. No new changes were made in the VF group during the test phase training cycle.

b. Victory Fitness Physical Training Program.

(1) For this project, the only change to the normal BCT protocol was modification of the morning physical training (PT) period. The Pilot Phase had 7 different types of exercises. These exercises were calisthenics, dumbbell drills, medicine ball exercises, movement drills, 30 second run/30 second walk (interval training), ability group runs, and flexibility training. The test phase had all of these exercises except the medicine balls.

(2) Calisthenic exercises are described in Appendix D. They were designed to contribute to strength, endurance, and mobility and to lay the groundwork for the enhancement of motor skills. They also serve as a

preparation (warm-up) for other activities to possibly assist in reducing injury rates (113, 121). A more complete rationale for calisthenics is at Appendix E. At the start of the program, four repetitions of each calisthenic exercise were executed. These repetitions were performed at a slow cadence until trainees developed the correct form. The number of repetitions was increased by one in each subsequent exercise period until 10 repetitions were achieved. As training progressed, less rest was allowed until the only pause between exercises was for the instructor to name the next exercise.

(3) Dumbbell drills are described in Appendix F. Dumbbell drills were designed to develop muscular strength and mobility, improve posture, and develop body mechanics for lifting. These were performed with 5, 8, or 10 pound dumbbells for men and 3 to 5 pound dumbbells for women (depending on the size and strength of the individual). Dumbbells were held in each hand. Training progression was similar to that of the calisthenics (4 repetitions progressing to 10) with emphasis on precise execution, especially early in the training. The entire sequence of exercises could be performed for a second or third set.

(4) Medicine ball exercises are described in Appendix G. Medicine ball training was designed to provide a different type of resistance than the dumbbell drills by allowing for more rotational and circular movements. Throwing of the balls allowed training in the giving and receiving of force with appropriate acceleration and deceleration. Exercises were first performed slowly ("by-the-numbers"), then in 20- to 30-sec timed sets. Balls were 4.5 and 6 pounds.

(5) Movement drills are described in Appendix H. They were designed to improve mobility, especially coordination for dynamic activities. Soldiers lined up in ranks and performed a particular drill over a 30 to 40 yard distance. When all trainees had completed a particular exercise, the direction was reversed and the drills repeated. Emphasis was on precision of movement rather than speed. To increase the intensity of the exercise, the number of people in each rank was reduced.

(6) The 30/30 runs involved short sprints of 30 seconds followed by 30 seconds of walking. This was designed to help develop cardiorespiratory endurance. The runs were performed at 70% of the trainee's maximal 200-meter speed. The maximal speed was determined in a single session by having the trainees run a maximal effort 200-meter sprint and then read their 70% value from a chart. The 30/30 runs were performed after a preparation (warm-up) that included calisthenics and movement drills.

(7) Flexibility exercises are shown in Appendix I. Stretches were held for 30 seconds and performed only at the end of the exercise session. Flexibility exercises were selected to emphasize the most commonly noted postural imbalances in trainees.

(8) It should be noted that the VF program was followed for only 7 of the 9 weeks of BCT (up until the final APFT) in both the pilot and test phases. After the 7th week, the training cadre switched to the traditional BCT PT program that involved pre-exercise stretches and an emphasis on APFT events. The rationale for switching was that soldiers would need to know traditional training for Advanced Individual Training (AIT) since this was the type of training conducted there. Examination of training schedules indicated that 2 to 4 sessions involved traditional PT (this differed by company).

c. Training Data. Each company in the VF and Control battalions was asked to keep a record of a) miles of running in formation and b) miles of road marching. Formation running was normally done in four "ability groups" established on the basis of run times on the first APFT. Road marching involved planned marches with loads (weapons, backpack, etc.) and walking to and from training activities without loads. The number of physical training sessions was obtained from training schedules.

d. Outcome Measures. To evaluate the effectiveness of the Victory Fitness Program, measures of injuries, physical fitness, and intrinsic motivation to exercise were used, as described below.

(1) Physical Fitness Outcomes.

(a) The APFT was used to determine physical fitness in this study (12, 69, 70). The APFT was administered by the drill sergeants who were very familiar with the well-standardized test procedures. The training cadre entered the results of the APFT into a database called the Master Tracking System (MTS). The MTS was a computer program maintained at the company level that allowed the training cadre to follow the status of trainees during training. APFT scores were downloaded from the MTS.

(b) The APFT consisted of three events: push-ups, sit-ups and a 2-mile run, conducted in that order. For the push-up, a trainee was required to lower his body in a generally straight line to a point where his upper arm was parallel to the ground, then return to the starting point with elbows fully extended. For the sit-up, the trainee's knees were bent at a 90° angle, fingers were interlocked behind the head, and a second person held the participant's ankles, keeping his or her heel firmly on the ground. The trainee raised his upper body to a vertical position so that the base of the neck was anterior to the base of the spine and then returned to the starting position. The number of push-ups and sit-ups that were successfully completed in separate 2-minute periods were recorded. For the 2-mile run, time to complete the distance was the performance measure.

(c) During the course of BCT, training companies normally administer 3 to 4 APFTs. All companies in the Control group administered 4 APFTs. In the VF group, 4 of the companies administered 3 tests with one company administering 4. In general, the initial test was given 3 days after arrival at the BCT unit while the final (record) test was given about the 45th training day (7th training week).

(d) The final (record) APFT was the one trainees must "pass" to graduate from BCT. To "pass" the APFT, all trainees were required to meet certain age and gender adjusted criteria (12). Soldiers who fail to pass the APFT on the first record test were allowed to retake the test, usually up to a maximum of 5 retakes. Soldiers who fail to meet the passing criteria after all retakes were considered APFT failures for the purposes of this study. APFT failures were sent to the APFT Enhancement Program where they were given specific training in the APFT events. They either eventually passed the test or were discharged but those sent to the APFT Enhancement Program were lost to follow-up in this study.

(e) Six outcome measures were obtained from the APFT data. The first three outcome measures involved the actual raw scores on push-ups (repetitions), sit-ups (repetitions) and the 2-mile run (time). The other 3 outcome measures involved 1) the proportion of soldiers passing on the first administration of the final (record) APFT, 2) the number of retakes among those failing the test the first time but eventually passing, and 3) the proportion of soldiers who failed after all retakes.

(2) Injury Outcomes.

(a) To obtain injuries that occurred during BCT, individual medical records were screened for each trainee in the two battalions in the test phase. For each visit to a medical care provider, the following information was collected: the date of visit, type of visit (first or follow-up), diagnosis, anatomical location of injury, disposition (final outcome of the visit), and days of limited duty (if any). These data were typically available on one of three forms: 1) Screening Note of Acute Medical Care (Department of the Army Form 5181-R), 2) the Chronology of Medical Care (Standard Form 600), or 3) Emergency Care and Treatment Form (Standard Form 558). Trainee medical care at Fort Jackson, South Carolina is described in Appendix J.

(b) We defined an injury case as a trainee who sustained physical damage to the body (55) and sought medical care. Using the diagnosis in the medical records, injuries were grouped by "type" for analysis. "Types" included overuse injuries, traumatic injuries, and lower extremity overuse injuries. Overuse injuries were those presumably due to or related to long-term energy exchanges resulting in cumulative microtrauma. Traumatic injuries were those presumably due to sudden energy exchanges resulting in abrupt overload. Injury

types were determined by diagnosis. Overuse injuries included musculoskeletal pain (not otherwise specified), stress fractures, stress reactions, tendinitis, bursitis, fasciitis, overuse syndromes, and strains. Traumatic injuries included pain (due to a traumatic event), sprains, dislocations, fractures, blisters, abrasions, lacerations, and contusions. A lower extremity overuse injury was an overuse injury (as defined above) that also involved the lower extremity or lower back. Environmental injuries (which included heat-related injuries, cold-related injuries and insect bites) were not included in the analysis. These definitions are consistent with those used in past investigations (30, 31, 63, 66, 71, 76, 80, 84).

(c) We examined three "levels" of injury that involved progressively increasing severity. The first level (any injury) included all visits to a health care provider for any type of injury. The second level (a time-loss injury) included only those injuries that resulted in one or more days of limited duty. The third level was a Physical Training and Rehabilitation Program (PTRP) injury.

(d) A PTRP injury was one that resulted in a recommendation that the trainee be temporarily removed from training and sent to the PTRP for recovery. The recommendation for PTRP placement is based on medical necessity. Most PTRP recommendations were given by physical therapists; however, other health care providers such as orthopedic surgeons or occupational therapists can make the recommendation. The Physical Therapy Clinic is the liaison for the program. The following criteria are considered when determining PTRP recommendations: a) symptoms unlikely to resolve in less than 5-7 days, b) the severity of the injury, c) activity modifications within the training environment does not provide sufficient protection for injured structures, d) the soldier has missed multiple mandatory events, e) the medical condition prevents the trainee from participating in training; the trainee cannot keep up with the unit, f) the medical condition prevented the soldier from preparing sufficiently for a mandatory event, g) the trainee demonstrated the motivation needed to rehabilitate from the injury and return to duty. Trainees who entered the PTRP spent time recovering from their injuries, performed limited exercise, and participated in some military duties and training. Names of individuals recommended to the PTRP were obtained from rosters kept in the Physical Therapy Clinic. To assure that all PTRPs were accounted for, the physical therapy rosters were compared to rosters obtained from the S-3 (Plans, Training and Operations Section) of the VF and Control battalions and checked again with the orderly room of the PTRP unit. Medical records of PTRP personnel were reviewed shortly after they entered the PTRP unit.

(e) By combining injury types and levels we obtained 9 injury outcome measures: any injury, any overuse injury, any traumatic injury, any lower extremity injury, time-loss injury, time-loss overuse injury, time-loss traumatic injury, time-loss lower extremity overuse injury, and PTRP injury. PTRP injuries were not broken down further because of the small sample size.

(3) Intrinsic Motivation Questionnaire Outcomes.

(a) The Intrinsic Motivation Questionnaire (IMQ) measured various aspects of an individual's subjective experience with respect to exercise training. It was based on the original work of the Rochester Motivational Research Group (103, 111) but the actual questionnaire was specifically designed for this study. The questionnaire examined a trainee's intrinsic motivation as a function of 6 dimensions. These dimensions include interest and/or enjoyment in exercise, perceived competence at performing exercise, effort put into exercise, perceived value or usefulness of exercise, pressure or tension in performing exercise, and choice in performing exercise. Each of these dimensions served as an outcome measure for the purposes of this study.

(b) Original versions of the IMQ consisted of 26-27 questions (98, 112). However, the exclusion of specific questions, modifications of questions, or even exclusion of specific dimensions appears to have little impact on the remainder of the questionnaire (98). The version of the IMQ used in this study is shown in Appendix K. The number of questions in each of the dimensions was reduced to 3 to create an 18 item questionnaire that could be administered in a short period of time. Note that in Appendix K the first two questions were not a part of the Intrinsic Motivation Questionnaire but rather addressed prior cigarette smoking and physical activity.

e. Training Exceptions. Training exceptions included individuals who came from the Fitness Assessment Program (FAP), individuals who were newstarted, and individuals who were discharged, as described below.

(1) Fitness Assessment Program (FAP) Personnel. When a new recruit first arrives at Fort Jackson, they are inprocessed at the Reception Station. As part of this inprocessing, recruits take a physical fitness test. The test items and criteria to enter BCT are shown in Table 3. If a trainee does not meet one or more of the criteria, he or she enters the FAP. In the FAP they perform physical training under the guidance of specially trained drill sergeants. The trainee can exit the FAP and enter BCT when he or she meets the Table 3 criteria. Names of FAP personnel who entered the VF or Control battalions were obtained from the orderly room of the Fitness Training Company (which controls the FAP).

Table 3. Reception Station Physical Fitness Test: Criteria to Enter BCT

	Men	Women
Push-ups (n)	13	3
Sit-ups (n)	17	17
One-mile Run (min)	8.5	10.5

(2) Newstarts. Newstart-outs were trainees leaving the VF or Control battalions and going to another BCT unit before the end of the 9-week BCT cycle. Newstart-ins were trainees who did not start training with the VF or Control battalions, but rather entered these units after training had begun. Trainees were newstarted (recycled) because they did not complete mandatory requirements for reasons such as motivation, injury (PTRP), emergency leave, or inability to meet specific training standards (i.e., difficulty developing specific skills like basic rifle marksmanship). These trainees could come into or leave the unit at any point depending on the nature of the problem. Newstart data were obtained from summaries provided by the battalion S-3 (Plans, Training, and Operations Section).

(3) Discharges.

(a) A discharge was a trainee who was not suitable for service in the Army and was formally released from his or her service committment. There were numerous reasons a trainee could have been discharged but most reasons fell into two major categories: medical conditions that existed prior to service (EPTS discharge) or poor entry-level performance. The latter category is often called an entry-level separation (ELS) or Chapter 11 discharge. ELS discharges are most often the result of the trainee's inability to adapt to the military environment because of lack of ability (cannot adequately perform critical military tasks) or for psychosocial reasons (motivation, inability to follow orders, personality problems, etc.).

(b) Trainees who were discharged were identified from records in the training battalion S-1 (Personnel Section). The medical records and discharge packets were reviewed at the Transition Point Headquarters where the records of all discharged individuals were consolidated.

f. Demographics. Trainee demographics were obtained from both medical records and from the MTS. Personnel at the Reception Station placed demographic information in the MTS shortly after the trainee arrived at Fort Jackson. Demographic information from the MTS included gender, age, military rank, ethnicity, service component (i.e., active duty, Reserves, National Guard), educational level, and marital status. Other demographics were recorded from DA Form 88 (Report of Medical Examination) in the trainee's medical record. These included height, body weight, ethnicity, gender, and date of birth (for age). Body mass index (BMI) was calculated as body weight/height^2. Data that overlapped in the medical records and MTS (age, gender, and ethnicity) were crosschecked for accuracy.

g. Data Analysis. Because of the wide variety of data collected in this study, the statistical analyses are described in detail in the Results section where the specific data are presented. In general, frequency data involving counts of people were analyzed using the Pearson chi-square statistic. In analyses

involving training days, the Mann-Whitney U-test was used to examine whether or not the two groups experienced a particular event on a similar training day. Continuous variables were analyzed by t-test if only comparing the two groups; if comparing more than two groups or if additional variables or levels of variables were examined (e.g., comparing groups on multiple APFT tests) analysis of variance (ANOVA) or analysis of covariance (ANCOVA) was used. Survival analysis (Kaplan-Meier and Cox regression) was used to analyze differences between the VF and Control groups in time to first injury. The Statistical Package for the Social Sciences (SPSS), Version 10.0.5, was used for these analyses.

6. PILOT PHASE FINDINGS AND CHANGES

a. The pilot study involved detailed observation and interaction between drill sergeants, commanders, Fitness School personnel, and USACHPPM personnel. This interaction resulted in a number of changes in training procedures and training exercises for the test phase. The major changes were elimination of medicine ball drills, addition of timed sets of push-ups and sit-ups, earlier introduction of ability group runs, and changes in administration of the movement drills, as described below.

b. Medicine ball drills were eliminated from the test phase because the medicine ball drills caused administrative problems and because of the difficulty in developing proper execution skills in the short period of time allowed for the exercises. One medicine ball was required for every two people. Often, when balls were checked out of the logistics section, too many or too few were obtained. When too few were obtained some individuals were not able to perform the drills; when too many were obtained, it was difficult to maintain accountability. Also, during the throwing exercises, a trainee could miss a catch and chase a ball over a long distance (especially where the terrain was sloped downward), resulting in disruption of the group drills. Elimination of the medicine ball drills allowed more time for some of the other exercises.

c. Another change in the program was the addition of timed sets of push-ups and sit-ups to the calisthenic routine. The pilot study indicated that, compared to historic norms, improvements in push-up and sit-up performance were not adequate. Thus, in order to improve performance, more specificity was introduced into the program.

d. Ability group running was introduced in the first week of training. In the pilot program, ability group running did not begin until the fourth week of training. The improvements in 2-mile run times during the pilot phase were similar to historic values. However, drill sergeants complained that ability group runs were used not only to develop aerobic fitness to pass the APFT, but also as a discipline and motivational tool. Thus, short ability group runs were introduced in the first week and the distance was gradually increased over the course of the Victory Fitness program.

e. Increased emphasis was put on proper execution of movement drills. Observations by the USAPFS suggested the drill sergeants were executing the movement drills too often and with too much speed. Additional training was provided by the USAPFS to the drill sergeants so the volume and speed of the movement drills would be more appropriate to the desired development of mobility and coordination.

7. TEST PHASE RESULTS

a. Cohort. The total cohort consisted of 2580 individuals. There were 1284 trainees in the VF group (769 men, 515 women) and 1296 trainees in the Control group (645 men, 651 women). This includes individuals who were discharged and/or newstarted.

b. Demographics.

(1) Table 4 shows that there were only small differences in physical characteristics between the two battalions.

Table 4. Comparison of Demographics (Physical Characteristics) of Trainees in VF and Control Battalions

Variable	Battalion	Men				Women			
		N	Mean	SD	p-value[a]	N	Mean	SD	p-value[a]
Age (years)	VF	759	20.9	3.4	0.13	505	20.9	3.7	0.09
	Control	630	20.7	3.3		637	20.7	3.4	
Height (inches)	VF	758	69.5	2.9	0.18	507	64.6	2.5	0.13
	Control	629	69.3	2.8		636	64.4	2.5	
Weight (pounds)	VF	758	166.4	29.3	0.23	507	136.3	21.4	0.15
	Control	628	163.7	27.7		636	134.7	20.0	
BMI[b] (kg/m^2)	VF	758	24.3	3.8	0.21	507	23.0	3.1	0.64
	Control	627	24.0	3.7		635	22.9	2.9	

[a]From independent sample t-test
[b]BMI=Body Mass Index (calculated from height and weight)

(2) The Control Battalion had a greater proportion of women than the VF Battalion (50.2% vs 40.1%, $p<0.01$). Other demographic comparisons between the VF and Control groups (separated by gender) are shown in Table 5. Most demographics were very similar for the two groups but there were some small differences. A larger proportion of men in the VF battalion were Army Reservists and fewer were Regular Army compared to the Control Battalion. A similar trend was noted for the women. More women in the VF Battalion were married compared to the Control group. This was not seen among the men.

Table 5. Demographic Comparison of VF and Control Battalion

Variable	Category	Men			Women		
		VF Group Proportion of Variable (%)	Control Group Proportion of Variable (%)	p-value[a]	VF Group Proportion of Variable (%)	Control Group Proportion of Variable (%)	p-value[a]
Race	White	58.3	53.2	0.22	49.3	43.3	0.14
	Black	23.8	29.6		33.6	40.2	
	Hispanic	12.5	11.5		9.7	10.3	
	Asian	2.6	2.9		3.7	4.0	
	American Indian	1.6	1.2		2.1	1.2	
	Other	1.3	1.6		1.6	0.9	
Marital Status	Single	87.9	87.7	0.89	85.3	89.0	0.06
	Married	12.1	12.3		14.7	11.0	
Rank[b]	Private One	60.8	60.3	0.24	53.3	54.0	0.87
	Private Two	21.8	19.2		21.5	20.8	
	Private First Class	13.9	15.4		17.3	18.4	
	Specialist	3.4	5.2		7.9	6.8	
Citizenship	Native Born	93.4	92.8	0.82	92.8	89.9	0.18
	Naturalized	2.5	2.4		2.0	3.5	
	Not Citizen	4.0	4.7		5.2	6.7	
Education	<High School[c]	0.3	0.3	0.12[c]	0	0	0.14[c]
	High School Grad	82.0	80.9		81.1	85.2	
	GED[d]	12.9	11.0		8.2	7.0	
	1-3 Years College	2.0	3.2		4.6	2.4	
	College Grad	2.8	4.5		6.0	5.4	
Component	Regular Army	73.7	78.2	0.03	69.7	73.7	0.10
	Army Reserve	13.1	8.6		14.7	10.5	
	National Guard	13.1	13.2		15.5	15.8	
Exercise or Sport Frequency[e]	None	8.2	5.8	0.13	10.4	10.2	0.78
	<1 per week	13.7	11.2		14.5	16.9	
	1per week	17.4	16.7		18.8	20.0	
	2 to 3 per week	37.4	37.9		39.6	37.4	
	4 or more per week	23.7	28.4		16.7	15.5	
Cigarette Smoking[e]	None	54.9	59.5	0.51	58.0	62.6	0.47
	Smoked but quit	9.9	9.0		12.0	9.4	
	1-10 cig per day[f]	11.2	10.5		11.8	12.0	
	11-20 cig per day[f]	14.8	12.2		13.1	11.1	
	>20 cig per day[f]	9.3	8.7		5.1	5.0	

[a]The p-value is from the chi-square statistic comparing VF to Control Battalion
[b]Each successive category represents a higher rank
[c]<High School was not included in chi-square calculation
[d] GED=General Education Development Certificate
[e]From Questionnaire (see Appendix K)
[f]Cig=Cigarettes

c. Training Exceptions. Table 6 shows a comparison of full cycle trainees and training exceptions in the two battalions. Full cycle trainees are those who began with the battalion on the first training day and graduated on the last training day. The VF group had a significantly larger proportion of FAP personnel and more of the VF men were discharged. There were no significant

differences between the VF and Control groups on the proportion of full cycle or newstart trainees.

Table 6. Comparison of Full Cycle Trainees and Training Exceptions in VF and Control Groups

	Gender	N		Proportion of Respective Battalion (%)		p-value[a]
		VF	Control	VF	Control	
Full Cycle	Men	688	583	89.5	90.4	0.57
	Women	446	561	86.6	86.2	0.83
FA	Men	33	15	4.3	2.3	0.04
	Women	90	69	17.5	10.6	<0.01
Discharges	Men	27	12	3.5	1.9	0.06
	Women	25	33	4.9	5.1	0.87
Newstart-ins	Men	17	24	2.2	3.7	0.19
	Women	10	21	1.9	3.2	0.18
Newstart-outs	Men	39	27	5.0	4.2	0.43
	Women	34	37	6.6	5.9	0.64

[a]From chi-square statistic

d. Training Data.

(1) Table 7 contains the estimated ability group running mileage and road marching mileage obtained from each company in the two battalions. As expected, the Control group had more than double the formation running mileage of the VF group. This does not include VF battalion mileage accumulated during 30/30 runs and movement drills since these data were not obtained. Road marching mileage and the number of physical training sessions did not differ for the two groups.

(2) The VF Battalion had to use a mess hall in another battalion because their mess hall was being renovated during both the pilot and test phases. This mess hall was located an estimated 0.25 miles from the VF battalion area. One company estimated that an additional 58 miles were accumulated during the BCT cycle as a result of marching to and from this mess hall. This estimate was based on the facts that three meals a day could have been eaten in this mess hall (excluding meals in the field), that each meal required a trip to and from the mess hall, and that the training cycle was 9 weeks in length. This estimate seems reasonable since if all meals had been eaten in the mess hall the total accumulated mileage would have been 95 miles (63 days X 3 meals/day X 0.25 miles X 2 trips/meal).

Table 7. Training Mileage and Training Sessions in VF and Control Groups

		Formation Running (miles)	Road Marching (miles)	Physical Training Sessions (n)
VF	Mean	17.1	59.3	34.0
	SD	1.9	14.8	2.4
Control	Mean	37.2	52.2	34.4
	SD	6.4	11.2	1.9
p-value[a]		<0.01	0.41	0.78

[a]From independent sample t-test comparing company mileage in VF and Control Battalions

e. Physical Fitness Outcomes.

(1) APFT Administration Dates. Table 8 shows the training dates on which the APFTs were administered. All initial tests were administered within 3-5 days from the start of the training cycle. There was somewhat more variability in administration of the diagnostic test (Test 3) with a range of 24-38 days from the start of the training cycle. The final test was administered 42-50 days from the start of the training cycle. When the two battalions were compared, there were no significant differences on the dates of administration for the initial, final, or middle tests. On average, the battalions administered the APFT within 0-4 training days of each other.

