U.S. Army Physical Readi

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Company-level leaders and above frequently discuss concerns about how to train soldiers physically for the rigors of combat. How should the U.S. Army conduct physical readiness training (PRT)? Common concerns include—

- The wide-ranging and often unpredictable physical tasks soldiers may be called on to perform.
- Overall low levels of fitness and perceived high rates of excess weight in new recruits.

U.S. Army soldiers perform the supine bicycle exercise during a group physical training session at Fort Eustis, Va., 22 April 2014.
(U.S. Air Force photo by Senior Airman Teresa J.C. Aber)

ness Training Protocols

- Injury rates from training for recruits and seasoned soldiers.
- Perceived lack of effectiveness and efficiency of current U.S. Army PRT protocols.
- Lack of applicability of the current Army Physical Fitness Test (APFT) to combat.

Numerous voices contribute to this discussion on a broad professional level. U.S. Army Command and General Staff College students have written extensively on the topic.[1] The Army recently updated its doctrinal guidance in Field Manual (FM) 7-22, *Army Physical Readiness Training*. It is researching and developing a new APFT.[2] Many units at the battalion and company level implement PRT programs to meet specialized training objectives consistent with the unit's mission-essential task list. In addition, soldiers individually contribute to the discussion when they use popular exercise programs such as those available online at www.GymJones.com, www.Crossfit.com, www.MilitaryAthlete.com, www.MtnAthlete.com, www.Sealfit.com, and www.CrossfitEndurance.com. Soldiers choose exercise programs based on their own understanding of the physical requirements of their jobs.

Analysis

The road to the U.S. Army's current PRT approach began in the late 1990s as Army leadership recognized the need to provide updated PRT and doctrinal guidance. Researchers from the U.S. Army Center for

Photo by Marie Berberea, Cannoneer staff

Soldiers in the Master Fitness Trainer Course step across Prichard Field at Fort Sill, Okla. as part of a warm-up before physical readiness training, 5 June 2013.

Health Promotion and Preventive Medicine and trainers from the U.S. Army Physical Fitness School combined efforts to produce the first-generation PRT in the early 2000s. The new PRT was intended as an update to a traditional methodology of calisthenics, push-up and sit-up variations, and long-distance running in formation. The genesis of PRT "involved six different types of exercises: calisthenics, dumbbell drills, movement drills, interval training, long-distance running, and flexibility training."[3]

In October 2012, new doctrinal guidance was published in FM 7-22. The FM is like a 400-page, college-level textbook. The content is organized by PRT philosophy, strategy, and activities. The manual improves on outdated doctrine by including designs meant to decrease injuries resulting from sudden increases in running mileage; phased training (systematic planning of PRT) and specified rest and recovery points; a greater range of fitness needs applicable to combat, such as mobility, flexibility, and agility; and some limited accommodations for updated training guidelines from organizations such as the American College of Sports Medicine.

Unfortunately, the complexity and breadth of its approach can be overwhelming. I have heard from many soldiers who have found FM 7-22 difficult to understand, including sergeants and staff sergeants responsible for leading and guiding PRT. It attempts to engage audiences—from brigade command-level leadership, to rifle team leaders and combat arms units, to support units—but those audiences seem to be struggling with it.

Moreover, the FM does not provide metrics, definitions, or measurable standards (with the exception of some general movement execution standards). This leaves a dizzying amount of information for users to define for themselves.

The FM attempts to match PRT phases (initial conditioning phase, toughening phase, and sustaining phase) to the Army force generation (ARFORGEN) force pools (rotational phases known as RESET, train/ready, and available).[4] However, the ARFORGEN

phases mean very little to platoon-level leaders who plan and administer PRT sessions. The cycle is rarely executed to time standards even at the brigade level, and leader turnover throughout the process makes execution of similarly phased PRT impractical.

The Master Fitness Trainer Course (reconstituted in the last two years to teach PRT per FM 7-22) holds a great deal of potential. This four-week course develops PRT trainers at the noncommissioned officer (NCO) and junior officer level who then return to their units as PRT experts.[5] However, the course needs to be more fully developed and given a much higher degree of emphasis and prestige to effect real change.