Table 8. Comparison of Battalions on Training Days when APFT was Administered (Numbers are the training days counting from the first day trainees were in the battalion)

Battalion	Company	Training Day			
		Initial (Test 1)	(Test 2)	Diagnostic (Test 3)	Final (Test4)
VF	A	3	NT[b]	24	45
	B	3	23	37	50
	C	3	NT[a]	31	43
	D	2	NT[a]	31	43
	E	5	NT[a]	31	48
	Mean	**3**	**23**	**31**	**47**
	SD	**1**	**0**	**5**	**3**
Control	A	3	17	38	47
	B	3	17	31	43
	C	3	17	38	44
	D	3	24	38	48
	E	3	17	31	42
	Mean	**3**	**18**	**35**	**45**
	SD	**0**	**3**	**4**	**3**
p-value[b]		0.69	-	0.15	0.55

[a]NT=No test administered
[b]Comparison of training day number between VF and Control Groups using Mann-Whitney U-Test

(2) APFT Raw Scores.

(a) Most companies in the VF battalion had only 3 APFTs and the date on which Diagnostic (Test 3) test was administered did not differ between the VF and Control group. Thus, comparisons between groups on APFT raw scores involved the Initial, Diagnostic, and Final APFTs (for the companies administering 4 APFTs, this is the first, third and fourth tests, respectively).

(b) APFT raw scores were compared using ANOVA and, where necessary, ANCOVA. The first analysis involved a one-way ANOVA comparing the two battalions on their initial APFT scores. If there were no significant differences, a 2X3 (battalion X test) mixed model analysis was performed

comparing the battalions as independent groups and the tests as repeated measures. If there were significant differences on the one-way ANOVA, an ANCOVA was performed. The covariate was the initial test and a 2X2 mixed model involved the two battalions over the 2 remaining tests, after adjustment for initial score differences. Only trainees with complete data on all three tests were considered in these analyses because ANOVA or ANCOVA (necessary to compare the battalions) requires complete data on all subjects.

(c) Table 9 shows the APFT results for the trainees that completed three tests. Average APFT results for all available trainees on all tests are shown in Appendix L.

Table 9. Comparison of APFT Raw Scores for the VF and Control Battalions

Gender	Test	Bn	Push-Ups (reps)		Sit-Ups (reps)		Two-Mile Run (min)	
			Mean	SD	Mean	SD	Mean	SD
Men	Initial (Test 1)	VF	31.9	12.5	43.6	11.9	17.6	2.6
		Control	32.9	14.4	42.7	12.6	17.0	2.4
	Diagnostic (Test 3)	VF	41.7	13.0	52.6	12.2	15.6	1.8
		Control	47.1	14.3	55.1	14.2	15.2	1.8
	Final (Test 4)	VF	47.8	12.9	59.1	11.1	15.0	1.3
		Control	51.9	13.4	59.9	13.7	14.8	1.3
Women	Initial (Test 1)	VF	10.1	8.9	37.3	13.8	21.7	2.8
		Control	10.3	9.3	34.4	13.9	21.1	2.6
	Diagnostic (Test 3)	VF	17.1	10.9	49.5	13.7	19.3	2.2
		Control	27.7	16.4	46.9	18.1	18.9	2.2
	Final (Test 4)	VF	23.5	11.4	58.5	12.1	18.4	1.6
		Control	31.5	17.4	52.7	18.2	18.2	1.7

(d) On the push-up event (Table 9), there were no significant differences between battalions on the Initial raw scores for men ($p=0.14$) or women ($p=0.43$). The 2 X 3 ANOVA for both men and women, showed a significant difference between battalions ($p<0.01$) and among tests ($p<0.01$); the battalion X test interaction was also significant ($p<0.01$). Figure 1 shows the results graphically. The Control men and women improved more than the VF men and women. The Control group had a larger increase in scores between the initial and diagnostic tests than between the diagnostic and final tests. The VF group had a much more linear increase in scores with the improvement between the initial and diagnostic tests similar to the improvement between the diagnostic and the final tests.

(e) For the men, there were no significant differences between battalions on the initial sit-up raw scores ($p=0.21$) (Table 9). The 2 X 3 ANOVA demonstrated no significant differences between battalions ($p=0.23$) but there were differences among tests ($p<0.01$) and the test X battalion interaction were significant ($p<0.01$ for both). Figure 2 graphically shows the male sit up scores. Similar to push-ups, the Control Battalion had a larger increase in the average score from the initial to the diagnostic test and a smaller increase from the

diagnostic to the final test. The VF group had a more linear increase in scores. Despite the difference in the pattern of changes, improvements on the sit-ups were similar for the VF and Control men.

(f) For the women, there were significant differences between battalions on the initial sit-up raw scores ($p<0.01$) (Table 9). Women in the VF Group performed about 3 more sit-ups on average compared to the Control group. After adjustment for these initial differences with ANCOVA, there were significant differences between battalions ($p<0.01$) and among tests ($p<0.01$) and the battalion X test interaction was also significant ($p<0.01$). Figure 3 shows the female sit-up test scores. The average change in scores from the initial test to the diagnostic test was identical (13 repetitions) for both groups. From the diagnostic to the final test the VF group improved an average of 9 repetitions while the Control group improved an average of 6 repetitions. The VF women improved more than the Control women on sit-ups after adjustment for initial score differences.

(g) For the 2-mile run, there were significant differences between battalions on the initial APFT for both men ($p<0.01$) and women ($p<0.01$) (Table 9). The Control men and women both ran an average of 36 seconds faster than the VF men and women. After adjustment for these initial differences with ANCOVA, the men showed significant differences among tests ($p<0.01$) but not between battalions ($p=0.15$) and the test X battalion interaction was not significant ($p=0.25$). Results for the women were similar. After adjustment for initial differences with ANCOVA, there were significant differences among tests ($p<0.01$) but not between battalions ($p=0.54$) and the test X battalion interaction was not significant ($p=0.26$). Figure 4 graphically depicts the 2-mile run scores. It can be seen that the Control group ran faster on the initial test but the VF group (both men and women) progressively closed the gap from an average of 36 seconds (initial test) to an average of 12 seconds (final test).

Table 10. Comparison of VF and Control Battalions for Pass Incidence on Initial APFT

Gender	Battalion	N	Proportion Passed (%)	p-value[a]
Men	VF	732	40.4	0.34
	Control	597	43.0	
Women	VF	485	30.5	0.93
	Control	611	30.3	
Men and Women	VF	1217	36.5	0.96
	Control	1208	36.6	

[a]From chi-square statistic comparing VF and Control Groups

Figure 1. Comparison of PU Scores
in VF and Control Groups

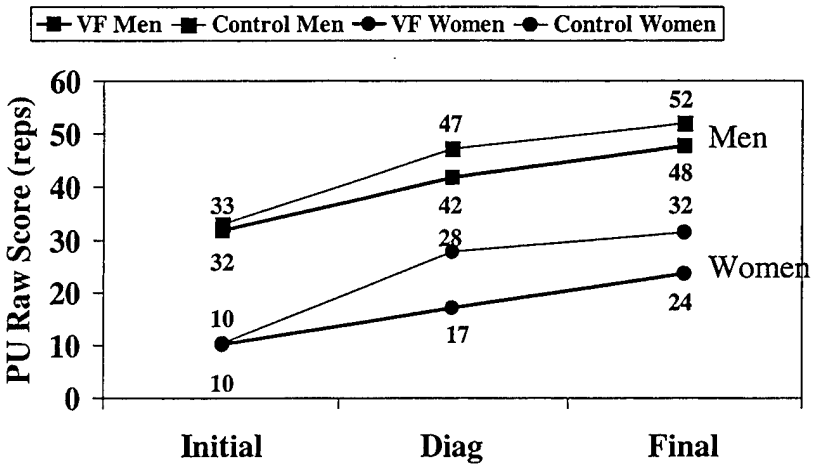


Figure 2. Comparison of Male Sit-Up Scores
in VF and Control Battalions

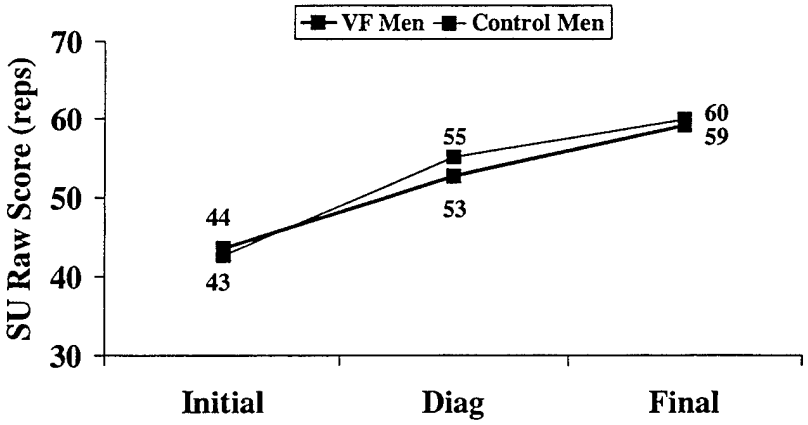


Figure 3. Comparison of Female Sit-Up Scores in VF and Control Battalions

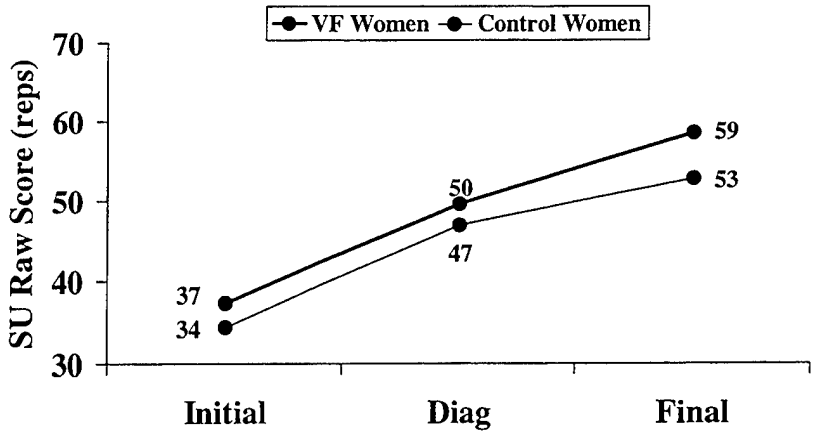
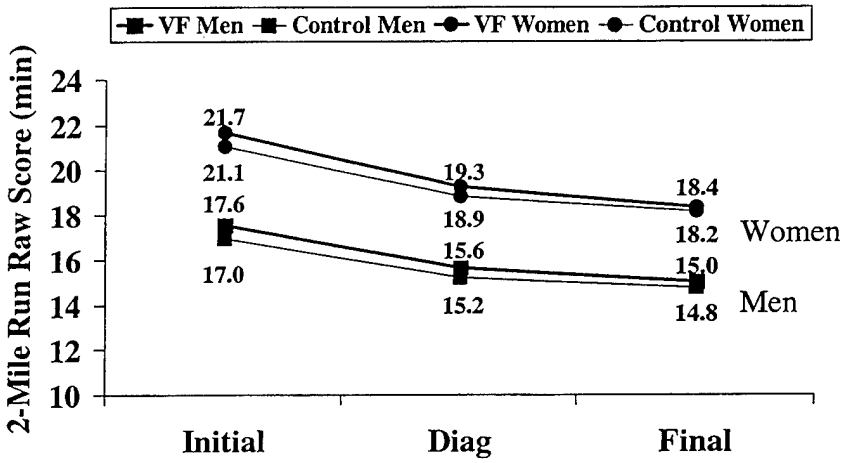


Figure 4. Comparison of Two-Mile Run Scores in VF and Control Battalions



(3) APFT Pass Rates.

(a) Initial APFT Pass Rates. Table 10 shows there were no differences between the VF and Control groups on the proportion of trainees passing the first (initial) APFT.

(b) Final (Record) APFT Pass Rates. Table 11 shows the first time pass incidence on the Final APFT. The VF Battalion had a higher proportion of trainees passing the APFT the first time on the final test compared to the Control Battalion.

Table 11. Comparison of VF and Control Battalions on First Administration of Final APFT

Gender	Battalion	N	Proportion Passed (%)	p-value[a]
Men	VF	702	84.8	0.04
	Control	609	80.5	
Women	VF	454	80.0	<0.01
	Control	594	70.2	
Men and Women	VF	1156	82.9	<0.01
	Control	1203	75.4	

[a]From chi-square statistic comparing VF and Control Groups

(c) Final APFT Retakes. Among trainees who did not pass the final APFT the first time, Table 12 shows the average number of retakes administered in the two battalions. The VF group required fewer retakes to pass the final APFT compared to the Control group.

Table 12. Comparison of VF and Control Battalions on Number of Final APFT Retakes

Gender	Battalion	N	Mean (No. of Retakes)	SD	p-value[a]
Men	VF	107	2.2	1.1	<0.01
	Control	119	2.8	1.5	
Women	VF	91	2.1	1.0	0.02
	Control	177	2.8	1.7	
Men and Women	VF	198	2.1	1.0	<0.01
	Control	296	2.8	1.6	

[a]From Mann-Whitney U-Test comparing VF and Control Groups

(d) Final APFT Failures. Table 13 shows the proportion of trainees who took the Final APFT and ultimately did not achieve 50 points on each APFT event even after all retakes. The proportion of both men and women failing was greater in the Control group than in the VF group but this was statistically significant only for the women. When both genders were combined, the Control group had a significantly greater proportion of final APFT failures compared to the VF group.

Table 13. Comparison of VF and Control Battalions on Proportion of Final APFT Failures

Gender	Battalion	N	Proportion Failed (%)	p-value[a]
Men	VF	702	1.7	0.18
	Control	606	2.8	
Women	VF	450	1.6	<0.01
	Control	588	4.6	
Men and Women	VF	1152	1.6	<0.01
	Control	1194	3.7	

[a]From chi-square statistic comparing VF and Control Groups

f. Injury Outcomes.

(1) Completeness of Medical Records Screening. Table 14 shows that over 98% of trainee medical records were reviewed and there were no differences in the overall proportion of medical records reviewed in the two groups. There were also no significant group differences in the proportion of medical records reviewed in the various subgroups (full cycle, FAP personnel, discharges, or newstarts).

Table 14. Comparison of VF and Control Battalions on Proportion of Medical Records Reviewed

	VF			Control			p-value[a]
	Trainees (N)	Medical Records Reviewed (N)	Medical Records Reviewed (%)	Trainees (N)	Medical Records Reviewed (N)	Medical Records Reviewed (%)	
Cohort	1284	1266	98.6	1296	1271	98.1	0.30
Full Cycle	1134	1123	99.0	1144	1133	99.0	0.98
FAP	123	119	96.7	84	84	100.0	0.24
Discharges	52	49	94.2	45	41	91.1	0.55
NS-ins[b]	27	23	85.2	45	35	77.8	0.44
NS-outs[b]	73	72	98.6	64	63	98.4	0.92

[a]From chi-square statistic comparing battalions on proportion of records reviewed and not reviewed
[b]NS=Newstart

(2) Crude Cumulative Injury Incidence. Crude cumulative injury incidence was calculated as trainees with one or more injuries (numerator) divided by trainees with a medical record (denominator) for each of the 9 injury outcomes. To examine differences between VF and Control groups, the Pearson chi-square statistic was used to test the hypothesis of no difference between groups. The crude injury incidence compares the two groups without regard to the time spent in the unit, demographic differences, or training exceptions.

(a) All Injuries. Table 15 shows a comparison of the VF and Control Battalions on the incidence of injuries of any type. For all injuries, there

were no significant battalion differences for the men; women in the VF Battalion had a lower overall injury incidence. Overuse injuries were lower in the VF Battalion for both men and women. There were no group differences in the incidence of traumatic injuries for either men or women. Women in the VF Battalion had a lower incidence of lower extremity overuse injuries and the men showed a similar trend.

Table 15. Cumulative Incidence of All Injuries for VF and Control Groups

Injury Type	Battalion	Men				Women			
		N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
All Injuries	VF	759	15.7	1.2	0.14	507	39.6	1.2	<0.01
	Control	631	18.7			640	47.8		
Overuse Injuries	VF	759	11.6	1.3	0.04	507	32.87	1.3	<0.01
	Control	631	15.4			640	42.7		
Traumatic Injuries	VF	759	4.9	0.9	0.70	507	10.1	0.7	0.13
	Control	631	4.4			640	7.5		
LE Overuse Injuries[b]	VF	759	8.2	1.3	0.0	507	27.2	1.2	0.03
	Control	631	10.9			640	33.3		

[a]Risk ratio calculated as (Control/VF)
[b]LE=lower extremity

(b) There were more FAP personnel in the VF group (see Table 7). Table 16 shows that the crude cumulative injury incidence was 1.3 to 2.0 times higher in the FAP personnel compared to the non-FAP personnel. A separate analysis was performed without the FAP personnel but, as shown in Appendix M, this had little influence on the crude cumulative injury incidences.

Table 16. Cumulative Incidence of All Injuries for FAP and Non-FAP Personnel in the VF and Control Groups

	Men						Women					
	VF			Control			VF			Control		
	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]
FAP	33	30.3	0.02	15	33.3	0.14	88	54.5	<0.01	69	59.4	0.04
Not FAP	726	15.0		616	18.3		419	36.5		571	46.4	

[a]From chi-square statistic

(c) Time-Loss Injuries. Table 17 shows the cumulative incidence of time-loss injuries. For the men, none of the time-loss injury measures differed between battalions. For the women, overuse injuries and lower extremity overuse injuries were significantly lower in the VF Battalion. All time-loss injuries tended to be lower in the VF Battalion. Separate analysis of time-loss injuries without the FAP personnel had little influence on group differences as shown in Appendix M.

(d) Table 18 shows that crude cumulative incidence of time-loss injury was 1.4 to 2.8 times higher in the FAP personnel compared to the non-FAP personnel.

Table 17. Cumulative Incidence of Time-Loss Injuries for VF and Control Groups

Time-Loss (TL) Injury Type	Battalion	Men				Women			
		N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
All TL Injuries	VF	759	11.6	1.1	0.54	507	32.1	1.2	0.07
	Control	631	12.7			640	37.3		
TL Overuse Injuries	VF	759	8.6	1.3	0.14	507	25.6	1.3	<0.01
	Control	631	10.9			640	32.8		
TL Traumatic Injuries	VF	759	3.6	0.7	0.27	507	7.7	0.8	0.20
	Control	631	2.5			640	5.8		
TL LE Overuse Injuries[b]	VF	759	6.1	1.3	0.25	507	20.9	1.3	0.02
	Control	631	7.6			640	26.9		

[a]Risk ratio calculated as Control/VF
[b]LE=lower extremity

Table 18. Cumulative Incidence of Time-Loss Injuries for FAP and Non-FAP Personnel in the VF and Control Groups
(what are this squares?)

	Men						Women					
	VF			Control			VF			Control		
	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]	N	Injured (%)	p-value[a]
FAP	33	30.3	<0.01	15	20.0	0.38	88	42.0	0.03	69	50.7	0.02
Not FAP	726	10.7		616	12.5		419	30.1		571	35.7	

[a]From chi-square statistic

(3) PTRP Injury Incidence. Table 19 shows the cumulative incidence of PTRP injuries. There were no differences between battalions among the men or women.

Table 19. Cumulative Incidence of PTRP Injuries in the VF and Control Groups

Battalion	Men				Women			
	N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
VF	759	1.3	1.2	0.67	507	3.9	1.1	0.72
Control	631	1.6			640	4.4		

[a]Risk ratio calculated as (Control/VF)

(4) Survival Analysis. There were 144 trainees in the VF Battalion (11.3% of the group) and 139 in the Control Battalion (10.9% of the group) that did not complete BCT because of discharge or newstarting (some newstart-ins were later discharged). These people did not have the same exposure to potential injury producing events. To account for the unequal time in the unit, survival analysis was used.

(a) Kaplan-Meier Survival Analysis. Kaplan-Meier survival analysis was used to compare time to first injury between those in the VF Battalion and those in the Control Battalion while controlling for exposure time. For this analysis, once a trainee had an injury, his or her contribution to time in BCT was

terminated. Those not completing BCT (discharges and newstarts) had their times censored on the day they left the unit. Survival curves were plotted to show the number of trainees who had not been injured on each successive day of training. The Log-Rank Test was used to compare the equality of the survival distributions. The results were very similar to the crude injury incidence analyses.

- All Injuries. Figure 5 shows that for all injuries there were no significant group differences in the survival distributions of the men; the VF women had greater cumulative survival than the Control women. Note that the differences between battalions early in training are small but become larger as BCT progresses. For all overuse injuries (Figure 6), VF men and women had greater cumulative survival than Control men and women. Again, battalion differences become larger as BCT progresses with the largest differences late in training. For traumatic injuries (Figure 7) there were no differences between battalions in the survival distributions for either men or women. For lower extremity overuse injuries (Figure 8), the VF women had greater cumulative survival than the Control women and the men showed this same trend.

- Time-Loss Injuries. Figure 9 shows that the survival distributions for all time-loss injuries did not differ between the VF and Control men. VF women tended to have greater cumulative survival than Control women with the largest differences later in training. For time-loss overuse injuries (Figure 10), the survival curves were not different between groups for the men but the VF women had greater cumulative survival than Control women. The women's curves show that the largest differences occurred later in training. For time-loss traumatic injuries (Figure 11), there were no differences between battalions in the survival distributions. For time-loss lower extremity overuse injuries (Figure 12), there were no differences between battalions for the men but the VF women demonstrated greater cumulative survival than control women. Differences in the women's survival curve were greatest later in training.

Figure 5. Comparison of All Injuries in VF and Control Bn

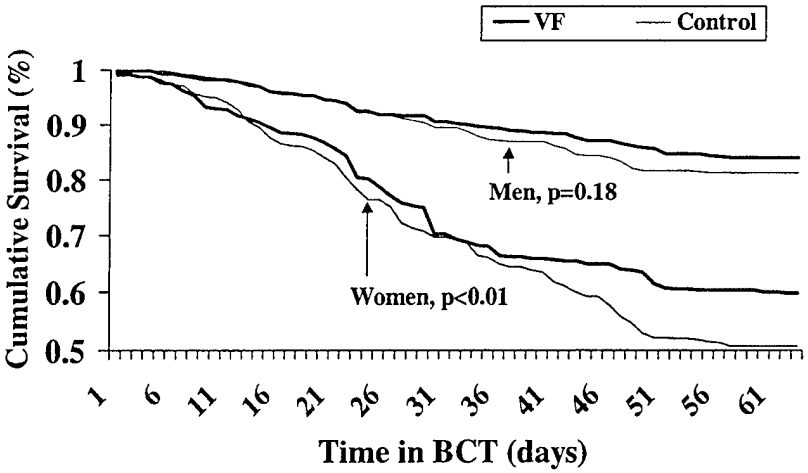


Figure 6. Comparison of Overuse Injuries in VF and Control Bn

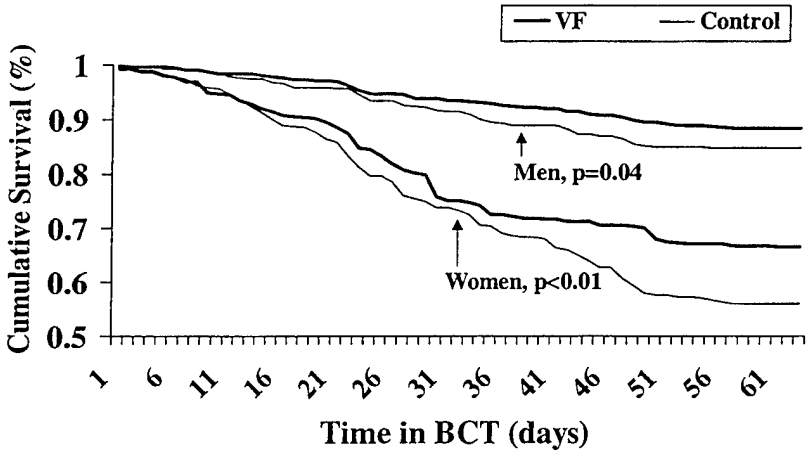


Figure 7. Comparison of Traumatic Injuries in VF and Control Bn

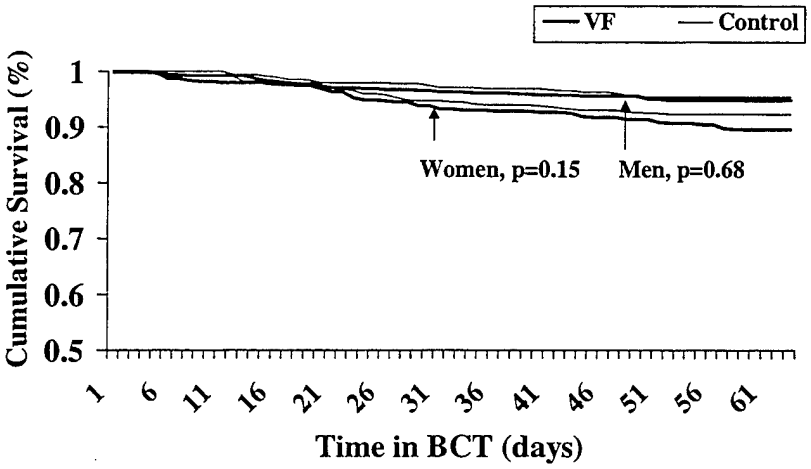


Figure 8. Comparison of Lower Extremity Overuse Injuries in VF and Control Bn

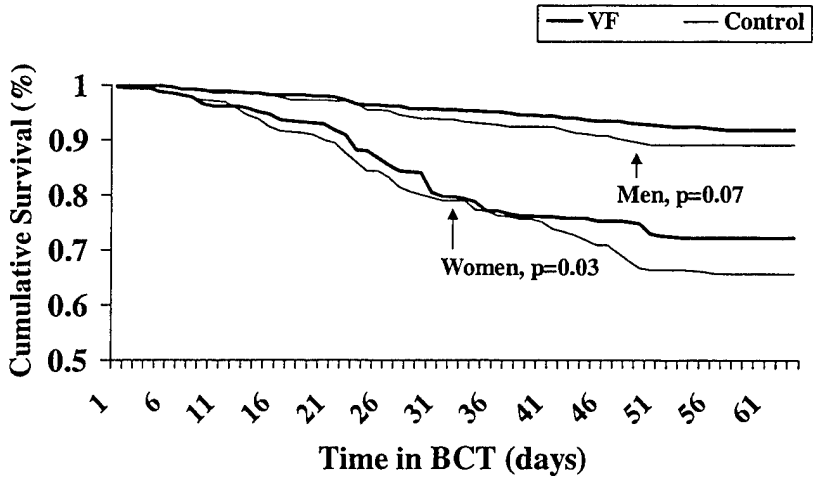


Figure 9. Comparison of Time-Loss Injuries in VF and Control Bn

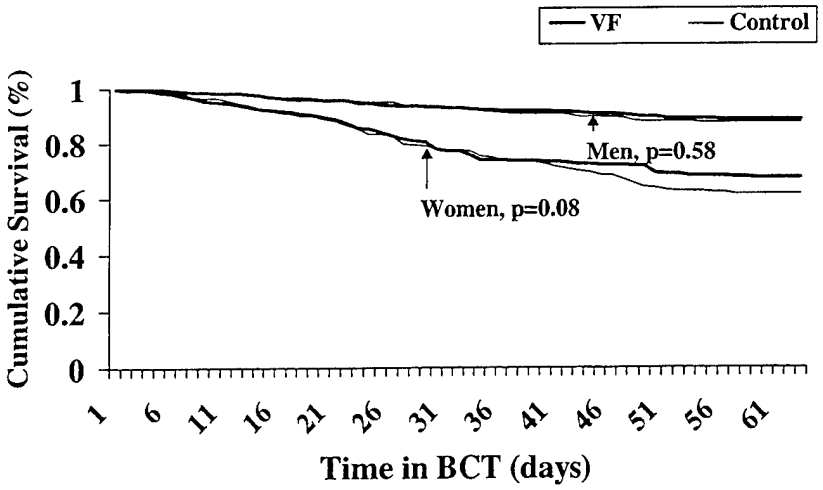


Figure 10. Comparison of Time-Loss Overuse Injuries in VF and Control Bn

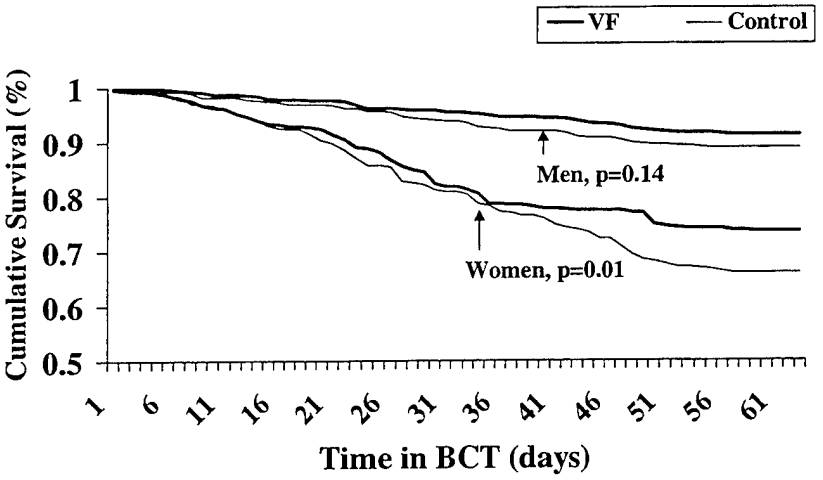


Figure 11. Time-Loss Traumatic Injuries in VF and Control Bn

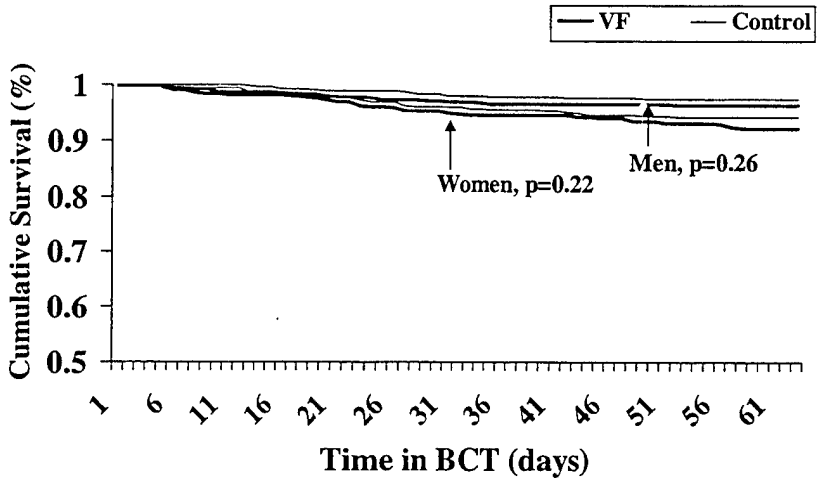
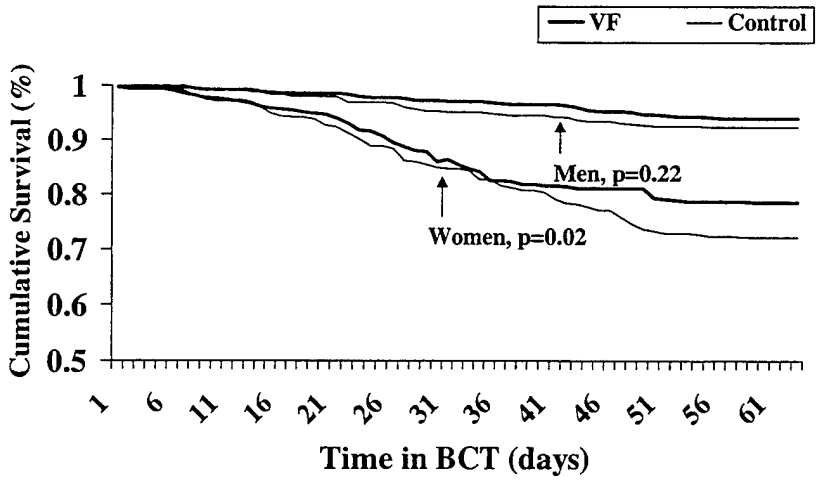


Figure 12. Comparison of Time-Loss Lower Extremity Overuse Injury in VF and Control Bn



(b) Cox Regression. Analysis of demographic variables and training exceptions revealed some differences between battalions (see Tables 5, 6, and 7). To examine differences in the VF and Control groups while controlling for these variables, Cox regression (a survival analysis technique) was used. Cox regression examines relative group differences in time to the first injury while controlling for the effects of covariates. Covariates were all demographic variables and training exceptions that differed between battalions (a p-value <0.10, for either gender). These variables were FAP status, discharge status, martial status, service component, age, sit-up performance, and 2-mile run times. For this analysis, once a trainee had an injury, his or her contribution to time in BCT was terminated. Those not completing BCT (discharges and newstarts) had their times censored at the day they left the unit. All covariates were entered into the model as categorical with the exception of age, sit-up performance, and 2-mile run times; these were entered as continuous variables. For all categorical variables, simple contrasts with a baseline variable (defined with a risk ratio of 1.00) were used. All regression models for the men had a total of 1441 trainees while models for the women had 1166 trainees (only trainees with complete data could be included).

- Tables 20 to 23 show the risk of injury in the Control group relative to the VF group (with 95% confidence intervals) while controlling for the influence of the other variables. The relative risk of an injury of any type (Table 20) was 37% higher in the Control men and 35% higher in the Control women compared to the VF men and women. For overuse injuries (Table 21), the relative risk of injury was 57% higher in the Control men and 45% higher in the Control women. There were no differences between the VF and Control groups for traumatic injuries (Table 22). For lower extremity overuse injuries, Control men had a 65% higher injury risk while Control women had a 30% higher injury risk, relative to the VF group (Table 23).

- Tables 24 to 27 show the risk of time-loss injuries in the Control group relative to the VF group when controlling for the influence of the variables mentioned above. The relative risk of experiencing a time-loss injury of any type (Table 24) did not differ between the VF and the Control men; however, the Control women were at 27% higher risk than the VF women. For time-loss overuse injuries (Table 25), the relative risk of injury was 46% higher in the Control men and 37% higher in the Control women. There were no differences between the VF and Control groups for time-loss traumatic injuries (Table 26). For time-loss lower extremity overuse injuries (Table 27), Control men had a 56% higher injury risk while Control women have a 39% higher injury risk, relative to the VF group.

Table 20. Cox Regression Results Comparing All Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.37	1.05-1.80	0.02	1.35	1.12-1.64	<0.01
FAP						
No	1.00	---	---	1.00	---	---
Yes	1.69	0.93-3.07	0.09	1.37	1.07-1.75	0.01
Discharge						
No	1.00	---	---	1.00	---	---
Yes	5.39	2.82-10.29	<0.01	2.26	1.44-3.54	<0.01
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	0.90	0.58-1.37	0.61	1.11	0.85-1.47	0.43
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.86	0.55-1.33	0.49	0.86	0.64-1.17	0.34
NG[b]	0.77	0.50-1.19	0.24	0.92	0.71-1.19	0.50
Age	1.05	1.01-1.09	0.01	1.01	0.99-1.04	0.43
Sit-Ups	1.01	1.00-1.02	0.16	0.99	0.98-1.00	<0.01
Two-Mile Run	1.11	1.06-1.17	<0.01	1.05	1.01-1.09	<0.01

[a]From Wald statistic
[b]NG=National Guard

Table 21. Cox Regression Results Comparing Overuse Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.57	1.15-2.14	<0.01	1.45	1.17-1.78	<0.01
FAP						
No	1.00	---	---	1.00	---	---
Yes	1.33	0.64-2.75	0.50	1.31	1.00-1.71	0.05
Discharge						
No	1.00	---	---	1.00	---	---
Yes	5.39	2.82-10.29	<0.01	2.40	1.50-3.85	<0.01
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	0.86	0.52-1.40	0.58	1.08	0.80-1.45	0.63
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.95	0.59-1.55	0.85	0.93	0.68-1.28	0.93
NG[b]	0.87	0.54-1.40	0.63	0.91	0.68-1.20	0.91
Age	1.06	1.02-1.11	<0.01	1.01	0.98-1.04	0.40
Sit-Ups	1.01	0.99-1.02	0.28	0.99	0.98-1.00	<0.01
Two-Mile Run	1.12	1.05-1.18	<0.01	1.04	1.01-1.08	0.04

[a]From Wald statistic
[b]NG=National Guard

Table 22. Cox Regression Results Comparing Traumatic Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.06	0.63-1.76	0.84	0.92	0.60-1.41	0.70
FAP						
No	1.00	---	---	1.00	---	---
Yes	3.25	1.35-7.82	<0.01	1.56	0.92-2.66	0.10
Discharge						
No	1.00	---	---	1.00	---	---
Yes	4.47	1.37-14.54	0.01	0.90	0.22-3.70	0.88
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	1.17	0.53-2.55	0.70	0.90	0.48-1.71	0.75
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.63	0.25-1.58	0.32	0.75	0.36-1.56	0.43
NG[b]	0.57	0.23-1.43	0.23	1.21	0.71-2.08	0.49
Age	1.01	0.93-1.09	0.84	1.04	0.98-1.09	0.20
Sit-Ups	1.01	0.99-1.03	0.34	1.00	0.99-1.02	0.73
Two-Mile Run	1.10	1.00-1.21	0.06	1.07	0.98-1.16	0.12

[a]From Wald statistic
[b]NG=National Guard

Table 23. Cox Regression Results Comparing Lower Extremity Overuse Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.65	1.14-2.39	0.01	1.30	1.03-1.64	0.03
FAP						
No	1.00	---	---	1.00	---	---
Yes	0.89	0.32-2.43	0.76	1.05	0.77-1.43	0.76
Discharge						
No	1.00	---	---	1.00	---	---
Yes	4.86	1.95-12.12	<0.01	1.80	1.02-3.17	0.04
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	0.96	0.56-1.70	0.94	1.06	0.76-1.48	0.73
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.93	0.52-1.68	0.83	0.91	0.64-1.30	0.61
NG[b]	0.93	0.55-1.65	0.85	0.78	0.56-1.08	0.13
Age	1.07	1.01-1.12	0.01	0.99	0.98-1.05	0.48
Sit-Ups	1.01	0.99-1.02	0.55	1.06	0.98-1.00	0.02
Two-Mile Run	1.13	1.06-1.20	<0.01	1.80	1.01-1.11	0.01

[a]From Wald statistic
[b]NG=National Guard

Table 24. Cox Regression Results Comparing Time-Loss Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.23	0.89-1.69	0.21	1.27	1.02-1.57	0.03
FAP						
No	1.00	---	---	1.00	---	---
Yes	2.04	1.09-3.82	0.03	1.37	1.05-1.81	0.02
Discharge						
No	1.00	---	---	1.00	---	---
Yes	5.67	2.74-11.73	<0.01	2.32	1.41-3.84	<0.01
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	1.08	0.67-1.75	0.74	1.21	0.89-1.64	0.23
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.59	0.33-1.07	0.08	1.01	0.73-1.39	0.97
NG[b]	0.82	0.49-1.35	0.44	0.87	0.64-1.17	0.35
Age	1.05	1.01-1.10	0.02	1.01	0.98-1.04	0.73
Sit-Ups	1.00	0.99-1.02	0.76	0.99	0.98-1.00	0.02
Two-Mile Run	1.14	1.08-1.21	<0.01	1.06	1.02-1.10	0.01

[a]From Wald statistic
[b]NG=National Guard

Table 25. Cox Regression Results Comparing Time-Loss Overuse Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.46	1.02-2.10	0.04	1.37	1.08-1.74	<0.01
FAP						
No	1.00	---	---	1.00	---	---
Yes	1.47	0.68-3.21	0.33	1.33	0.98-1.79	0.06
Discharge						
No	1.00	---	---	1.00	---	---
Yes	5.60	2.42-12.96	<0.01	2.42	1.42-4.13	<0.01
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	1.01	0.59-1.73	0.98	1.12	0.80-1.57	0.50
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.56	0.28-1.12	0.10	1.13	0.80-1.58	0.49
NG[b]	0.92	0.54-1.57	0.76	0.83	0.60-1.16	0.28
Age	1.07	1.02-1.12	<0.01	1.01	0.97-1.04	0.70
Sit-Ups	1.00	0.99-1.02	0.70	0.99	0.98-1.00	0.01
Two-Mile Run	1.15	1.08-1.22	<0.01	1.05	1.00-1.10	0.03

[a]From Wald statistic
[b]NG=National Guard

Table 26. Cox Regression Results Comparing Time-Loss Traumatic Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	0.84	0.44-1.61	0.60	0.93	0.55-1.47	0.68
FAP						
No	1.00	---	---	1.00	---	---
Yes	4.45	1.79-11.09	<0.01	1.41	0.76-2.60	0.28
Discharge						
No	1.00	---	---	1.00	---	---
Yes	4.11	0.97-17.48	0.06	1.19	0.29-4.94	
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	1.34	0.54-3.35	0.53	1.39	0.71-2.72	0.34
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.77	0.27-2.18	0.62	0.75	0.32-1.77	0.51
NG[b]	0.54	0.16-1.76	0.30	1.39	0.76-2.55	0.29
Age	1.02	0.93-1.13	0.64	1.02	0.95-1.09	0.61
Sit-Ups	1.00	0.97-1.03	0.84	1.00	0.98-1.02	0.79
Two-Mile Run	1.13	1.01-1.26	0.04	1.07	0.97-1.17	0.17

[a]From Wald statistic
[b]NG=National Guard

Table 27. Cox Regression Results Comparing Time-Loss Lower Extremity Overuse Injuries

Variable	Men			Women		
	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]	Adjusted Risk Ratio	95% Confidence Interval	p-value[a]
Battalion						
VF	1.00	---	---	1.00	---	---
Control	1.56	1.01-2.41	0.05	1.39	1.07-1.80	0.02
FAP						
No	1.00	---	---	1.00	---	---
Yes	0.58	0.14-2.40	0.46	1.14	0.81-1.61	0.46
Discharge						
No	1.00	---	---	1.00	---	---
Yes	5.64	2.02-15.72	<0.01	1.76	0.92-3.35	0.09
Marital Status						
Single	1.00	---	---	1.00	---	---
Married	1.05	0.56-1.99	0.87	1.07	0.73-1.55	0.75
Component						
Regular Army	1.00	---	---	1.00	---	---
Reserves	0.56	0.24-1.29	0.18	1.08	0.73-1.58	0.71
NG[b]	1.03	0.55-1.91	0.94	0.77	0.53-1.12	0.17
Age	1.07	1.01-1.13	0.02	1.01	0.97-1.05	0.70
Sit-Ups	1.01	0.99-1.03	0.41	0.99	0.98-1.00	0.15
Two-Mile Run	1.17	1.08-1.26	<0.01	1.07	1.02-1.12	<0.01

[a]From Wald statistic
[b]NG=National Guard

g. Intrinsic Motivation Questionnaire.

(1) Reliability. In order to examine the reliability of the IMQ, the questionnaire was administered to a group of trainees (n=58) twice within 2 days. Test-retest reliability (Spearman Rho) of each of the 18 questions and the 6 scales is shown in Table 28. Coefficients for individual questions range from 0.85 to 0.42 with the lowest values on Questions 8 and 9. Coefficients for the scales range from 0.87 to 0.65.

Table 28. Test-Retest Reliability of the Individual Questions and Scales on the IMQ

Question Number or Scale	Spearman Rho Correlation Coefficient
3	0.83
4	0.80
5	0.65
6	0.83
7	0.73
8	0.54
9	0.42
10	0.82
11	0.75
12	0.72
13	0.61
14	0.82
15	0.62
16	0.85
17	0.72
18	0.60
19	0.76
20	0.59
Interest/Enjoyment	0.87
Perceived Competence	0.81
Effort Importance	0.81
Value/Usefulness	0.74
Pressure/Tension	0.71
Choice	0.65

(2) Internal Consistency. The Cronbach Alpha was used to examine the internal consistency of the scales, based on the average inter-item correlation. It indicates the extent to which if a trainee responded high (or low) on one question of the three scale questions, he or she also responded high (or low) on the other scale questions. Table 29 shows the Cronbach Alpha for each of the six scales. Coefficients ranged from 0.87 to 0.37. Because of the low internal consistency of the Pressure/Tension and Choice scales, they were not considered in further analysis.

Table 29. Internal Consistency of the IMQ Scales

IMQ Scale	Cronbach's Alpha
Interest/Enjoyment	0.82
Perceived Competence	0.87
Effort Importance	0.70
Value/Usefulness	0.58
Pressure/Tension	0.37
Choice	0.40

(3) Analysis of Group Differences in IMQ Scales. Table 30 shows a comparison of the VF and Control Battalions on the IMQ scales. Differences in scores on the IMQ scales were compared using ANOVA and ANCOVA. The first analysis involved a one-way ANOVA comparing the two battalions on their initial IMQ scores. Since there were initial differences on 3 of 4 scales (interest/ enjoyment, effort/importance, and value/usefulness scales), ANCOVA was used for further analysis of all 4 scales (for consistency of analysis). For the ANCOVA, the final scores were analyzed between groups with the initial score as the covariate. This statistically controls differences in the initial scores. Only trainees who were full cycle were considered in these analyses because only these subjects completed both pre and post questionnaires. Appendix N contains an analysis of trainees who were not full cycle.

(4) ANCOVA showed that there were no differences between the VF and Control groups on the interest/enjoyment scale. For the perceived competence scale, men in the Control group demonstrated higher scores than the VF men after initial score adjustment. This same trend was present for the women but was not statistically significant. On the effort/importance scale, differences were small but the VF men and women scored significantly higher than the Control men and women after initial score adjustment. VF women perceived more value and usefulness compared to the Control women; a similar trend was present for the men.

(5) Table 30 also shows that scores generally increased from the initial to the final administration of the test. Paired t-tests showed that scores increased on all scales for the men in both battalions ($p<0.02$). For the women, scores increased on all scales for both battalions ($p<0.01$) except for the effort/importance scale ($p=0.93$ for the VF group and $p=0.74$ for the Control group).

Table 30. Comparison of VF and Control Group on IMQ Scales

IMQ Scales			Men				Women			
			Mean	SD	p-values		Mean	SD	p-values	
					Initial[a]	Final[b]			Initial[a]	Final[b]
Interest/ Enjoyment	Initial	VF	16.7	3.4	0.03		16.3	3.2	0.02	
		Control	17.1	3.1			16.8	3.1		
	Final	VF	17.3	3.2		0.53	16.9	3.1		0.63
		Control	17.7	3.1			17.2	3.1		
Perceived Competence	Initial	VF	16.4	3.6	0.35		15.0	3.8	0.	
		Control	16.6	3.3			15.0	3.7		
	Final	VF	18.0	2.7		<0.01	17.0	3.0		0.20
		Control	18.5	2.4			17.2	2.9		
Effort/ Importance	Initial	VF	18.3	2.4	<0.01		17.8	2.8	<0.01	
		Control	18.9	2.3			18.5	2.4		
	Final	VF	18.6	2.4		0.03	18.1	2.4		0.02
		Control	19.1	2.2			18.6	2.4		
Value/ Usefulness	Initial	VF	18.3	2.4	<0.01		17.9	2.7	<0.01	
		Control	18.7	2.1			18.4	2.3		
	Final	VF	19.0	2.1		0.10	18.6	2.2		<0.01
		Control	19.3	2.1			19.0	2.1		

[a]From one-way ANOVA
[b]From ANCOVA correcting for differences in initial score

8. HISTORICAL COMPARISONS OF INJURY RATES AND APFT SCORES.

a. General. One question is whether differences in injury rates have historically been lower in the VF battalion compared to the Control battalion. Since trainee medical records have not been screened in the past in these two battalions, this question cannot be easily answered. However, it was possible to get historical data from two injury surveillance systems at Fort Jackson that provide a partial answer regarding historical injury rates. These surveillance systems were the Soldier Illness and Injury Tracking System (SI^2TS) and the PTRP Surveillance System.

b. Historical Injury Rates from the SI^2TS.

(1) The SI^2TS is maintained by the McWethy Troop Medical Clinic (TMC) at Fort Jackson, South Carolina. The system tracks BCT sick call (primary care) visits at the BCT battalion aid stations, TMC, and hospital (Moncrief Army Community Hospital). Data are collected from sign-in rosters and appointment sheets that indicate each soldier's gender, BCT unit, and chief complaint(s). At the end of each day, these data are compiled and entered into a database. This is considerably different from the type of data collected in the present study. Initial and follow-up visits cannot be distinguished. Only primary care visits are recorded, so visits to some specialty clinics (e.g., Orthopedics, General Surgery, etc.) are not included. However, the data collection procedures are consistent across training cycles making it a valuable tool for

tracking the number of sick call visits and for making comparisons among battalions.

(2) One injury category in the SI^{2}TS that is gender specific is lower extremity injury sick call visits. Table 31 shows these data for the VF and Control groups for 7 BCT cycles. The relative risk (VF/Control) of a lower extremity sick call visit has varied between 1.25 to 0.86 for the 4 cycles that began between May 1999 and February 2000. The largest difference prior to the study was the cycle that began in February 2000 where the women in the VF battalion had a 25% higher sick call rate for lower extremity complaints

(3) During the test phase (cycle that began in September 2000 in Table 31), the VF group had a considerably lower rate of visits compared to the Control group and this rate was lower than in any previous period. These data support the general findings of this study that the VF group had a genuinely lower injury rate than the Control group during the test phase.

Table 31. Comparison of Average Weekly Sick Call Visits for Lower Extremity Injuries (from the Soldier Injury and Illness Tracking System) for the VF and Control Battalions Over 7 BCT Cycles

		Cycle Start Date (Month and Year)						
		MAY99 -JUN99	AUG99	NOV99	FEB00	APR00	JUL00 (Pilot)	SEP00 (Test)
Men	VF[a]	3.6	3.0	5.2	5.4	NC[c]	3.5	2.3
	Control[a]	3.4	3.5	4.4	5.7	6.9	3.9	3.4
	Risk Ratio[b]	0.94	1.17	0.85	1.06	---	1.11	1.48
Women	VF[a]	9.7	9.9	12.4	16.9	NC[c]	10.2	9.0
	Control[a]	9.2	11.0	13.9	13.5	14.3	14.1	11.8
	Risk Ratio[b]	0.95	1.11	1.12	0.80	---	1.38	1.31

[a]Units: visits/100 trainees/wk
[b]Calculated as Control/VF (a ratio >1.0 indicates a lower rate in the VF group)
[c]NC=No Cycle (the VF battalion did not have a BCT cycle in this time period)

c. Historical Injury Rates from the PTRP Surveillance System.

(1) The PTRP Surveillance System is maintained by the Physical Therapy Clinic at McWethy TMC, Fort Jackson, South Carolina. The system tracks the number of trainees recommended and assigned to the PTRP. The data collected are similar but not identical to that collected in the present study. Only battalion starting strengths are used in the denominator so discharges and newstarts are not considered (this is due to the lack of manpower and the difficulty and time-consuming nature of tracking these training exceptions). Some individuals are recommended or assigned to the PTRP for illnesses (not just injuries). With these limitations, this database provides a second basis for historical comparisons of the battalions on injury incidence. Further, since both numerators (number of trainees recommended) and denominators (battalion strength) are available, it is possible to compare the battalions using chi-square statistics.

(2) Table 32 presents the PTRP recommendations for the VF and Control battalions. Historical differences between the battalions have generally been small. Only one comparison was statistically significant (men and women combined, NOV99) and this favored the Control group. During the test phase there were no statistically significant differences between the VF and Control battalions, but the VF battalion tended to have a lower PTRP rate when men and women were combined.

Table 32. Comparison of the VF and Control Battalions on PTRP Rates during 7 BCT Cycles (From PTRP Surveillance System)

		Cycle Start Date (Month and Year)						
		MAY-JUN99	AUG99	NOV99	FEB00	APR00	JUL00 (Pilot)	SEP00 (Test)
Men	VF[a]	1.0	1.5	1.6	2.0	NC[d]	0.7	1.1
	Control[a]	2.1	1.5	0.5	2.6	3.0	1.0	1.8
	Ratio[b]	2.10	1.00	0.31	1.30	---	1.43	1.64
	p-value[c]	0.12	0.97	0.15	0.53	---	0.56	0.27
Women	VF[a]	4.5	6.9	6.7	9.0	NC[d]	4.4	3.5
	Control[a]	3.5	5.5	4.4	7.6	7.8	3.4	4.6
	Ratio[b]	0.78	0.80	0.66	0.84	---	0.77	1.31
	p-value[c]	0.41	0.39	0.19	0.51	---	0.36	0.36
Men and Women	VF[a]	2.6	3.7	3.8	4.7	NC[d]	2.4	2.1
	Control[a]	2.7	3.0	2.0	4.7	4.3	2.1	3.2
	Ratio[b]	1.04	0.81	0.53	1.00	---	0.88	1.52
	p-value[c]	0.93	0.39	0.03	0.94	---	0.59	0.08

[a]Units are % of battalion starting strength recommended to PTRP
[b]Calculated as Control/VF (a ratio >1.0 indicates a lower rate in the VF battalion)
[c]From chi-square statistic
[d]NC=No Cycle (the VF battalion did not have a BCT cycle in this time period)

d. Historical Comparisons of Physical Fitness Test Scores.

(1) We obtained historical data on APFT scores from the Directorate of Information Management at Fort Jackson, South Carolina. After a BCT cycle was completed, the Information Management Branch at Ft Jackson obtained the MTS data and maintained a post-wide MTS database. For the purposes of the Victory Fitness Project, databases were downloaded and consolidated for the period May, 1999 to April, 2000. The download and consolidation involved 17,272 trainees.

(2) Since raw data were available, it was possible to perform statistical analyses comparing three groups: VF, Control, and historical MTS. Statistical analysis was performed in two steps. A one-way ANOVA comparing the three groups on initial scores was first conducted. If the initial scores were not different, a 3 X 3 ANOVA was performed comparing the three groups and three test periods (initial, diagnostic, and final). If differences were found in the one-way ANOVA, a 3 X 2 ANCOVA (groups X last two tests) was run using the

first test as the covariate (to control for initial differences). Because of the large number of subjects in the historical MTS group, most differences were expected to be significant and a large portion of the results focuses on the size of the differences.

(3) Table 33 shows APFT raw scores from the VF Battalion, the Control Battalion, and the historical MTS. For push-ups there were no differences in initial scores among groups for men ($p=0.11$) or women ($p=0.26$). ANOVA on the push-ups showed that for both men and women, there were significant main effects for groups ($p<0.01$) and tests ($p<0.01$); the group X test interaction was also significant ($p<0.01$). On the final test, the VF men and women were performing only 2 to 3 fewer push-up than the MTS men and women. The Control men performed 2 more push-ups than the MTS men on the final test; the Control women performed 6 more push-ups than the MTS women on the final test.

(4) For sit-ups, there were differences in initial scores for both men ($p=0.02$) and women ($p<0.01$). ANCOVA revealed significant main effects for groups ($p<0.01$) and tests ($p<0.01$); the group X test interaction was also significant ($p<0.01$). On the initial test, the MTS men performed 2 and 1 fewer sit-ups than the VF and Control men, respectively. By the end of training, MTS men exceeded VF and Control men by 4 and 3 sit-ups, respectively. On the initial test, the MTS women performed the same number of sit-ups as the control women but the VF women performed 3 more. At the end of training MTS women performed the same number of sit-ups as the VF women but 6 more than the control women.

(5) On the 2-mile run, there were initial score differences for both men ($p<0.01$) and women ($p<0.01$). ANCOVA revealed significant main effects for groups ($p<0.01$) and tests ($p<0.01$); the group X test interaction was significant ($p<0.01$). On the initial test, the MTS men were 12 seconds faster and 24 seconds slower than the VF and Control men, respectively. On the final test, the MTS men were 12 and 24 seconds faster than the VF and Control men, respectively. On the initial test, the MTS women were 6 seconds faster and 30 seconds slower than the VF and Control women, respectively. On the final test, the MTS women were 24 and 12 seconds faster than the VF and Control women, respectively.

(6) Table 34 shows the differences in performance changes (final minus initial average raw scores) among the three groups. On push-ups, the MTS group average differed from the VF group by no more than an average of 3 repetitions and from the Control group average by an average of no more than 5 repetitions. For sit-ups, the MTS average differed from the VF and Controlgroup averages by no more than 6 repetitions. On the run, the MTS group averages differed from the VF group averages by no more than 8 seconds and from the Control group averages by no more than 42 seconds.

Table 33. Comparison of APFT Raw Scores from the VF Battalion, Control Battalion, and the Historical MTS from May 1999 to April 2000

Gender	Test	Bn	Push-Ups (reps)		Sit-Ups (reps)		Two-Mile Run (min)	
			Mean	SD	Mean	SD	Mean	SD
Men	Initial (Test 1)	VF	32	13	44	12	17.6	2.6
		Control	33	14	43	13	17.0	2.4
		Historical MTS	32	14	42	13	17.4	2.6
	Diagnostic (Test 3)	VF	42	13	53	12	15.6	1.8
		Control	47	14	55	14	15.2	1.8
		Historical MTS	46	14	58	12	15.0	1.8
	Final (Test 4)	VF	48	13	59	11	15.0	1.3
		Control	52	13	60	14	14.8	1.3
		Historical MTS	50	13	63	11	14.6	1.3
Women	Initial (Test 1)	VF	10	9	37	14	21.7	2.8
		Control	10	9	34	14	21.1	2.6
		Historical MTS	9	9	34	14	21.6	3.0
	Diagnostic (Test 3)	VF	17	11	50	14	19.3	2.2
		Control	28	16	47	18	18.9	2.2
		Historical MTS	22	11	54	15	18.7	2.2
	Final (Test 4)	VF	24	11	59	12	18.4	1.6
		Control	32	17	53	18	18.2	1.7
		Historical MTS	26	10	59	11	18.0	1.7

Table 34. Absolute (Δ reps or min) and Relative Changes (Δ %) in APFT Raw Scores for the VF Battalion, Control Battalion, and the Historical MTS (May 1999 to Apr 2000)

Gender	Group	Push-ups		Sit-Ups		Run	
		Δ (reps)[a]	Δ (%)[b]	Δ (reps)[a]	Δ (%)[b]	Δ (min)[a]	Δ (%)[b]
Men	VF	16	50	15	34	-2.6	-14.8
	Control	19	58	17	40	-2.2	-12.9
	MTS	18	56	21	50	-2.8	-16.1
Women	VF	14	160	22	59	-3.3	-15.2
	Control	22	220	19	56	-2.9	-13.7
	MTS	17	189	25	74	-3.6	-16.7

[a]Calculated as Final minus Initial (Raw Scores)
[b] Calculated as Final minus Initial/InitialX100% (Raw Scores)

9. DISCUSSION. The VF battalion generally had more favorable injury and fitness outcomes than the Control battalion. The VF battalion had a lower rate of overuse injuries (especially after correction for initial differences between battalions), but there were no group differences in the rate of traumatic injuries or in the PTRP injury incidence. A greater proportion of individuals in the VF group passed the APFT on the first record test and fewer VF individuals failed the APFT after all retakes. On APFT raw scores, there were no differences between battalions on 2-mile run improvements. The VF women improved more on sit-ups than the Control women but there were no group differences among the men. The push-up raw scores of the VF group were lower than those of the Control group but these push-up scores were still sufficient to allow the VF group higher APFT pass rates that the Control group.

a. Injuries

(1) As mentioned in the introduction, there are a number of risk factors for injuries in BCT and we endeavored to control or equalize these in the VF and Control battalions at the start of the study. For example, injury rates in the summer are higher than injury rates in the fall (75). We minimized this seasonal factor by examining two battalions that were only one week apart in their training cycles. Older running shoes have been shown to be associated with higher stress fracture rates in Marine Recruit Training (45). Since 1998 all trainees at Fort Jackson are required to buy running shoes in the Reception Station (where inprocessing is conducted just prior to BCT) so both battalions began the pilot and test phases with new running shoes. Low physical activity and cigarette smoking prior to BCT are known injury risk factors (45, 66, 84). These lifestyle characteristics did not differ between the battalions at the start of the study (Table 5). The Control battalion had a greater proportion of women than the VF battalion and women are at higher injury risk (24, 63, 84, 92). A gender-specific analysis was conducted thus controlling for this risk factor.

(2) There were other known injury risk factors that differed between the VF and Control battalions at the start of the study and that we could not control. Most of these differences placed the VF group at higher injury risk than the Control group. For example, the VF group had a disproportionate number of individuals from the FAP and FAP personnel who were at higher injury risk (Tables 16 and 18). The VF group had a lower level of aerobic fitness (Table 9), and this is a well-established injury risk factor (45, 66, 77, 84). The VF group also had a larger proportion of male discharges and a previous study indicated that discharged men are at higher injury risk (74). Because of the necessity to walk to a nearby mess hall, the VF group accumulated more estimated march mileage. A pilot study suggests that higher march mileage is associated with higher injury risk in BCT (Appendix O). There were other small differences in age and marital status, which can also influence injury risk (45, 66, 83).

(3) Since we could not directly control for battalion differences in some potential injury risk factors at the start of the study, we adjusted for these differences *post hoc* using Cox Regression. Table 35 shows the crude and adjusted risk ratios from the injury incidence analyses and Cox regressions, respectively. After Cox regression adjustment, injury risk in the Control group increased relative to the VF group for all outcome measures, especially for the four overuse injury measures. In no cases were any of the traumatic injury rates significantly different between groups before or after adjustment; however, the Cox adjustment tended to further decrease the differences in traumatic injury rates between the two battalions.

Table 35. Crude and Adjusted Risk Ratios (Control/VF) for Injury Outcome Measures

	Men		Women	
	Crude Risk Ratio (95%CI)[a]	Adjusted Risk Ratio (95%CI)[ab]	Crude Risk Ratio (95%CI)[a]	Adjusted Risk Ratio (95%CI)[ab]
All Injuries	1.2 (0.9-1.5)	1.4 (1.1-1.8)*	1.2 (1.1-1.4)**	1.4 (1.1-1.6)**
Overuse Injuries	1.3(1.0-1.7)*	1.6 (1.2-2.1)**	1.3 (1.1-1.5)**	1.5 (1.2-1.8)**
Traumatic Injuries	0.9 (0.6-1.5)	1.1 (0.6-1.8)	0.7 (0.5-1.1)	0.9 (0.6-1.4)
Lower Extremity Overuse Injury	1.3 (1.0-1.9)	1.7 (1.1-2.4)*	1.2 (1.0-1.5)*	1.3 (1.0-1.6)*
TL Injuries[c]	1.1 (0.8-1.5)	1.2 (0.9-1.7)	1.2 (0.9-1.4)	1.3 (1.0-1.6)*
TL Overuse Injuries[c]	1.3 (0.9-1.8)	1.5 (1.0-2.1)*	1.3 (1.1-1.5)**	1.4 (1.1-1.7)**
TL Traumatic Injuries[c]	0.7 (0.4-1.3)	0.8 (0.4-1.6)	0.8 (0.5-1.2)	0.9 (0.6-1.5)
TL Lower Extremity Overuse Injuries[c]	1.2 (0.9-1.9)	1.6 (1.0-2.4)*	1.3 (1.0-1.6)*	1.4 (1.1-1.8)*

[a]95%CI=95% Confidence Interval
[b]Adjusted risk ratios from Cox regression (see Tables 20-27)
[c]TL=Time Loss
*p<0.05
**p<0.01

(4) Hamstring flexibility, foot arch height, knee Q-angle, and past ankle sprains are also known injury risk factors in BCT but we were not able to measure or control for these (35, 36, 66, 84).

(5) We intentionally designed the VF program with reduced running mileage, and this may partly account for the lower incidence of overuse injuries in the VF group. Studies of runners and basic trainees have strongly suggested that as the total amount of running increases, the incidence of injuries also increases (65, 89, 90, 96, 107, 116). One study (65) compared two companies of US Army infantry basic trainees, one of which ran a total of 56 miles, the other 130 miles during 12 weeks of infantry basic training. The data clearly showed a higher injury incidence in the higher mileage company. However, cumulative injury incidence was similar in both companies *per mile run* suggesting a finite risk of injuries with each mile run. Although this study (65) did not obtain initial 2-mile run scores, final run scores did not differ among the companies. Another study of Australian Army recruits showed that substituting running with loaded road marching reduced the incidence of knee and lower limb injury; however, no measures of physical fitness were obtained in this study (109). Two other studies (105, 110) suggest that substituting interval training with running may also reduce injury rates in basic training, but these studies are confounded by multiple interventions and the effect of interval training *per se* on injury rates cannot be determined. The present study supports the idea that lower running

mileage is associated with a lower incidence of overuse injuries while not compromising improvements in 2-mile run times during BCT.

(6) The ability group mileage ran by the VF group was less than half the mileage accumulated by the Control group. We did not ask the VF battalion to record mileage completed in interval training and movement drills because of the difficulty in accurately gathering this information and because of the additional administrative burden this would impose. The VF and Control battalions had similar road marching mileage but the mileage marching to and from the mess increased the total for the VF group. Marching to the mess hall differed considerably from other road marches. Walking to the mess hall involved short distances and trainees sat down to eat a meal at the conclusion of the walk. The return walk was also very short. In contrast, other road marches were longer and could result in fatigue and changes in gait (29, 39, 43) that may have increased injury rates. How the additional mileage to the mess hall may have effected injury rates is unclear. The literature indicates that individuals who walk have lower injury risk than runners (33).

(7) Another factor that may partially account for the lower overuse injury incidence in the VF group is the variety of exercises in the program. There are no studies indicating that a greater variety of exercises will reduce injuries but sports medicine professionals often recommend "cross-training" for this purpose (125). The cross-training concept simply involves alternating different types of exercises on different days: exercises involving different fitness components (e.g., aerobic and strength) or different body parts can be used. The probability of overuse injuries may be reduced by reducing the repetitive use of particular body parts or energy systems and by allowing more time for recovery. An example of cross-training using the same fitness component is running one day, cycling the next, and swimming the next. All these forms of exercise can improve cardiovascular endurance by inducing central cardiovascular changes (42) but the exercise stress is distributed across different parts of the body. An example of cross-training using different fitness components is simply running one day and weight lifting the next.

(8) The traditional physical training program used by the Control group alternated days of running with days of calisthenic type activities that emphasize push-ups and sit-ups. This procedure does alternate exercise between different fitness components and stresses different energy systems. However, the VF program offered many more different types of exercises (calisthenics, dumbbell drills, movement drills, interval runs, and formation runs) that may have allowed for more muscle group rest and recovery while adaptative changes were occurring. The greater distribution of exercise stress across the body may have reduced overuse injuries in the VF group.

(9) Stretching was de-emphasized in the VF group. Well-randomized studies indicate that stretching before exercise in BCT (106) or

stretching before and after running exercise (129) does not reduce the incidence of injuries (review in 122). In the present study, the VF group did not perform pre-exercise stretching and the incidence of overuse injuries was lower than that of the Control group. Certain of the VF calisthenic drills (e.g., the bend and reach) incorporated some degree of muscle stretching and some stretching was performed after exercise. How this may have influenced injury rates is not clear because no previous study has examined post-exercise stretching alone. Post-exercise stretching served a "restorative" function in this study. That is, it attempted to correct potential flexibility imbalances since higher levels of flexibility on one side of the body than on the other can increase injury risk (73, 79).

(10) Historical comparisons of injury rates using existing injury tracking systems at Fort Jackson generally supported the finding that injuries were lower in the VF group. On the SI^2TS, VF men and women had a lower rate of lower extremity injury sick call visits during the test cycle than at any time in their last 5 training cycles. In the test cycle, these injury rates were also lower in the VF group compared to the Control group. The PTRP Surveillance System showed that the proportion of VF trainees recommended to the PTRP during the test cycle was lower than at any other time in the last 5 training cycles (men and women combined). During the test phase the proportion of trainees recommended to the PTRP was lower in the VF group although this was not statistically significant.

b. Physical Fitness

(1) Overall APFT Pass Rates. The VF group and Control group had equal APFT pass rates at the start of training (37% of battalion strength) but by the end of 7 weeks of training the VF group had a higher pass rate. Compared to the Control group, the VF group had 51 additional trainees (4% of battalion strength) successfully complete the APFT on the first record test. Thus, the battalion using the VF program was more successful in passing the APFT.

(2) Push-ups and Sit-ups

(a) The VF program did not strongly emphasize push-ups and sit-ups like the traditional BCT PT program. In the VF program, push-ups and sit-ups were integrated into the calisthenics program, but they were given little more prominence than the other calisthenic exercises. Despite this, the sit-up performance of the men in the VF group was similar to that of the Control group and VF women's sit-up performance exceeded that of the Control women. The VF group did not fare as well on push-ups. The push-up raw scores for both men and women were lower in the VF group compared to the Control group. This suggests that the amount of push-up training should be increased. However, more of the VF group the APFT on the first administration of the test

and there were fewer final failures indicating that the lower VF push-up raw scores were still above the minimally passing level (12).

(b) We did not keep track of the actual push-up and sit-up training volume in the two groups; however, our observations suggest the volume was lower in the VF group. Previous studies have shown that specific exercise on a muscular strength/endurance test will result in the greatest improvement on that test (20, 46-50, 82, 99, 115, 120). However, exercises that improve the muscular strength or muscular endurance of muscle groups involved in a test can also improve test performance (57, 78, 82, 115, 118). The dumbbell and calisthenic drills exercised some of the same muscle groups involved in the push-up and sit-up tests and may have aided in improving performance on these APFT events. Physiological mechanisms involved in the improvements from non-specific muscular strength/endurance training appear to include increases in muscle mass (especially in subjects with the lowest initial strength) and improved ability to use short-term energy sources (adenosinetriphosphate, creatine phosphate, and glucose/glycogen) through increased substrate availability and changes in enzyme profiles (82, 97).

(c) If the training volume on a specific task becomes too great, performance gains can be minimal or actually decrease (94). It is possible that in the Control group, the training volume was high enough to cause performance decrements in some individuals. In the VF group, a combination of a lower training volume and a wider variety of exercises that improve strength and/or endurance of the muscle groups involved in the APFT events may have been beneficial for reducing overtraining.

(d) The interaction in the ANOVA on the push-up and sit-up raw scores indicated that there was a different rate of improvement in the two groups. Examination of Figures 1, 2, and 3 show that VF group had a much more linear improvement while the Control group experienced a spike of improvement, but then improvement flattened. The high volume of push-up and sit-up training in the Control group may explain the spike but this high volume may have contributed to fatigue and a lack of continued improvement.

(3) Two-Mile Run

(a) Average performance on the final APFT 2-mile run was almost identical for the VF and Control groups. This was despite the fact the initial run times for the VF group were 36 seconds slower than the Control group. By the final APFT, the 2-mile run times only differed by 12 seconds and there were no significant differences between the two groups. This suggests that the small amount of ability group running performed by the VF group, when combined with interval training and movement drills, was of sufficient volume and intensity to provide an aerobic training stimulus as great as that of the Control group.

(b) Previous studies support the concept that much lower volumes of running can result in speed improvements similar to that seen with greater volumes of running in BCT. One study compared 2 companies of trainees running 56 vs 130 miles (12 weeks of training) and found no significant difference in final 2-mile run score (65). Another study compared 3 groups of Marine recruits who ran totals of 55, 41, and 33 miles over their 12-week training course. Investigators found only a 3% difference in final run times between the highest and lowest mileage groups (116). One problem with both of these studies is that the initial run scores were not obtained so it is not clear if the groups differed at the start of training. Our study did control for initial running performance scores and showed that a progressive running program that accumulated only 17 miles of ability-group formation running in 9 weeks (in combination with interval training, movement drills, and other military training) resulted in improvements in running performance similar to a program with 38 miles of running.

(c) As noted above, time-loss lower extremity overuse injury rates were lower in the VF group. Calculations from Table 17 show that 152 trainees in the VF group experienced lower extremity time-loss overuse injuries compared to 220 in the Control group. Thus, 68 more trainees in the VF group (5% of the battalion strength) were able to perform lower body PT without interruption. This uninterrupted training time may account for a portion of the favorable outcome of the VF group on the 2-mile run, despite the lower training volume.

(4) Limitations

(a) The APFT is not strongly associated with military job performance or the capacity to perform functional soldiering tasks (56, 85, 100). It does not test mobility, dynamic coordination, strength and flexibility balances, and other measures presumably influenced by the VF program. However, the APFT was the fitness criteria used to evaluate the effectiveness of the VF program for two reasons. First, it is the test that new recruits must pass to graduate from BCT and later, to be retained in service. Thus, the APFT is the current Army standard for measuring the success of a physical training program. Second, the APFT is a generally valid measure of at least two components of physical fitness: cardiorespiratory endurance and muscular strength/endurance (70). Thus, even though the APFT did not test all components that the VF program was designed to enhance, it did test some of these components.

(b) As noted in the methods section, the VF program was carried out for only 7 of the 9 weeks of BCT. This may have had some influence on the results, especially the final APFT scores. However, it would not have affected the first time APFT pass rate since the final APFT was taken before the end of the VF program. Drill sergeants were given latitude to provide additional training for soldiers who were having difficulty with specific APFT events after the final APFT. However, this is normal practice in BCT and a practice likely to be carried

out even if the VF program is fully implemented. Motivated trainees with specific weaknesses in any task are typically given additional training. Also, injury rates have been shown to be highest in the first 4 weeks of training and lowest in the final weeks (83), so any effects the change in PT methods had on injury rates was likely to be small.

(c) Since portions of the VF program were designed to be restorative, it would have been useful to measure bilateral strength differences (muscle balances) in the VF and Control groups before and after the study. If the exercises had been restorative in the sense that they lessened or improved imbalances, improved strength symmetry would have been seen. Muscle imbalances could be tested by isometric strength measurements of muscle groups on both sides of the body. Similarly, flexibility balances/imbalances could be evaluated by range-of-motion measurements on both sides of the body.

c. Intrinsic Motivation Questionnaire (IMQ).

(1) The scores on the IMQ generally increased from the pre- to the post-test. This may suggest that trainees developed higher intrinsic motivation to exercise as a result of their experiences in BCT. However, the post-IMQ questionnaire was administered in the last week of BCT after trainees had completed all the requirements for graduation. The graduation event was only a few days away. The higher scores may also reflect a heightened state of arousal as a result of successful completion of BCT and the impending graduation.

(2) The higher level of perceived competence in the Control group may be related to the less complex exercises the group had to perform during BCT. Control group trainees may have felt they had adequately mastered the stretching exercises, variants on push-up/sit-up exercises, and running in the traditional program. On the other hand, the VF group may not have felt as proficient in performing their activities since they had to learn more complex drills and exercises with precision of movement emphasized throughout. Another reason for the lower perceived competence in the VF group may have been related to the shift to the more traditional form of physical training after the 7th week of training. There were only 2 to 4 traditional sessions and trainees may have felt they had not adequately mastered the traditional exercises. A final reason for the lower perceived scores in the VF group may be related to the drill sergeants who arrived later in the VF unit and did not participate in the train-the-trainer sessions. Trainees may have been confused if untrained drill sergeants gave them conflicting commands.

(3) The higher level of value and usefulness that the VF group reported may reflect a greater value participants put on the VF program compared to the Control program. It may also reflect an internalization of the positive attitudes of the cadre toward the program. Caution must be exercised in

interpretation here since the internal consistency of this subscale was marginal (Table 29).

11. SUMMARY. The VF battalion had more favorable injury and fitness outcomes than the Control battalion. The VF battalion had a lower rate of overuse injuries than the Control battalion, but there were no group differences in traumatic injuries. A greater proportion of individuals in the VF group passed the APFT on the first record test and fewer VF individuals failed the APFT after all retakes. On APFT raw scores, there were no differences between battalions on 2-mile run improvements after correction for the slower initial run times of the VF group. The VF women improved more on sit-ups than the Control women but there were no group differences among the men. The VF group did have lower push-up raw scores but the performance level was still high enough to allow the VF group greater passing rates on the APFT. Thus, the VF Program reduced overuse injuries while allowing higher APFT success.

12. RECOMMENDATIONS.

a. Implement the PRT Program throughout US Army Training and Doctrine Command (TRADOC) in BCT. The lower injury rate and higher APFT success rates indicates that the PRT program was a success. Additionally, feedback from Advanced Individual Training (AIT) seem to indicate lower sick call rates on arrival at AIT and higher final APFT pass rates (108), despite the fact that AIT used traditional physical training.

b. Teach PRT for BCT in drill sergeant's school to institutionalize the concepts.

c. Test PRT in AIT using a design similar to that of the present study. The goal of this study would be to reduce injury rates while better conditioning new soldiers. Study injury rates and fitness levels in a cohort of trainees that uses the PRT Program in both BCT and AIT.

d. If the program is successful in AIT, study implementation of the program in an operational Army unit.

Appendix A
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Appendix B
Historical Perspective on Victory Fitness Program

Physical activity to improve physical capacity has been linked to military activities throughout history. Artifacts from the Sumerian and Hittite civilizations (3000-1500 B.C.) depict the combat-related sports of boxing and wrestling as well as forms of acrobatics and gladiatorial combat. Egyptian tombs (about 2000 B.C.) show scenes of what may be club swing, gymnastic exercises, acrobatics, and juggling. Minoan artifacts (1950-1550 B.C.) depict military troops running and show sprinting type activities (61).

During the Greek Classical Period (700-200 B.C.) exercise and sport appeared to play a central role in the lives of the citizens. The gymnasium served both as a social meeting place as well as a place to exercise (27, 44, 61). Military training was emphasized for all free Greek citizens of age 18-20 years (128) since wars were frequent on the Greek peninsula. Restorative exercises, martial exercise, sports, and games were woven into the life of the Greek citizen to prepare him for good health, military service, and ethical conduct (128). The recorded works of Hippocrates (460-370 B.C.) recommend systematic exercise for health and to increase physical capacity of the body. These recommendations appear to have been widely accepted and practiced in classical Greece. Hippocrates served as a major influence for the Roman physician Galen (129-210 A.D.) who also encouraged regular and systematic exercise. Unlike Hippocrates, Galen's recommendations may never have received wide acceptance in Roman society (25, 128). Little new work was published in relation to exercise for about 1300 years until Girolamo Mercurialis wrote a paper on preventive and therapeutic gymnastics in 1569. Mercurialis acknowledged the influence of Hippocrates and Galen (128).

The Napoleonic Wars at the start of the 19th Century had a major influence on the development of physical education in Europe. The Swedish royalty provided strong support for Per Henrik Ling's Swedish Gymnastic System because of threats from the Napoleonic Army and their belief that the system would physically train the population for war (134). The system Per Henrik Ling (1776-1839) developed involved free standing movements as well as drills on a variety of apparatus. Borrowing from the classic Greek model, Ling defined four areas of physical education: 1) medical (to overcome ailments), 2) military (to use a weapon or one's body to overcome the will of another), 3) pedagogical (to bring one's body under control of one's will) and 4) aesthetic (to give bodily expression to one's inner being) (128).

Baron Nils Posse had 2 years of Swedish Gymnastic training in Stockholm, was a graduate of the Royal Swedish Military Academy, and served for 5 years in the Swedish Army. He arrived in the U.S. in 1885 and introduced the Swedish system in the Boston Schools with philanthropic help from Mary

Hemenway. By 1890 over 400 teachers had been trained in the Swedish system and the "Boston Normal School of Gymnastics" was a popular system throughout New England and the East Coast (21, 128).

Around 1786 in Germany, Johann Cristoph Fredrich Guths Muth developed a separate system of gymnastic exercises. These exercises included what he termed "warlike" (i.e., military), "athletic", "medical", and "educational" gymnastics (128). All of these exercises were directed at educating the body in the performance of specific movement patterns while increasing the body's physical capacity.

Fredrich Jahn witnessed the defeat of the Prussian Army at Jena (1806) at the hands of Napoleon. Historians cite this as a seminal event in his life that presumably influenced him to develop the Turnverine Gymnastic Society. His goal was to physically develop a German youth that would be able to overcome the French Army (52, 128). Jahn borrowed heavily from the ideas of Guths Muth but also added some innovations. After Napoleon's defeat, Jahn called for more personal freedom but this ran counter to the ideas of the monarchy and led to the ultimate banning of the Turnverines in Germany (52). Many of the Turnverines went to America and by the 1850's there were over 20 Turnverine or "Turner" schools in the United States (128).

Herman Koehler was a graduate of one of the Turner schools and between 1885 and 1923 he served as Master of the Sword at the U.S. Military Academy (USMA) at West Point, New York. At the USMA, Koehler emphasized martial arts but also stressed the "restorative" aspects of gymnastics. Koehler believed "that the mechanical proficiency {developed} through physical training is essential for self-reliance, courage, and personal discipline" (128). Koehler's 1919 "West Point Manual of Disciplinary Physical Training" (87) included calisthenics, conditioning and restorative exercises, rifle drills, vaulting and obstacles, athletics, and contests and games.

Koehler's leadership in the physical training arena was apparent in the publication of what may be the first official Army-wide physical training manual. Entitled "Calisthenic Exercises", this small 54-page book was published in 1891 (4). As the title suggests, most of the manual is concerned with describing in great detail the proper execution of calisthenic exercises. Leaping and hopping exercise, precursors of plyometrics, are also described along with sections on walking, marching and double-timing.

The 1914 "Manual of Physical Training" (8) was prepared by LTC Fred Sladen, CPT Herman Koehler, and 1LT Phillip Mathews. The manual described the goals of physical training as "the development of the physical attributes of every individual to the fullest extent of possibilities". "Physical attributes" were defined, in order of importance, as: 1) general health and vigor, 2) muscular strength and endurance, 3) self-reliance, 4) smartness, activity, and precision.

Self-reliance was assumed to be developed from the knowledge that the individual had developed high levels of strength and endurance, which "...after all is a physical quality, as it induces men to dare because of the consciousness that they can do so." Smartness, activity, and precision were assumed to be

"...the physical expression of mental activity. All are essential soldierly qualities as they make for self-respect, neatness and grace, which combined spell discipline. Precision and exactitude should therefore always be insisted upon in the performance of all exercises prescribed" (8).

The 1914 manual prescribes separate exercises for recruits and trained soldiers. Exercises in the manual include calisthenics, marching at double-time and running, climbing, hopping, leaping, rifle exercises, and gymnastic exercises with apparatus (horizontal bars, parallel bars, rings, etc.). Calisthenic exercises are considered highly important for all-around development and are prescribed as a part of every exercise session. Dumbbell exercises involve 2 to 2.5 pound wooden dumbbells using many of the same motions as the calisthenic exercises. Club exercises involve complex circular movements of the arms holding clubs that resemble bowling pins. Club exercises are used "to develop grace, coordination, and rhythm". Rifle exercises are to develop "handiness with the piece" and to "wield the piece to advantage" while "developing the muscles of the arms, upper back, shoulders, and chest..." (8).

The early 1900's in the United States witnessed an emerging movement toward physical education through sports and games that contrasted sharply with the formal German and Swedish systems. Thomas Wood and Clark Hetherington were exponents of this new movement. With the onset of WWI many men were found to be unfit for service and government resources were directed to encourage military drills and calisthenics programs in the schools. The National Defense Acts (1916 and 1920) initiated the Reserve Officer Training Corps (ROTC) and military training on college campuses received tax dollars and competed with physical education departments for resources (21, 128).

Restorative exercises and martial arts received renewed interest during WWI but once the war was over, the sport and game movement accelerated. A contributing factor to the decline in the restorative and martial arts was the decrease in immigration and the reduction in the European influence on physical training in America (21). The emphasis on sports and games was assisted by the development of intramural sports programs in high schools and colleges. The Boston Normal and Turner systems did not die out totally. The Boston Normal School methods were integrated into teacher education programs at Wellesley College and Boston University. The Turner systems continued at Indiana University (21). The "New Physical Education" of sports and games stressed education *through* the physical while the German and Swedish gymnastic systems stressed education *of* the physical through systematic

exercise (127). Education of the physical means direct teaching of individuals on how to move (the development of movement patterns, posture, grace, and rhythm) while increasing physical capability.

The Turner and Swedish gymnastic influence are still apparent in the 1928 US Army Training Regulation (TR) 115-5 (18) prepared under the direction of the Superintendent of the USMA. It superseded the 1914 manual. TR 115-5 contained two sections, one involving exercises without apparatus, and one involving exercises with apparatus. The section without apparatus includes calisthenics (including corrective exercises), mass athletics, and group games. The section with equipment (Part II) includes dumbbell drills, Indian club exercises, rifle drills, climbing and jumping, gymnastics, swimming, boxing and wrestling. Systematic exercises are provided for a 3-month period for recruits and for trained soldiers.

Part II of TR 115-5 was superseded by the first Army Field Manual (FM) 21-20, published in 1941 (6) under the proponency of the Superintendent of the USMC(USMA?). This small, 36 page manual included calisthenics, marching, running, jumping and climbing, personal contests, rifle drills and swimming. Much of the Turner and Swedish gymnastic exercises have disappeared since dumbbell drills, club exercises, and gymnastics are not included. It is the first publication to contain standards for a physical fitness test (a 100-yard dash, running high jump, running broad jump), although these tests are not mandated.

The influence of WWII on physical training is apparent in the 1946 FM 21-20 (5). This 392-page publication contained a wider variety of exercises than the 1941 publication and the exercises are described in detail. Chapter 1 defines the components of physical fitness as strength, endurance, agility, and coordination. Chapter 4 contains all of the calisthenic exercises used in the Victory Fitness Program (and many more). There is a long chapter on combatives, possibly reflecting the experiences of WWII. Rifle drills, tumbling, posture training, marching and running, and swimming are included. Strength exercises (using barbells), guerrilla exercises, grass drills, log exercises, obstacle and confidence courses are described for the first time. A physical fitness test with a scoring system is described "to enable the physical training instructor to ascertain the physical condition of the men at the time tested". The events of the outdoor fitness test include pulls-ups, squat jumps, push-ups, sit-ups and a 300-yard run. The indoor fitness test includes pull-ups, squat jumps, push-ups, sit-ups, a shuttle run, and a 60-second squat thrust. A scoring system is given that assigns points (1 to 100) to various performances on each test event. A confidence course that can currently be found on many military posts (e.g., Fort Jackson, South Carolina, Fort Benning, Georgia) is laid out in an Appendix.

The 1950 FM 21-20 (7) was very similar to the 1946 edition. Published on the eve of the Korean War, this publication had few of the exercises from the 1914 manual, with the exception of calisthenics. The chapter on tumbling from

the 1946 edition was removed and the influence of the sport and game movement in American physical education can be seen with the introduction of a section on mass games (football, baseball, soccer, etc).

The 1957 FM 21-20 (9) was a very small publication and did not contain many practical exercises for physical trainers. Chapter 2 contains 43 pages of human anatomy and physiology. A 5-event fitness test is described that includes a 40-yard low crawl, horizontal ladder, dodge-run-and-jump, grenade throw, and a 1-mile run. The FM also contains, for the first time, exercise programs for personnel over 40 years of age. Technical Manual (TM) 21-200 (3) also published in 1957 contained many of exercises from the 1946 publication but the strength course and tumbling are not included.

The 1969 FM 21-20 is entitled "Physical Readiness Training" (13). It discusses the 3 stages of physical conditioning as 1) the Toughening Stage ("approximately 2 weeks in duration and usually characterized by muscle stiffness and soreness followed by recovery"), 2) the Slow Improvement Stage ("approximately 6 to 10 weeks in duration and characterized by slow and steady improvement..." 3) Sustaining Stage ("...goes on indefinitely in order to maintain the level of conditioning achieved..."). The principles of physical conditioning are described as overload, progression, balance, variety, and regularity. Chapters are similar to the 1946 publication but sections on relays, team contests, and specific sports (basketball, soccer, softball, speedball, etc) are included. Three sets of calisthenic drills (7 drills each) are described. The Basic Combat Proficiency Test contains the same items as 1957. An equipment free Minimum Physical Fitness Test is also included that involves squat benders, push-ups, sit-ups, legs-over, squat thrusts, a stationary run. A separate airborne test involves chin-ups, knee benders, push-ups, sit-ups, and a 1-mile run.

The 1973 FM 21-20 (14) is similar to the 1969 publication in all but physical fitness testing. A great variety of tests are described which include the Advanced Physical Fitness Test, Staff and Specialist Fitness Test, Airborne Trainee Physical Fitness Qualification Test, Ranger/Special Forces Physical Fitness Qualification Test, Minimum Physical Fitness Test, Inclement Weather/Limited Facilities Physical Fitness Test, and Basic Physical Fitness Test. Most of these have similar but not identical events, which include the inverted crawl, sit-ups, push-ups, run-dodge-and-jump, horizontal ladder, 1- or 2-mile run. Point standards are given for many of these tests by age group.

The 1980 FM 21-20 (15) contains much the same material as the 1969 manual but in a reorganized format. The numerous fitness tests from the 1973 manual have been replaced with a 3-event Army Physical Readiness Test consisting of push-ups, sit-ups and a 2-mile run. A point system is provided for both men and women.

The 1985 FM 21-20 (11) is entitled "Physical Fitness Training" and includes entire chapters on theoretical aspects of cardiorespiratory fitness, muscular strength and endurance, flexibility, diet, and injuries. Partner-resisted exercises (for equipment-free strength development) and weight training exercises are included. Only 8 calisthenic exercises are provided. Some grass drills, guerrilla exercises, and rifle exercises have been retained but log drills have not.

The 1992 FM 21-20 (10) is very similar to the 1985 publication but log drills have returned, there is a chapter on body composition, and the chapter on environmental considerations is more extensive.

FM 21-20 will be replaced by FM 3-25.20, a draft of which was available on the US Army Physical Fitness School website at the time of this writing. The major principles of this emerging doctrine are described in the background section of this paper. The principles of exercise precision and variety, as well as the dumbbell exercises return the US Army back to some of LTC Herman Koehler's principles and exercises tempered with new knowledge that has developed in the exercise sciences since this time.

Appendix C
Another Way to Look at Endurance Training

In the new doctrine being developed at the USAPFS, the components of fitness will be simplified to three: strength, endurance, and mobility (how well you move your body). The concept of endurance, in effect, replaces the previous doctrinal component of cardiorespiratory (CR, also known as aerobic) training. The term is being replaced since it has come to be synonymous with running. CR training does not account for the full spectrum of endurance needs.

Basically, endurance can be divided into two categories, aerobic (needed for sustained, sub-maximal activity) and anaerobic (needed for intermittent, high-intensity activity). The type of running that pervades army culture is considered distance running and is aerobic in nature. However, an analysis of the mission essential task list (METL) for nearly all units will show a significant need for anaerobic endurance. Thus, ***an endurance program based solely on distance running, while likely to improve CR/aerobic endurance, will fail to prepare most units for the type of endurance they will need on the battlefield.***

An endurance training program must take into account not only the ***metabolic*** (energy production) demands of a task or exercise, but also the ***neuromuscular*** (messages between nerves and muscles) and ***musculoskeletal*** (muscle and bone) requirements. What follows is a brief discussion of each of these demands as they relate to running:

Metabolic Demands: The metabolic demands of running are dependent upon the intensity and duration of the run. Running is fueled by a molecule called adenosine triphosphate (ATP). A sprint of up to about 15 seconds uses the ATP that is already stored in muscle. Hard running for a longer duration requires that ATP be produced from sugar stored within the muscle called glycogen. The 400-meter dash is a good example of task that primarily uses ATP from muscle glycogen. If the speed of a 400-meter dash is held for a longer duration, or if repetitions of 400 meters are repeated with insufficient rest between repetitions, lactic acid begins to build within the muscle, demanding that we stop or decrease the intensity of the run.

Both the short sprint and the 400-meter dash can occur in the absence of oxygen, and are thus ***anaerobic*** in nature. In fact, the reason for lactic acid build up is lack of oxygen to support the use of muscle glycogen. The task of the distance runner is to limit the intensity of the run enough so that sufficient oxygen is present as muscle glycogen is broken down for energy. This is ***aerobic*** exercise that, in addition to glycogen, also uses fatty acids for energy.

When sprints or longer dashes are repeated, recovery from the previous efforts determines the quality of the subsequent efforts. Here, aerobic conditioning improves recovery and, in effect, improves performance for

repeated anaerobic tasks. It would seem logical that more sub-maximal, aerobic exercise, such as distance running, would be beneficial. However, as we saw in the research study discussed above, more is not always better. In addition, running beyond what is needed for the Army Physical Fitness Test and mission requirements steals valuable PT time that could be spent developing components of mobility, such as power. In fact, strength and conditioning coaches for a variety of sports limit the distance running of their athletes because there is evidence that power is robbed by too much "easy effort" activity.

Power, the ability to create force rapidly, is an important physical attribute for athletes and soldiers. Skillful use of power is the common theme among a wide-range of athletic activities: a takedown in wrestling, throwing the discuss, pass rushing in football, the home-run swing in baseball. For soldiers, power has the same importance for negotiating obstacles, evacuating a casualty, individual movement techniques, and hand-to-hand combat.

Neuromuscular Demands: The neuromuscular demands of distance running are minimal. Challenging the neuromuscular system means PT tasks that require balance, coordination, agility, and power. ***Without starts, stops, changes of direction, and changes of intensity, distance running does little to prepare the neuromuscular system for any other task.*** In contrast, sprints, agility drills, grass and guerilla drills and calisthenics, just to name a few, are PT modalities that place high neurological demands on the body. When trained appropriately, those activities improve mobility.

Musculoskeletal Demands: Distance running repeatedly stresses the same muscles, bones, and joint structures of the legs, pelvis and low back. While proper progression, overload, and recovery in a running program will improve performance while minimizing injury risk, as we discussed above, lower extremity overuse injuries continue to be a significant problem for many Army units.

Not only can the repetitive stresses associated with distance running induce injury, perhaps even more importantly, they do little to prepare soldiers for the varied musculoskeletal stresses associated with common unit missions. Moving at angles across uneven terrain while load-bearing demands musculoskeletal resiliency that is not completely trained by distance running.

This is not to say that distance running will necessarily lead to injuries. On the contrary, studies have shown that running, in and of itself, does not further the wear-and-tear on the joints associated with aging. But, when combined with pre-existing joint and posture problems or inadequate rehabilitation from previous injuries, running can indeed make things worse.

Appendix D. Calisthenic Exercises

Calisthenic Drill 1; Exercise 1

The Bend and Reach

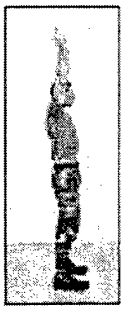
Purpose: This exercise develops the ability to squat and reach through the legs. It is a lead-up exercise for the forward roll. It also serves to prepare the spine and extremities for more vigorous movements. From a flexibility perspective, it takes the hips and spine through full flexion.

Starting Position: Straddle stance with arms overhead.

Cadence: Slow.

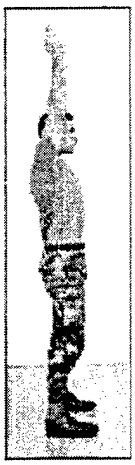
Count:

1. Squat with the heels flat as the spine rounds forward to allow the straight arms to reach as far as possible between the legs.
2. Return to the starting position.
3. Repeat count one.
4. Return to the starting position.



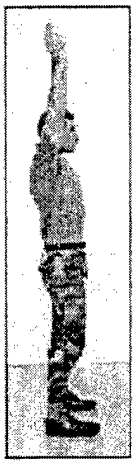
Starting Position

Count 1



Count 2

Count 3



Count 4

Check Points:

- From the starting position, ensure that soldiers have their hips set, their abdominals tight, and their arms as fully overhead as possible.
- The head flexes to allow the gaze to the rear. This brings the head in line with the bend of the trunk.
- The heels remain flat.
- On counts two and four, do not go past the starting position.

Precautions: To protect the spine, this exercise should be performed at a slow cadence. Move into the count one position in a slow, controlled manner. Do not bounce into and out of this position in a ballistic manner, as this may place an excessive load on the spine.

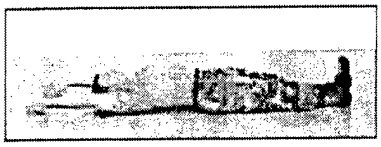
Calisthenic Drill 1; Exercise 4

The Rower

Purpose: This exercise improves the ability to move in and out of the supine position to a seated posture. It coordinates the action of the trunk and extremities while offering a strong challenge to the abdominal muscles.

Starting Position: Supine position, arms overhead, feet together and pointing upward. The chin is tucked and the head is 1-2 inches above the ground. Arms are shoulder width apart with palms facing with fingers and thumb extended and joined.

Cadence: Slow/Moderate.

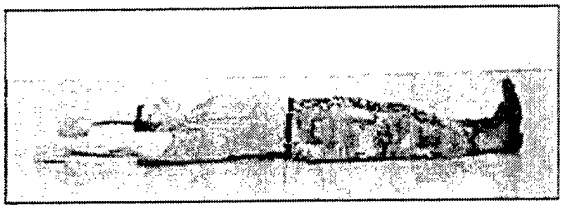


Starting Position

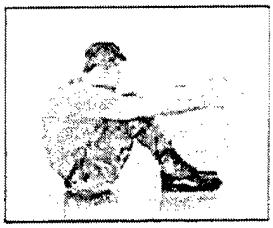
Count:

1. Sit up while swinging arms forward and bending at the hip and knees. At the end of the motion, arms will be parallel to ground, palms facing inward.
2. Return to the starting position.
3. Repeat count one.
4. Return to the starting position.

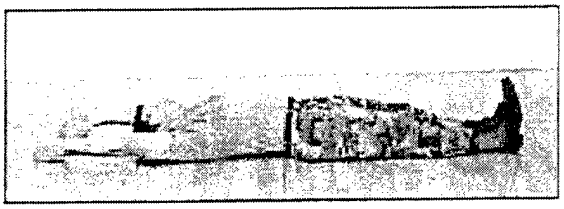
Count 1



Count 2



Count 3



Count 4

Check Points:

- At the starting position, the low back must not be arched excessively off the ground. To prevent this, tighten the abdominal muscles to tilt the pelvis and low back toward the ground.
- At the end of count one, the feet are flat and pulled near the buttocks. The legs stay together throughout the exercise.

Precautions: Soldiers that arch their back during the rower risk trunk injury and should not do further repetitions.

Calisthenic Drill 1; Exercise 5

The Squat Bender

Purpose: This exercise reinforces proper lifting while developing strength of the back and lower extremities.

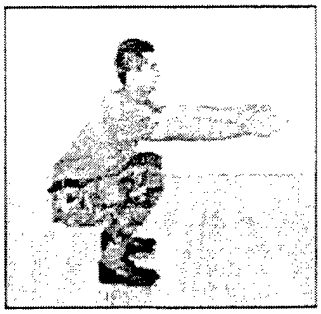
Starting Position: Straddle stance with hands on hips.

Cadence: Slow/Moderate.

Starting Position

Count:

1. Squat while raising the arms to parallel with the ground, palms facing inward.
2. Return to the starting position.
3. Slightly bend the knees while bending forward at the waist and reaching toward the toes.
4. Return to the starting position.



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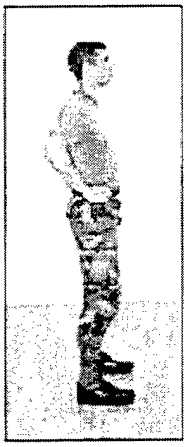

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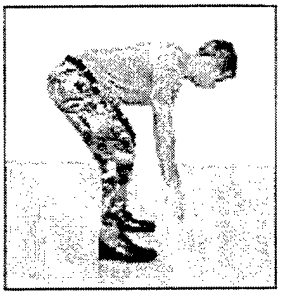


Count 3

Count 4

Check Points:

- ☐ At the end of count one, the shoulders, knees and balls of the feet should be aligned perpendicular to the ground. The heels remain on the ground and the back is straight.
- ☐ At the end of count three, the back is straight, the knees are slightly bent, and the head is in line with the trunk.

Precautions: Soldiers who round their backs do not receive the full benefit of this exercise and may be placing their spines at risk for injury. Allowing the knees to go beyond the toes on count one will increase stress to the knees.

Calisthenic Drill 1; Exercise 9

The Squat Thrust

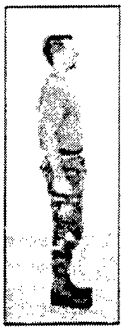
Purpose: This exercise develops efficient movement to and from the ground. It promotes stability of the trunk and shoulder girdle, and range of motion of the hips and knees.

Starting Position: Position of attention.

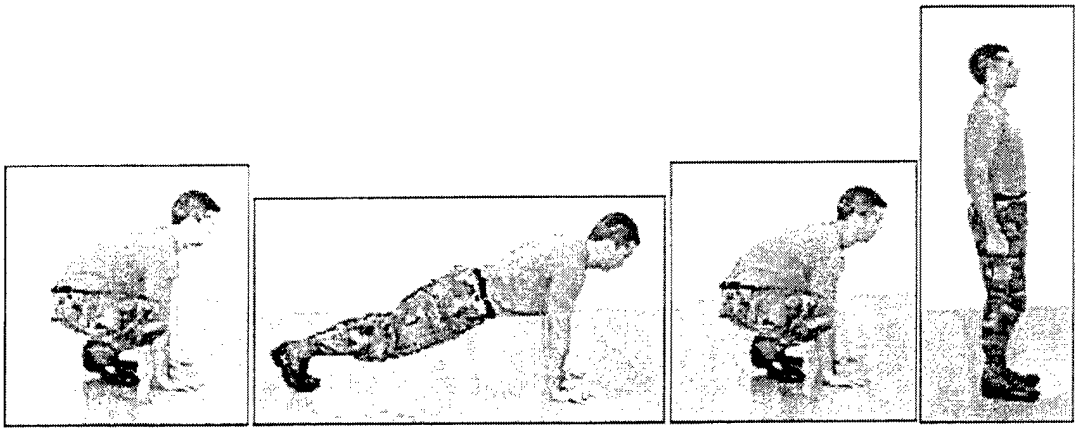
Cadence: Slow/Moderate.

Count:

1. Squat and place the hands on the ground, shoulder width apart.
2. Thrust legs backward to a front leaning rest position.
3. Return to position one.
4. Return to the starting position.



Starting Position



Count 1 **Count 2** **Count 3** **Count 4**

Check Points:

- ❑ The heels are together and raised on counts one and three.
- ❑ The hands are in line with the shoulders with fingers spread (middle finger pointed straight ahead) on counts one and three.
- ❑ On count two, the abdominal muscles must be kept tight to maintain straightness from head to heels.

Precautions: Soldiers with knee limitations may squat to their comfort zone. Do not allow the trunk to sag on count two.

Variation: Soldiers that cannot prevent the trunk from sagging on count two may quickly step in and out of the front leaning rest position (counts two and three, leading with the left leg).

Calisthenic Drill 1; Exercise 10

The Squat Stepper

Purpose: This exercise develops functional strength of the legs, especially the hips and hamstrings. It is a lead up to the Squat Jumper in Calisthenic Drill 2.

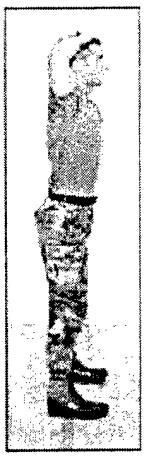
Starting Position: Crouch in a staggered stance with left foot to the rear with heal up. The right leg bears most of the body weight with the foot flat. Bend slightly forward at the hips, keeping the trunk straight. The hands are interlaced on top of the head, with the elbows pulled to the rear.

Starting Position

Cadence: Slow/Moderate.

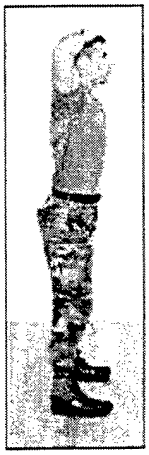
Count:

1. Rise out of the crouch, stepping forward with the left foot to the regular stance.
2. Return to crouch with the right foot to the rear.
3. Repeat count one with the right leg.
4. Return to the starting position.



Count 1

Count 2



Count 3

Count 4

Check Points:

- ☐ Maintain straightness of the trunk throughout the motion.
- ☐ In the crouch, align the shoulders with the knee and ball of the foot of the forward leg.
- ☐ Keep the feet directed forward and elbows behind the ears.

Precautions: Soldiers should assume the crouch positions within individual limitations.

Variation: Soldiers with upper extremity profiles may perform the exercise with hands on hips.

Calisthenic Drill 1; Exercise 11

The Bent-Leg Body Twist

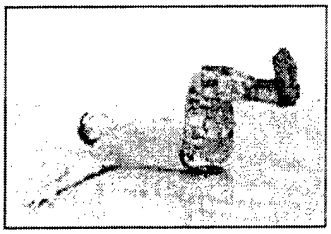
Purpose: This exercise strengthens trunk muscles and promotes control of trunk rotation.

Starting Position: Supine with the hips and knees bent to 90-degrees. Arms are at shoulder level with elbows straight and palms down with fingers spread. Legs and feet are together.

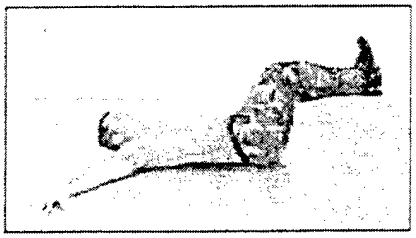
Cadence: Slow.

Count:

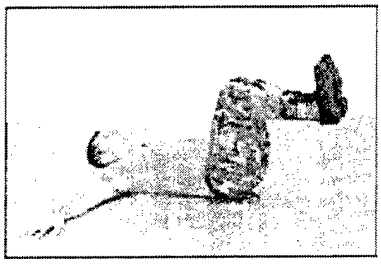
1. Rotate the legs to the left while keeping the upper back and arms in place.
2. Return to the starting position.
3. Repeat count one to the right.
4. Return to the starting position.



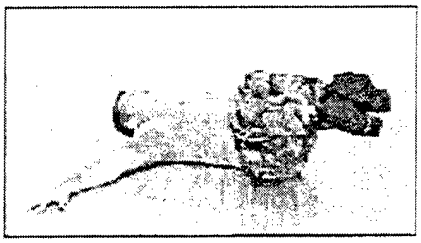
Starting Position



Count 1



Count 2



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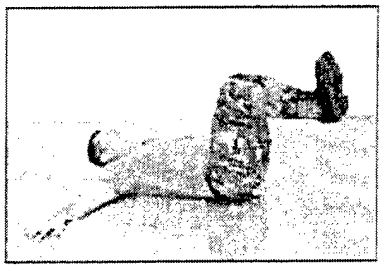


Count 4

Check Points:

- ☐ Tighten abdominal muscles in the starting position. Maintain this contraction throughout the exercise.
- ☐ The head should be 1-2 inches off the ground with the chin slightly tucked.
- ☐ Ensure that the hips and knees maintain their 90-degree angles.
- ☐ Attempt to rotate the legs to about 8-10 inches off the ground.
- ☐ The opposite shoulder must not rise off of the ground.

Precautions: Soldiers should not rotate the legs to a point beyond which they can no longer maintain an abdominal contraction.

Calisthenic Drill 1; Exercise 12

The Push-Up

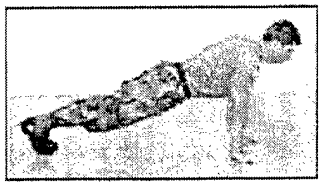
Purpose: This exercise strengthens muscles of the chest, shoulders, arms, and trunk. When proper trunk position is maintained, it develops trunk stability.

Starting Position: Perform a squat thrust to move into the front leaning rest, maintaining the body straight from head to heels. Body weight is supported on the hands and balls of the feet.

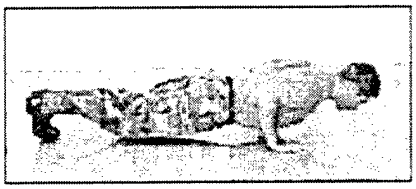
Cadence: Moderate.

Count:

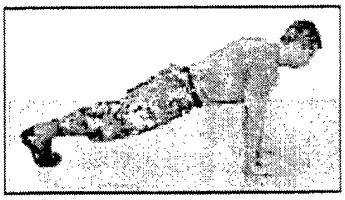
1. Bend the elbows, lowering the body until the upper arms are parallel with the ground.
2. Return to the starting position.
3. Repeat count one.
4. Return to the starting position.



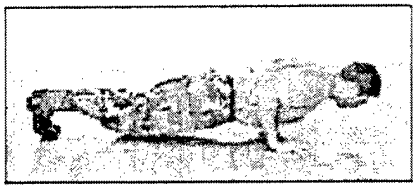
Starting Position



Count 1



Count 2



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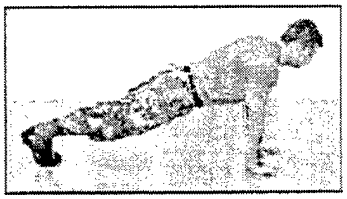


Count 4

Check Points:

- ☐ The hands are in line with the shoulders with fingers spread (middle fingers point straight ahead).
- ☐ On counts one and three the upper arms stay close to the trunk, elbows pointing rearward.
- ☐ On counts two and four the elbows straighten but do not lock.
- ☐ The trunk must not sag. To prevent this, tighten the abdominal muscles while in the starting position and maintain this contraction throughout the exercise.

Precautions: Soldiers should cease repetitions or go to their knees when the trunk begins to sag or counts two and four involve jerking movements.

Variations: Soldiers may perform the push-up from their fists if wrist discomfort is an issue. When no longer able to execute the push-up with proper form, soldiers may drop to their knees for the second and fourth counts. They must still maintain a straight line from head to knees.

Appendix E. The Purpose of Calisthenics

In an age when each new fitness craze is accompanied by a gadget and gyms seems to cram every bit of floor space with shiny new resistance machines, a discussion of calisthenics may strike an archaic cord. How could exercise so low-tech compete with modern minds and materials? Let's take a look.

Calisthenics have a long history of service to the Army. LTC Herman J. Koehler, Master of the Sword at the U.S. Military Academy from 1885-1923, was the first to systematically apply calisthenics to soldiers. Deriving much of his program from European models of physical culture, where strong, graceful movement was a valued end state and as well as a means to martial readiness, Koehler laid the basis for all military calisthenics to follow. However, in the last two decades calisthenics have taken a back seat to running.

The few calisthenics that are performed today are either preparation for the Army Physical Fitness Test (pushups and sit-ups) or a haphazard mix of exercises that are not precisely planned or administered. When this is the case, important movement skills will be neglected. In addition, injury risk will rise for three main reasons. First, neglecting important movement skills in physical readiness training (PRT) leaves the soldier unprepared for the movement when it must be performed in a less controlled environment. The soldier that has never practiced jumping and landing in PRT, is less likely to perform those movements safely and efficiently when running the obstacle course for speed. Second, choosing just a few calisthenics will develop just those few movement patterns. The result may be muscle imbalances that lead to poor posture and faulty movement. Finally, when calisthenics are not applied and progressed in a systematic manner, there is a tendency to perform more repetitions than some of the soldiers are prepared for and, thus, invite overuse injuries.

Over the last year, the U.S. Army Physical Fitness School (USAPFS) has sought to address these concerns. Two calisthenic drills have been developed to systematically match soldiers with the right exercises at the right time. Phased training is the key to this approach. In the toughening phase, new soldiers and those returning from profiled status train with calisthenic drill 1. The 12 exercises in this drill develop stationary movement skills that are prerequisite to the more challenging calisthenic drill 2. Together with the other activities in the toughening phase (e.g. dumbbell, climbing and movement drills), the soldier gradually develops the strength, endurance and fundamental movement skills (mobility) necessary for success in the conditioning phase.

To illustrate why calisthenics are the centerpiece of the revised physical readiness doctrine, consider the following benefits:

- Utility: Calisthenics allow a skilled primary instructor and a few assistants to train dozens of soldiers in a relatively small space and in a time-efficient manner. In addition, no other

mode of PRT develops all the components of fitness to such an equal degree. Calisthenics build strength by challenging control of body weight. They promote endurance without the repetitive motion that often leads to overuse injuries. Finally, they improve mobility by progressively taking the major joints through a full, controlled range of motion.

- Versatility: The new calisthenic drills may serve not only as preparation (warm-up) for more vigorous PRT (grass and guerilla drills, conditioning obstacle course, etc.), but also as the main mode of training. One set of calisthenic drill one, combined with movement drills, prepares the body for nearly any challenge to follow. Performing multiple sets of this drill, or combining it with drill two, creates a training effect that stimulates strength, endurance and mobility.
- Function: Functional exercise prepares you for sports, work or the demands of everyday life. Function is currently a popular term in the civilian fitness community. Though the term may be a bit trendy at the moment, that doesn't diminish the fact that, when planning PRT programs, we must consider the functional movements required of soldiers. The new calisthenic drills develop the ability to squat, reach, twist, lunge, jump, land, push and get up and down – exactly the type of actions demanded of soldiers negotiating obstacles, uploading for deployment, getting in and out of vehicles...
- Discipline: Calisthenics demand attention to detail. On count one of the squat bender, the back is straight, the heels are down and the arms are parallel to the ground. If the back is rounded, heels are up and the arms are pointing to the ground, the execution is incorrect - the soldier must pay more attention to detail.
- Body Awareness: This benefit of calisthenics is closely tied to disciplined execution. When soldiers are held accountable for the execution of each exercise, they become mindful of their bodies. They gradually become aware of the component actions that must blend smoothly into a complex act such as a lunge and reach. By watching the skillful execution of the instructor and hearing the "beat" of the cadence, they intuitively develop a sense of timing and grace.
- Effect of the Mass: Dozens of soldiers bellowing the repetitions, with their movements and voices in unison, is an impressive display when viewed both within and outside the formation. It conveys physical readiness, discipline and spirit – essential attributes of the warrior.

The new calisthenics have been implemented in a few units, both in training and operational environments. In a basic combat training battalion, calisthenics, dumbbell and movement drills, and a revised running program reduced injuries without sacrificing APFT success. Though such controlled studies have not been replicated at other sites, feedback from PRT leaders trained in the last year by the USAPFS has been positive. Given the demanding physical tasks required of soldiers and the limited preparation they receive for those tasks from pushup, sit-ups, and running, we feel that implementation of the revised PRT doctrine, with calisthenic drills as the centerpiece, is not an option but a necessity.

Appendix F. Dumbbell Exercises

Dumbbell Drill 1; Exercise 1

The Lift and Carry

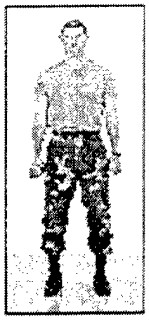
Purpose: This exercise develops the ability to safely squat and lift from the ground. It strengthens the legs and arms while promoting trunk stability.

Starting Position: Regular stance with dumbbells at the side.

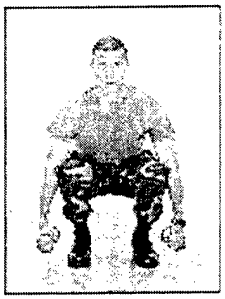
Cadence: Slow/Moderate.

Count:

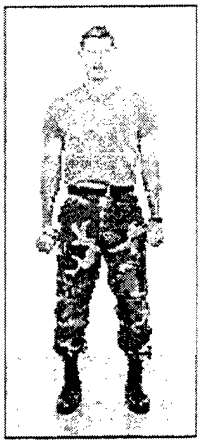
1. Squat with the heels flat, knees over balls of the feet, and the trunk tilted slightly forward but straight from head to hips.
2. Return to the starting position.
3. Perform a hammer curl to place the weights on the shoulder.
4. Return to the starting position.



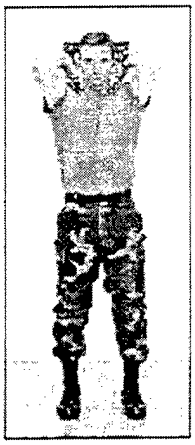
Starting Position



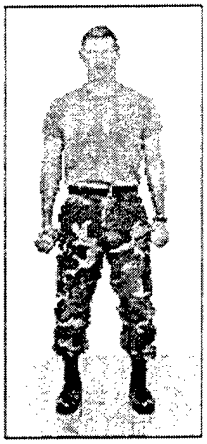
Count 1



Count 2



Count 3



Count 4

Check Points:

- From the starting position, ensure that soldiers have their hips set and their abdominals tight.
- On count one, squat as deeply as possible with a straight trunk.
- On count one, balls of the feet, knees, and shoulders line up vertically.
- On count three, the trunk must not sway.
- On count three, the dumbbells are aligned vertically and the elbows are directed forward.
- Keep the wrists straight throughout the exercise.

Precautions: If the back begins to round on count one, do not continue to squat any deeper.

Dumbbell Drill 1; Exercise 2

The Bent-Over Row

Purpose: This exercise develops strength of the upper back and shoulder muscles, promotes endurance of the low back muscles, and trunk stability.

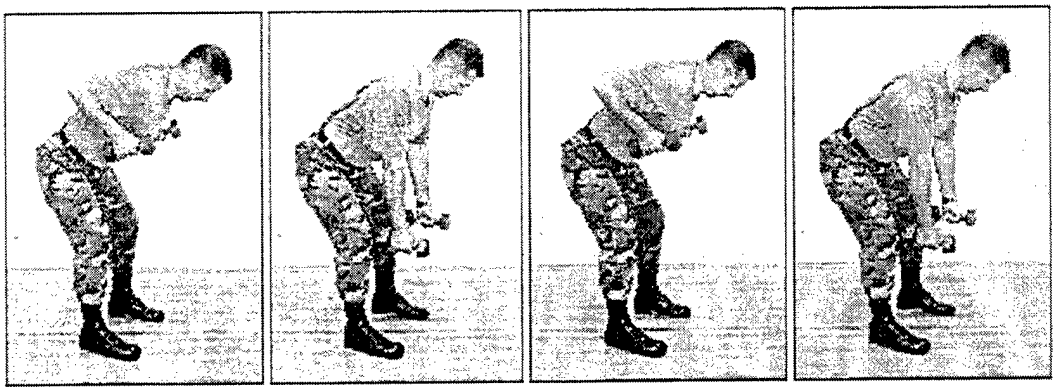
Starting Position: Regular stance, knees slightly bent, trunk forward 45-degrees, arms hanging straight down.

Cadence: Slow/Moderate.

Count:

1. Raise the dumbbells to shoulder level.
2. Return to the starting position.
3. Repeat count one.
4. Return to the starting position.

Starting Position



Count 1 Count 2 Count 3 Count 4

Check Points:

- From the starting position, ensure that the back is straight, head is in line with the back, knees are slightly bent, arms are straight but not locked, and the dumbbells are in front of the knees.
- On counts one and three, the elbows are bent approximately 90-degrees.
- Throughout the exercise, the back remains straight; the trunk is tilted forward 45-degrees.
- Keep the wrists straight throughout the exercise.

Precautions: Do not allow the back to round.

Dumbbell Drill 1; Exercise 3

The Rear Lunge

Purpose: This exercise develops functional leg strength, especially of the hips and hamstrings, and promotes trunk stability.

Starting Position: Regular stance with dumbbells at the side.

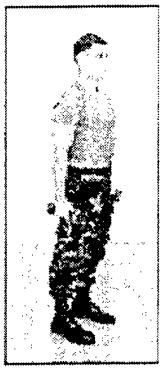
Starting Position

Cadence: Slow/Moderate.

Count:

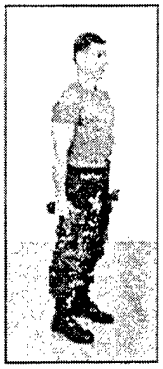
1. Lower the body by stepping to the rear with the left leg, tilting the straight trunk slightly forward, and bearing the body weight on the bent right leg.
2. Return to the starting position.
3. Repeat count one to the opposite side.
4. Return to the starting position.

Count 1



Count 2

Count 3



Count 4

Check Points:

- From the starting position, ensure that soldiers have their hips set, their abdominals tight, and their dumbbells resting on their shoulders in a vertical orientation. The elbows are directed forward.
- On counts one and three, the forward heel remains flat, and the rear heel is up.
- On counts one and three, the forward knee remains directly over the ball of the foot.
- On counts one and three, the straight trunk is tilted slightly forward so that the shoulders are in line with the forward knee and the ball of the foot.
- On counts one and three, the dumbbell orientation remains in-line with the ground.
- On counts two and four, raise the body upward with a vigorous push of the forward leg without jerking the trunk backwards.
- Keep the wrists straight throughout the exercise.

Precautions: Do not allow the forward knee to go beyond the toe, nor waiver from side to side. Do not jerk the trunk rearward to return to the starting position.

Variations: Soldiers execute the exercise with the dumbbells resting on the shoulders in the hammer curl position.

Dumbbell Drill 1; Exercise 4

The Shoulder Raise

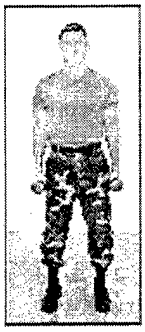
Purpose: This exercise develops shoulder strength and promotes trunk stability.

Starting Position: Regular stance with dumbbells at the side.

Cadence: Slow/Moderate.

Count:

1. Raise the dumbbells directly to the side to shoulder level, palms down.
2. Return to the starting position.
3. Raise the dumbbells directly to the front to shoulder level, palms facing inward.
4. Return to the starting position.



Starting Position

Count 1

Count 2

Count 3

Count 4

Check Points:

- From the starting position, ensure that soldiers have their hips set, their abdominals tight.
- On counts one and three, the elbows are straight but not locked.
- On counts one and three, do not raise the dumbbells past shoulder level.
- Keep the wrists straight throughout the exercise.

Precautions: Excessive weight may strain the shoulders, as may excessive raising of the dumbbells on counts one and three.

Dumbbell Drill 1; Exercise 5

The Forward Lunge

Purpose: This exercise stimulates balance, develops leg strength, and promotes trunk stability.

Starting Position: Regular stance with dumbbells at the sides.

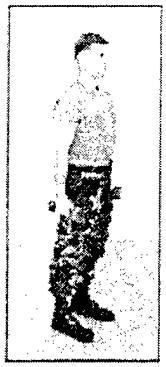
Cadence: Slow/Moderate.

Count:

1. Take an exaggerated step forward with the left leg, allowing the left knee to bend until the left thigh is parallel to the ground.
2. Return to the starting position.
3. Repeat count one with the right leg.
4. Return to the starting position.

Starting Position

Count 1



Count 2

Count 3

Count 4

Check Points:

- From the starting position, ensure that soldiers have their hips set, their abdominals tight, and their dumbbells resting on the shoulders in a vertical orientation. The elbows are directed forward.
- On counts one and three, the forward heel remains flat, and the rear heel is up.
- On counts one and three, the forward knee remains directly over the ball of the foot.
- On counts one and three, the trunk remains straight (compared with the slight forward lean on the rear lunge).
- On counts one and three, the dumbbell orientation remains in-line with the ground.
- On counts two and four, push off vigorously with the forward leg without jerking the trunk backwards.
- Keep the wrists straight throughout the exercise.

Precautions: Do not allow the forward knee to go beyond the toes, nor waiver from side to side. Do not allow the trunk to bend forward or rearward. Do not jerk the trunk rearward to return to the starting position.

Variations: Soldiers may execute the exercise with the dumbbells on the shoulders in the hammer curl position.

Dumbbell Drill 1; Exercise 6

The Curl and Press

Purpose: This exercise develops arm and shoulder strength while promoting trunk stability.

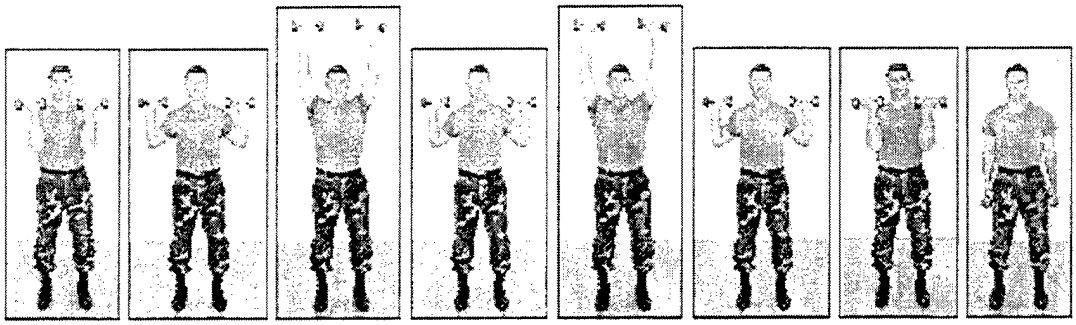
Starting Position: Regular stance with dumbbells at the side.

Cadence: Slow/Moderate.

Count:

1. Curl the dumbbells to shoulder level, hands facing the chest.
2. Bring dumbbells to the press position by rotating the arms outward.
3. Press the dumbbells overhead.
4. Return to the press position (count two).
5. Repeat the overhead press (count three).
6. Return to the press position.
7. Return to the curl position (count one).
8. Return to the starting position.

Starting Position



Count 1 Count 2 Count 3 Count 4 Count 5 Count 6 Count 7 Count 8

Check Points:

- From the starting position, ensure that soldiers have their hips set and their abdominals tight.
- Throughout the exercise, the legs and trunk remain still.
- At the press position (counts two, four, and six), the hands and elbows should line up vertically with the weights just above shoulder level. The arms should be directly to the side to allow the chest to open.
- On counts three and five, arms should be directly overhead with the elbows straight but not locked.
- Keep the wrists straight throughout the exercise.

Precautions: Do not allow the trunk to sway during any portion of this exercise, as this may place undue strain on the spine. Avoid shoulder strain by adjusting the weight of the dumbbell to allow proper execution.

Appendix G. Medicine Ball Drills

EXERCISE: Outside Rotation Pass

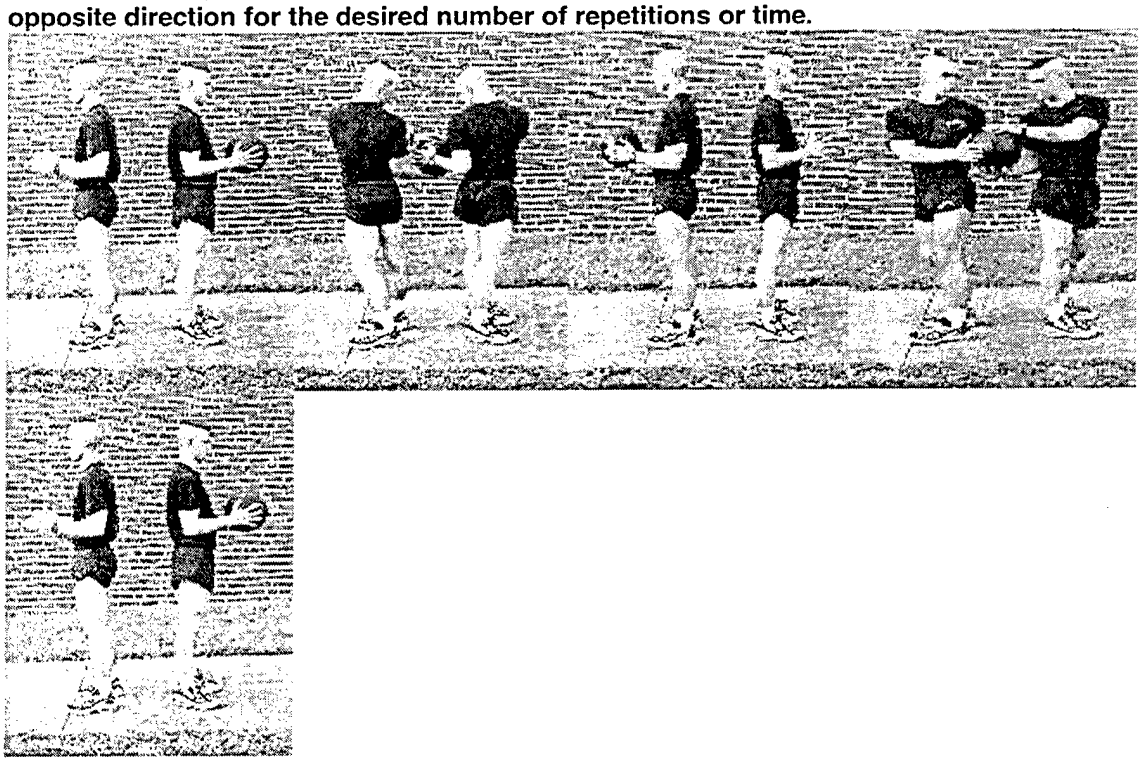
CADENCE: Slow

STARTING POSITIONS: Arms to Thrust, holding the medicine ball in front of the abdomen, with your back to your partner. Partner stands in the same position, two to three feet away, without the medicine ball.

MOVEMENT:

1. **Rotate to the left (partner rotates to the right), while extending the arms forward at chest level and hand the medicine ball to your partner.**
2. **Partner receives the medicine ball with his left hand on top and his right hand on the bottom and returns to the Arms to Thrust position, holding the medicine ball in front of the abdomen.**
3. **Repeat the actions performed in #1, with the partner handing off the medicine ball to the opposite side.**
4. **Rotate to the starting positions.**

Note: After completing the desired number of repetitions or time, perform steps 1-4 in the opposite direction for the desired number of repetitions or time.



EXERCISE: Sit-up and Reach Pass

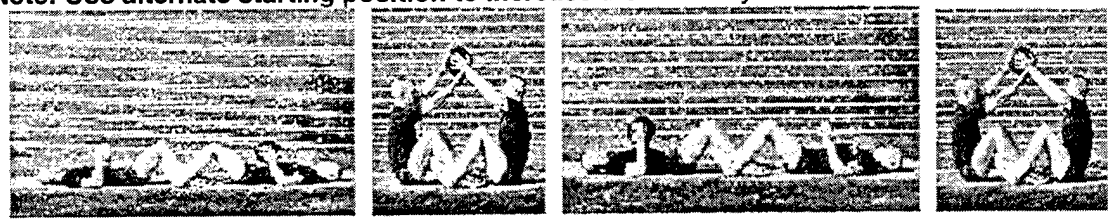
CADENCE: Slow

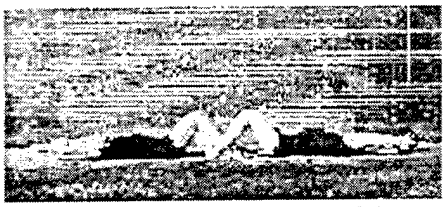
STARTING POSITIONS: Position on Back, feet interlocked, knees bent at 90 degrees, holding the medicine ball in front of the abdomen. Exerciser and partner will mirror each other's movement.

MOVEMENT:

1. Perform a sit-up and simultaneously reach up and forward, extending the arms; hand off the medicine ball to your partner.
2. Return to the starting positions (partner now has the medicine ball).
3. Repeat the actions performed in #1 with the partner passing the medicine ball to the exerciser.
4. Repeat the actions performed in #2 and return to the starting positions.

Note: Use alternate starting position to increase the intensity of this exercise.





Alternate Starting Position

EXERCISE: Prone Extension

CADENCE: Slow

STARTING POSITION: Lie prone on the ground, feet and legs together, toes pointed away and arms extended overhead. Exerciser and partner mirror each other's position, holding the medicine ball between their outstretched arms with their fingers interlaced on the sides of the medicine ball.

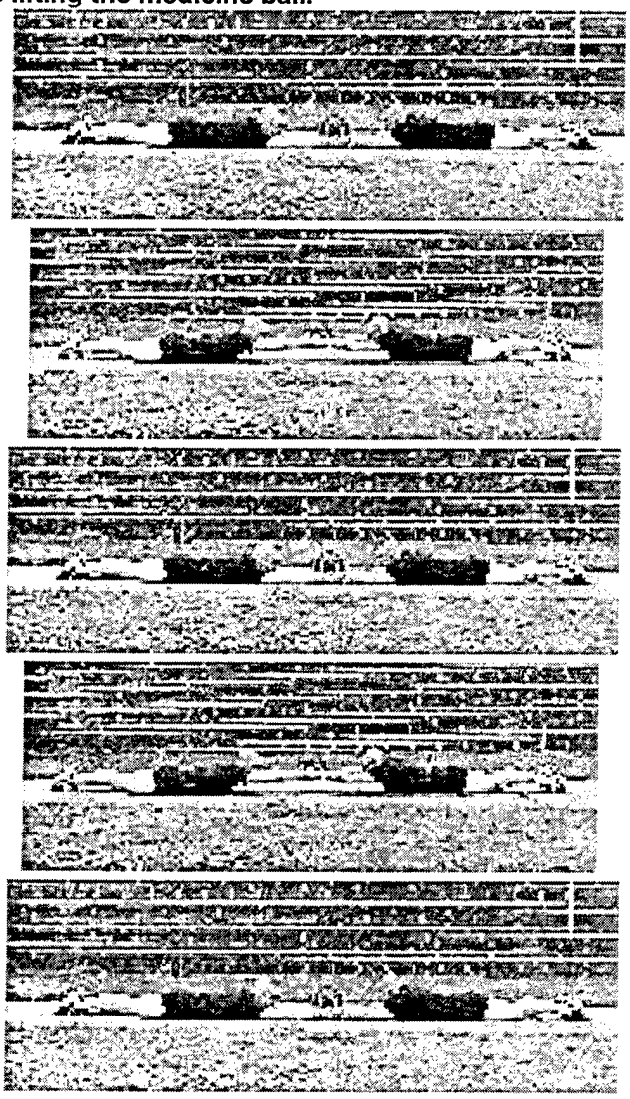
MOVEMENT:

1. Exerciser and partner lift the medicine ball six to eight inches off the ground.

2. Return to the starting position.
3. Repeat the actions performed in #1.

1. Return to the starting position.

Note: The intensity of this exercise is increased by simultaneously raising the feet and legs off the ground while lifting the medicine ball.



EXERCISE: Underhand Throw

CADENCE: Slow

STARTING POSITIONS: Forward Leaning with the feet 1½ shoulder widths, toes pointed out 45 degrees and squat with knees bent at 90 degrees, holding the medicine ball below the waist, with the arms extended. Partner is in the Arms to Thrust position.

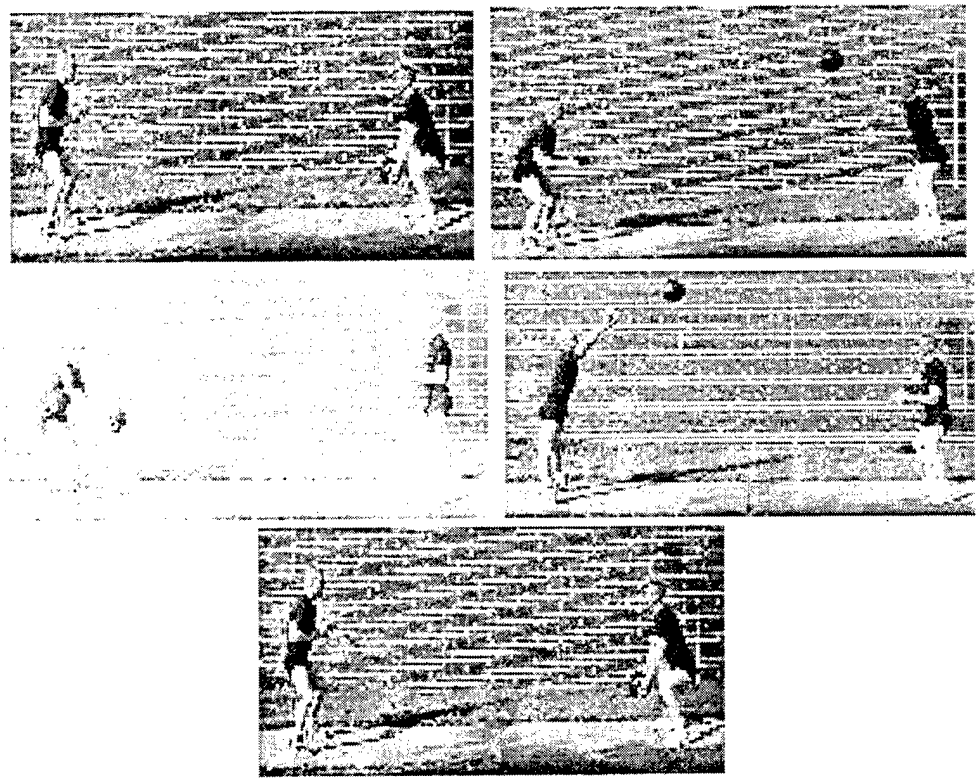
MOVEMENT:

1. **Stand up on the balls of the feet and simultaneously rise to the Arms Overhead position, throwing the medicine ball in a high arc to your partner.**

2. **Partner catches the medicine ball and immediately repeats the actions performed by the exerciser in #1.**

3. **The exerciser catches the medicine ball and immediately repeats the actions performed in #1.**

4. **Repeat the actions performed in #2 and return to the starting positions.**



EXERCISE: Rotation Throw

CADENCE: Slow

STARTING POSITIONS: Arms to Thrust, holding the medicine ball in front of the abdomen. Partner stands five yards away, without the medicine ball, facing the exerciser.

MOVEMENT:

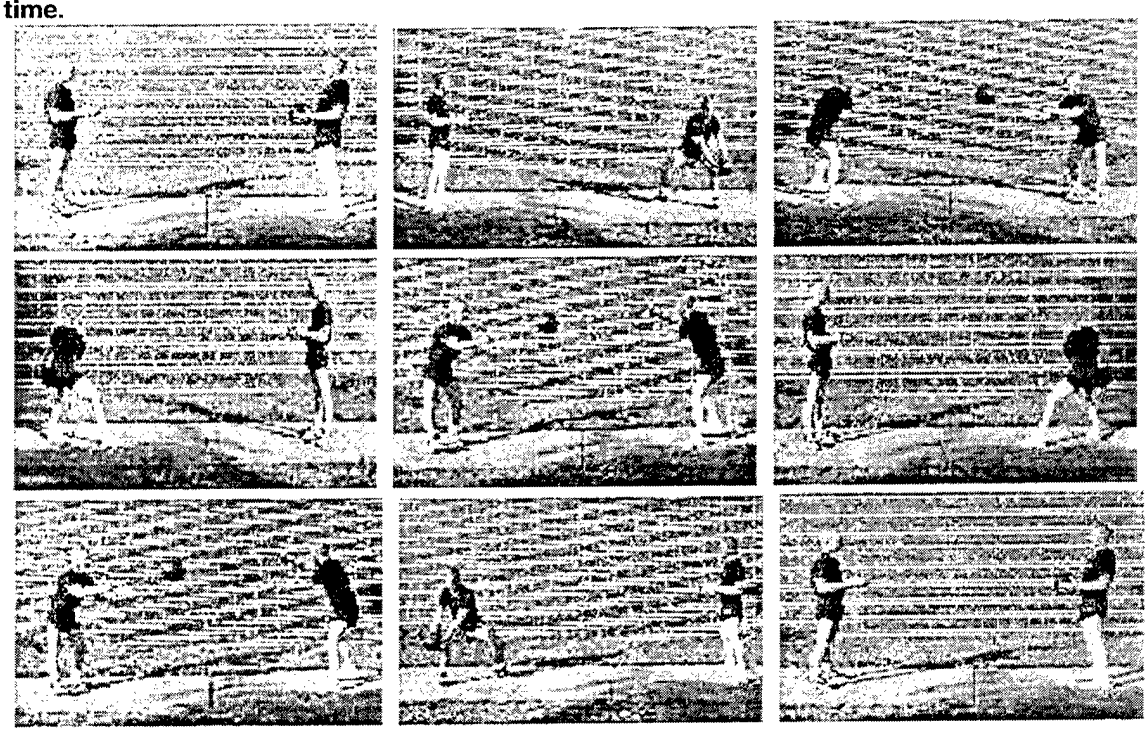
1. Step back diagonally with the left foot two to three feet to the rear holding the medicine ball to the side with your arms extended outward from the abdomen, then step up while throwing the medicine ball in a sideward motion to your partner's right side.

2. Partner catches the medicine ball and immediately repeats the actions performed by the exerciser in #1.

3. The exerciser catches the medicine ball and immediately repeats the actions performed in #1.

4. Repeat the actions performed in #2 and return to the starting positions.

Note: After completing the desired number of repetitions or time, perform steps 1-4, with the exerciser starting on the right side of the body for the desired number of repetitions or time.



EXERCISE: Chest Throw

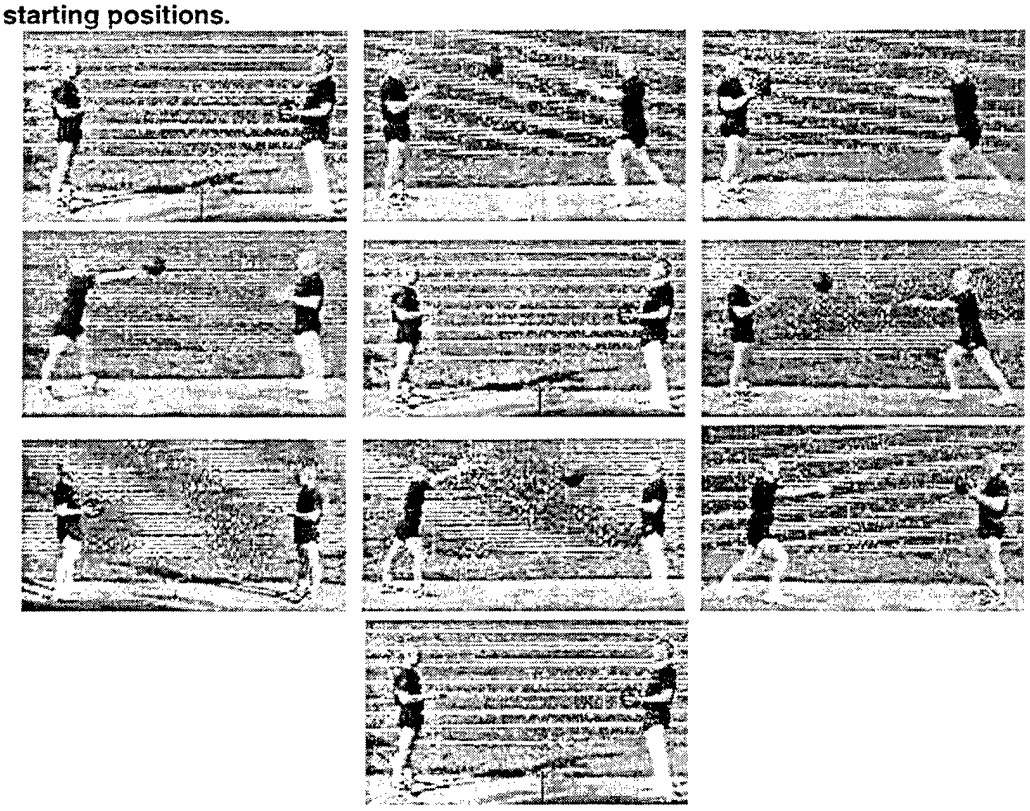
CADENCE: Slow

STARTING POSITIONS: Arms to Thrust, holding the medicine ball at the abdomen, facing your partner. Partner stands in the same position, five yards away, without the medicine ball.

MOVEMENT:

1. **Step forward with the left foot and extend the elbows to throw the medicine ball to your partner at chest height, then return to the starting position.**
2. **Partner catches the medicine ball, slightly bending his knees and elbows and immediately repeats the action performed by the exerciser in #1.**
3. **The exerciser catches the medicine ball and immediately repeats the actions performed in #1, stepping with the right foot.**
4. **Repeat the actions performed in #2, partner stepping with the right foot and return to**

the starting positions.



Appendix H. Movement Drills

Movement Drill 1; Exercise 1

Verticals

This exercise promotes a strong running posture. Keep a tall stance with a stable, upright trunk as you bring the hips quickly to 90-degrees of bend (the knees don't rise above waist level). Ground contact should be primarily with the balls of the feet. There should not be any back swing of the legs. Pretending there is a wall running down your back to the ground may help you keep the legs to the front. Arm swing is strong and smooth. Once soldiers master verticals, they can add a variation that involves accelerating the tempo at a certain point. For example, the first ten yards would be at normal speed. Then, at the ten-yard mark, soldiers would increase the leg turnover so as to take as many steps as possible to the twenty-yard mark. From 20-30 yards they would return to normal-speed, then at 30 yards they would repeat the "quick-feet" drill to end at 40 yards. The leader must ensure that form remains ideal even during the accelerated movements.

Movement Drill 1; Exercise 2

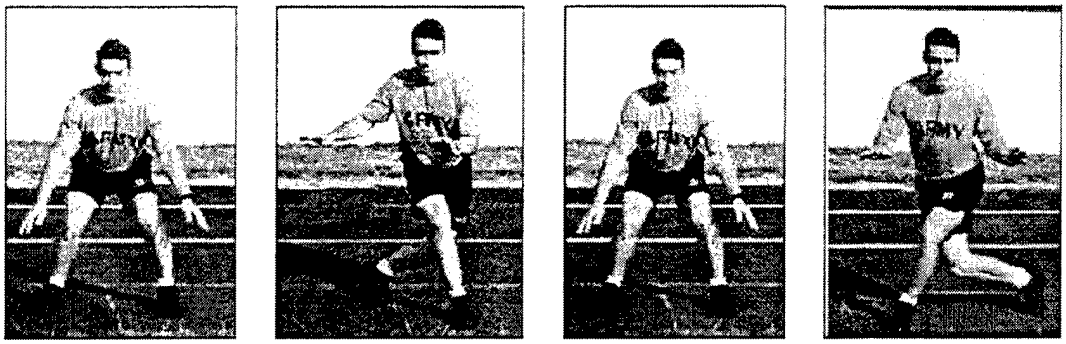
The Lateral Shuffle

This exercise gets soldiers accustomed to lateral movement. Start by assuming a slight crouch, with the back straight. Shuffle directly to the side by rising slightly and bringing the trailing leg to the lead leg. Next hop to the side and land back in the crouch with the knees about shoulder width apart. Always face the same direction so half the time is spent going left and half going right.

Movement Drill 1; Exercise 3

Crossovers

This is similar to the side-step shuffle except that the trailing leg crosses first to the front and then to the back. Keep the body oriented in the same direction on both the down and back portion of this drill. As soldiers master this movement, have them simulate holding their weapon and visually scanning the horizon.



Movement Drill 1; Exercise 4

The Backward Run

On this exercise, soldiers should work on reaching back with the rear leg and pushing off forcefully with the forward leg. Keep the body upright, not bent forward or backward at the waist.

Movement Drill 1; Exercise 5

The Skip

This exercise is just like the skip from grade school. Its purpose is to coordinate jumping from a single leg and to promote a powerful push-off from the ankle. After three to four weeks of training, soldiers should incorporate more arm swing as they jump so they get better elevation. Start slowly and progress the tempo with each 30-40 yard movement.

Movement Drill 1; Exercise 6

Cuts

This exercise improves soldier's ability to change direction safely and efficiently. To make the change of direction, plant on the outside leg with plenty of bend in the hip and knee, and with the foot pointing slightly inward toward the change of direction. To perform cuts, soldiers line up in columns facing four to six cones placed five yards apart and staggered as shown in the diagram below. Soldiers cut to the outside of each cone, then line up and repeat in the opposite direction. It is recommended that the primary and an assistant instructor stand in place of the first two cones with their arm extended at shoulder level to the side on which the soldiers will be cutting. This forces the cutting soldiers to stay low and allows the instructor to offer immediate feedback on the mechanics of cut. Cuts should not be performed on wet terrain.

Appendix I. Flexibility Exercises

Flexibility Drill, Exercise 2

The Hip Flexor Stretch

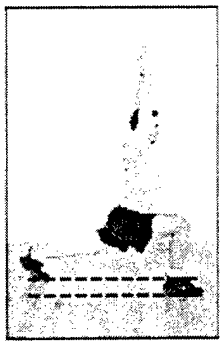
Purpose: This exercise develops flexibility of the hip flexors and trunk muscles.

Starting Position: On the command, "Starting Position, Move", assume the Regular Stance, hands on hips.

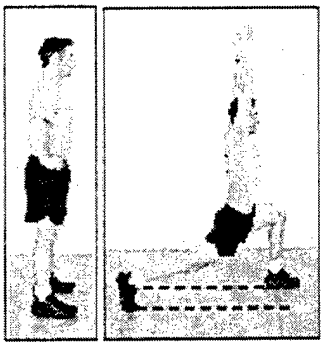
Exercise Position 1: On the command, "Exercise Position 1, Move", step rearward with your left foot, with both arms reaching overhead. This is the same position as count 1 of the Rear Lunge and Reach in Calisthenic Drill 1 (hold for 10-30 seconds).

Exercise Position 2: On the command, "Exercise Position 2, Move", step back to the Starting Position and perform the movements of Exercise Position 1 with the right leg, then return to the Starting Position.

Starting Position



Exercise Position 1



Exercise Position 2

Check Points:

- Maintain straightness of the back by keeping the abdominal muscles tight throughout the motion.
- Reach overhead with both arms. Arms should be shoulder width apart with palms facing inward with the fingers and thumb extended and joined.
- When assuming exercise positions 1 and 2, allow the body to continue to lower while holding the stretch. This promotes a better opening of the hip and trunk.
- Keep the feet directed forward. On the lunge, move the leg straight to the rear, as if standing on a railroad track.

Flexibility Drill, Exercise 5

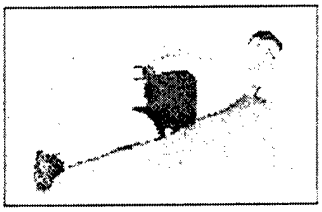
The Thigh Stretch

Purpose: This exercise develops flexibility of the thigh and hip flexor muscles.

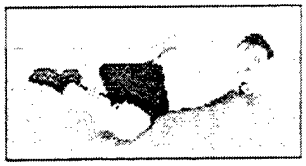
Starting Position: On the command, "Starting Position, Move", lay on your left side and place your left forearm on the ground, perpendicular to your chest. Grasp your right ankle with your right hand.

Exercise Position 1: On the command, "Exercise Position 1, Move", pull your right heel toward your buttocks and pull the entire leg rearward. Push your right thigh further to the rear with the bottom of your left foot. Hold this position for 10-30 seconds, then slowly return to the Starting Position.

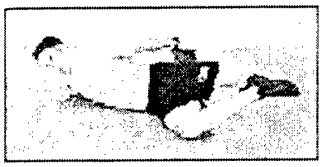
Exercise Position 2: On the command, "Exercise Position 2, Move", move to your right side and perform the movements of the Starting Position and Exercise Position 1. Hold this position for 10-30 seconds, then slowly return to the Starting Position on your right side.



Starting Position



Exercise Position 1



Exercise Position 2

Check Points:

- Keep the abdominal muscles tight throughout this stretch in order to keep the trunk straight.
- Do not pull the heel forcefully to the buttock if there is discomfort in the knee joint. In this case, you may still achieve a beneficial stretch by allowing the knee to straighten slightly and simply pulling the thigh further to the rear.

Flexibility Drill, Exercise 6

The Hip Stretch

Purpose: This exercise develops flexibility of the hip muscles.

Starting Position: On the command, "Starting Position. Move", assume a supine position on the ground.

Exercise Position 1: On the command, "Exercise Position 1, Move", Raise both feet off the ground and cross your left ankle over your right thigh. Grasp the left kneww with both hands and pull it towards your right shoulder while raising the right thigh toward the chest. Hold this position for 10-30 seconds, then slowly return to the Starting Position.

Exercise Position 2: "Exercise Position 2, Move", perform the movements of Exercise Position 1, crossing your right ankle over your left thigh. Grasp the right knee with both hands and pull it towards the left shoulder while raising the left knee toward the chest. Hold this position for 10-30 seconds, then slowly return to the Starting Position.

Starting Position | Exercise Position 1 | Exercise Position 2

Check Points:

- Keep the back flat on the ground.
- Raise the head 1-2 inches from the ground, chin slightly tucked.

Flexibility Drill, Exercise 3

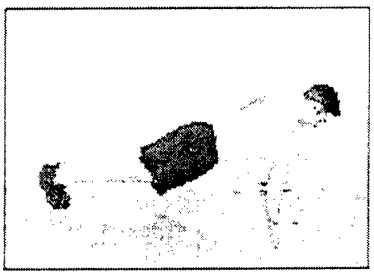
The Flex & Extend Stretch

Purpose: This exercise develops flexibility of the low back, hip, calf, hip flexor and abdominal muscles.

Starting Position: On the command, "Starting Position, Move", assume the Front Leaning Rest Position.

Exercise Position 1: On the command, "Exercise Position 1, Move", bend at your waist and lower the heels toward the ground while keeping your legs straight (hold for 10-30 seconds), then return to the Starting Position.

Exercise Position 2: "Exercise Position 2, Move", lower your body, sagging in the middle, keeping your arms straight and look upward (hold for 10-30 seconds), then slowly return to the Starting Position.



Starting Position

Exercise Position 1

Exercise Position 2

Check Points:

- In exercise position 1, the legs and back are straight.
- In exercise position 2, the thighs and pelvis may rest on the ground. Relax the back muscles while bearing bodyweight through the straight arms.

Flexibility Drill, Exercise 4

The Low Back and Chest Stretch

Purpose: This exercise develops flexibility of the low back and chest muscles.

Starting Position: On the command, "Starting Position, Move", assume the Front Leaning Rest Position, then drop to your knees, keeping your back straight and parallel to the ground.

Exercise Position 1: On the command, "Exercise Position 1, Move", sit back toward your heels while reaching forward with your arms. Hold this position for 10-30 seconds, then slowly return to the Starting Position.

Exercise Position 2: On the command, "Exercise Position 2, Move", straighten your left arm and place it sideward, palm down. Shifting your weight to your right and bending your right elbow, look to your left as you lower your left shoulder toward the ground. Hold this position for 10-30 seconds, then slowly return to the Starting Position.

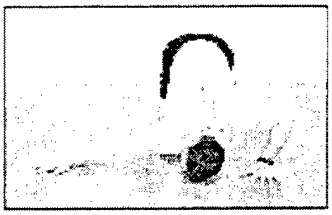
Exercise Position 3: On the command, "Exercise Position 3, Move", perform the movements of Exercise Position 1 to your right, then slowly return to the Starting Position.

Exercise Position 4: On the command, "Exercise Position 4, Move", perform the movements of Exercise Position 1, then slowly return to the Starting Position.

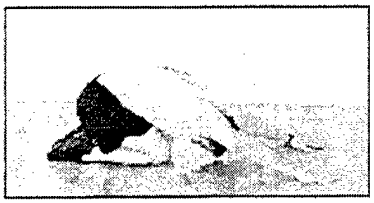
Starting Position

Exercise Position 1

Exercise Position 2



Exercise Position 3



Exercise Position 4

Check Points:

- In exercise positions 1 and 4, you may slide the hands forward of their original position in order to get a better stretch through the arms and trunk.
- In exercise positions 2 and 3, maintain a slight bend in the elbow of the outstretched arm throughout the stretch. Move the trunk and arm as needed so that you feel the stretch in the chest and not the shoulder joint.

Appendix J
Trainee Medical Care

A trainee in need of medical care at Fort Jackson could enter the medical system either at the training battalion (Battalion Aid Station (BAS)) or the hospital Treatment Referral Area. Daily sick call was conducted by a medic at the BAS. The medic made the decision to treat the trainee at the battalion and return him or her to duty, or refer the trainee to the McWethy Troop Medical Clinic (TMC) for further evaluation or treatment. For some follow-up visits or injuries outside of sick call, the trainee could report directly to the TMC. If the TMC was closed, the trainee could obtain medical care at the Moncrief Army Community Hospital Treatment Referral Area. Here, a medic also performed an initial screening and either treated and returned the trainee to duty or referred the trainee to a higher level of care.

Whenever a trainee entered the medical system, medical record forms were generated and placed in the trainee medical record. Trainee medical records were stored at the TMC.

Appendix K
Questionnaire

Last name_____ **ID**_____ **Company**_____

Circle the response that best corresponds to the following questions:

1. Over the last month, how often did you exercise or play sports for 15 minutes or more?

No exercise or sports in the last month	Less than once per week	One time per week	Two or three times per week	Four or more times per week

2. Which statement best describes your smoking habits in the last year (prior to BCT)?

I did not smoke	I smoked but quit	I smoked 10 or fewer cigarettes per day	I smoked 11 to 20 cigarettes per day	I smoked more than 20 cigarettes per day

For each of the following statements, circle the choice that best indicates how strongly you agree or disagree with the sentence, using the scale provided:

3. I enjoy exercise.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

4. I think I can perform exercise activities pretty well, compared to others my age.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

5. It is important to me to do well at exercise.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

6. I think exercise is boring.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

7. I consider exercise to be an important part of my lifestyle.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

8. I do not feel nervous when participating in exercise activities.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

9. I donot believe exercise is beneficial for me.

1. strongly disagree	2. disagree	3. somewhat disagree	4. neutral	5. somewhat agree	6. agree	7. strongly agree

10. I exercise because I have no choice.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

11. I am anxious when participating in exercise activities.

1	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

12. I think I can perform exercise activities well.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

13. I believe exercise is of some value to me.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

14. I feel tense when participating in exercise activities.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

15. I don't try very hard to do well when I exercise.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

16. I exercise because I want to.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

17. I put a lot of effort into the exercise activities I participate in.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

18. I feel like I have to exercise.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

19. I think exercise is fun.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

20. I do not perform well at exercise activities.

1.	2.	3.	4.	5.	6.	7.
strongly disagree	disagree	somewhat disagree	neutral	somewhat agree	agree	strongly agree

Appendix L
APFT Scores for All Available Trainees

Table 1J shows the APFT raw scores for each event for all available trainees on each test.

Table 1J. APFT Raw Scores for the VF and Control Battalions

Gender	Test	Bn	Push-Ups (reps)		Sit-Ups (reps)		Two-Mile Run (min)	
			Mean	SD	Mean	SD	Mean	SD
Men	Initial (Test 1)	VF	32.0	12.5	43.6	11.9	17.6	2.6
		Control	33.1	14.2	42.8	12.6	16.9	2.4
	Test 2	VF	[a]	[a]	[a]	[a]	[a]	[a]
		Control	44.8	14.8	51.3	12.9	15.6	1.9
	Diagnostic (Test 3)	VF	41.7	13.1	52.6	12.2	15.6	1.8
		Control	47.2	14.0	55.4	13.7	15.2	1.8
	Final (Test 4)	VF	47.8	12.9	59.1	11.1	15.0	1.3
		Control	51.9	13.3	60.1	13.3	14.7	1.3
Women	Initial (Test 1)	VF	11.7	8.6	38.6	13.6	21.5	2.8
		Control	12.2	8.9	35.9	13.8	21.0	2.7
	Test 2	VF	[a]	[a]	[a]	[a]	[a]	[a]
		Control	26.2	17.1	43.6	16.0	19.6	2.7
	Diagnostic (Test 3)	VF	19.1	10.4	50.6	13.4	19.1	2.1
		Control	28.4	16.0	48.9	16.9	18.7	2.2
	Final (Test 4)	VF	25.0	11.4	59.8	11.9	18.2	1.5
		Control	31.4	17.1	54.7	17.0	18.1	1.7

[a] VF Battalion did not take a second test

Appendix M
Crude Injury Incidence Without FAP Personnel

This appendix shows the cumulative injury incidence without the FAP personnel. This separate analysis was run because there were significantly more FAP personnel in the VF Battalion compared to the Control Battalion. Comparisons to Tables 15, 17 and 19 show that elimination of the FAP personnel had only a minimal influence on these results.

Table 1K. Cumulative Incidence of All Injuries in the VF and Control Groups (No FAP Personnel)

Injury Type	Battalion	Men				Women			
		N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
All Injuries	VF	726	15.0	1.2	0.10	419	36.5	1.3	<0.01
	Control	616	18.3			571	46.4		
Overuse Injuries	VF	726	11.3	1.3	0.05	419	30.8	1.3	<0.01
	Control	616	14.9			571	41.3		
Traumatic Injuries	VF	726	4.3	1.0	0.92	419	8.6	0.86	0.48
	Control	616	4.4			571	7.4		
LE Overuse Injuries[b]	VF	726	8.0	1.3	0.09	419	26.3	1.3	0.02
	Control	616	10.7			571	33.1		

[a]Risk ratio calculated as (Control/VF)
[b]LE=lower extremity

Table 2K. Cumulative Incidence of Time-Loss Injuries in the VF and Control Groups (No FAP Personnel)

Time-Loss (TL) Injury Type	Battalion	Men				Women			
		N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
All TL Injuries	VF	726	10.7	1.2	0.32	419	30.1	1.2	0.06
	Control	616	12.5			571	35.7		
Overuse Injuries	VF	726	8.1	1.3	0.10	419	24.8	1.3	0.03
	Control	616	10.7			517	31.2		
Traumatic Injuries	VF	726	2.9	0.8	0.61	419	6.4	0.9	0.67
	Control	616	2.4			571	5.8		
LE Overuse Injuries[b]	VF	726	5.8	1.3	0.18	419	20.3	1.3	0.03
	Control	616	7.6			571	26.3		

[a]Risk ratio calculated as (Control/VF)
[b]LE=lower extremity

(squares again)

Table 3K. Cumulative Incidence of PTRP Injuries in the VF and Control Groups (no FAP Personnel)

Battalion	Men				Women			
	N	Injured (%)	Risk Ratio[a]	p-value	N	Injured (%)	Risk Ratio[a]	p-value
VF	736	1.1	1.3	0.57	425	2.8	1.5	0.22
Control	630	1.4			582	4.3		

[a]Risk ratio calculated as (Control/VF)

Appendix N
IMQ for Trainees Not Completing Training

Table 1L shows a comparison of the VF and Control Battalions among trainees who did not complete BCT (discharges and newstarts). Not all of these trainees completed questionnaires. Forty-seven of the VF women and 46 of the Control women completed questionnaires. Fifty of the VF men and 24 of the Control men completed questionnaires. Thus, 93 of the 144 trainees in the VF group who were discharged or newstarted completed questionnaires (65%); 74 of 139 trainees in the Control group who were discharged or newstarted completed questionnaires (53%).

Table 1L shows that the Control group had higher initial scores than the VF group on many of the scales. This was consistent with the analysis of the full cycle trainees (see Table 30). Correction for initial score differences by ANCOVA was performed on all scales for consistency. The ANCOVA showed there were no significant differences among the VF and Control subjects, although the VF group tended to have larger and more positive changes on all scales except Effort/Importance.

Table 1L. Comparison of VF and Control Battalion on IMQ Scales

IMQ Scales			Men				Women			
			Mean	SD	p-values		Mean	SD	p-values	
					Initial[a]	Final[b]			Initial[a]	Final[b]
Interest/ Enjoyment	Initial	VF	14.6	4.7	0.03		14.0	4.3	0.14	
		Control	17.0	3.1			15.4	4.8		
	Final	VF	16.3	4.2			14.5	4.1		
		Control	17.0	3.4		0.46	15.8	4.0		0.59
Perceived Competence	Initial	VF	14.9	4.4	0.03		12.4	4.0	0.17	
		Control	17.1	3.5			13.6	4.7		
	Final	VF	16.2	3.7			13.6	3.9		
		Control	17.5	2.9		0.90	15.2	4.4		0.12
Effort/ Importance	Initial	VF	17.8	3.6	0.48		17.3	2.5	0.1	
		Control	18.4	2.4			18.1	2.9		
	Final	VF	17.1	3.2			16.4	2.9		
		Control	17.7	2.8		0.62	17.4	3.2		0.35
Value/ Usefulness	Initial	VF	17.1	3.9	0.06		16.2	3.8	0.04	
		Control	18.8	2.0			17.8	3.3		
	Final	VF	17.5	3.2			16.7	3.3		
		Control	18.0	3.0		0.7	17.5	3.4		0.58

[a]From one-way ANOVA
[b]From ANCOVA adjusting for initial score differences

Appendix O
Comparison of High and Low Road March Mileage Companies

Four companies in the 2nd Battalion of the 28th Infantry Regiment maintained records on the total amount of marching performed during one BCT cycle conducted from 28 July to 14 October, 1999. Injuries occurring in these companies were obtained from the SI^{2}TS. Log linear analysis produced a chi-square statistic that tested the differences between groups.

The four companies reported a total of 71, 74, 90 and 91 miles. The injury data from the 71 and 74 mile companies were combined as were the injury data from the 90 and 91 mile companies. Results are shown in Table 1M. Compared to the lower march mileage group, the higher mileage group had a higher prevalence of foot and ankle complaints, lower extremity complaints, and all injury complaints.

Table 1M. Comparison of Sick Call Visits in Companies Performing Higher and Lower Road Marching Mileage

	Foot and Ankle Complaints (visits/100 trainees)	Lower Extremity Injury Complaints (visits/100 trainees)	All Injury Complaints (visits/100 trainees)
71and 74 Miles	35.4	42.4	62.0
90 and 91 Miles	46.1	67.6	84.7
p-value[a]	<0.01	<0.01	<0.01

[a] chi-square statistic from log linear analysis

Appendix P
Acknowledgements

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SPC Danielle Artis, and SPC Juliet Mejia