Most important, FM 7-22 and Army PRT programs have yet to empower and inspire soldiers with effective ways to become fit. Much of PRT's unpopularity among soldiers comes from its exercise movements, which could be perceived as random or even silly by those who do not grasp their purpose. Lateral, medial, and bent-leg raises; single leg tucks; windmills; and half-squat laterals all could appear to 20-year-old men to be akin to the exercise videos their mothers did on Saturday. Soldiers see little carryover between these functional movements and real-life combat operations. That does not mean that such functional movements are not important; in fact, functional movements are very important.

Discussion

To improve the implementation of the Army's PRT, soldiers need to master a common lexicon and a basic level of physiological understanding. This paper attempts to begin a discussion that will lead to establishing definitions of commonly bandied but poorly understood concepts of physiology, biomechanics, and sports technique principles. Developing common understanding will enable pursuit of common goals.

What is fitness? Fitness definitions and taxonomies abound, but many (including dictionary definitions) are inadequate because they do not describe qualities that are easily measured. CrossFit founder Greg Glassman uses a definition that is quantifiable and appropriate for all applications of physical fitness.[6] (CrossFit is strength and conditioning program that has gained popularity among soldiers and athletes.) Fitness, Glassman asserts, is the ability to produce power across two broad domains: a time domain and a modal domain (sometimes called modalities).

Power is a quantifiable biomechanical phenomenon. It is defined as the rate at which work is performed.[7] Power can be expressed algebraically as

Photo By Clifford Kyle Jones, NCO Journal

Proper running form is among the lessons in the Master Fitness Trainer Course at Fort Jackson, S.C., 29 January 2013.

$$P = Fd/t$$

In this equation—

- P = Power (energy)
- F = Force (cause of motion)
- d = Distance (of displacement)
- t = Time

Power output can be increased or attenuated through manipulation of any one of the three variables: force (the cause of motion, which is greater if the cause of motion is heavier), the distance that weight travels, and the time it takes to move the weight through that distance.

In terms of application, therefore, the goal should be to train soldiers to move large loads over long distances quickly. This concept can be expressed as *intensity*. Intensity is exactly equal to average power output as discussed above, and its presence or lack thereof in exercise programming should be defined as how large the load, how far the distance, and how much time it takes to perform the movement. Infantrymen are taught from their first day in the Army that their job is to close with and destroy the enemy; their job often requires hours of foot movement followed by short bursts of explosive energy. Intensity describes both physical modalities.

The time domain refers to various approaches to training that take into account the duration of tasks, such as tasks performed quickly using high force, or tasks that require endurance over time using less force. To be proficient and efficient, soldiers routinely need to perform short, explosive movements; intense movements lasting up to two minutes; and sustained exercise. Efficient recruitment of muscle fibers and metabolic pathways must be trained, within the domains that each muscle fiber type and pathway is the primary source of power.[8]

Different muscle fiber types contract for different kinds of muscular power production over different durations. Moreover, the metabolic pathways that fuel muscles differ, depending on the intensity, duration, and type of physical activity. The fibers that make up the muscles of the body comprise at least three different types:

- Type I fibers have a high level of aerobic endurance but generate less peak power.

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Chuck Carswell, an instructor from the CrossFit Decatur, Ga. branch, explains how to correctly do the front squat during a CrossFit certification at the Caro Fitness Center (CrossFit Fort Stewart), 31 January 2012.

General physical skills	Definitions
Cardiovascular/ respiratory endurance	The ability of body systems to gather, process, and deliver oxygen.
Stamina	The ability of body systems to process, deliver, store, and utilize energy.
Strength	The ability of a muscular unit, or combination of muscular units, to apply force.
Flexibility	The ability to maximize the range of motion at a given joint.
Power	The ability of a muscular unit, or combination of muscular units, to apply maximum force in minimum time.
Speed	The ability to minimize the time cycle of a repeated movement.
Coordination	The ability to combine several distinct movement patterns into a singular distinct movement.
Agility	The ability to minimize transition time from one movement pattern to another.
Balance	The ability to control the placement of the body's center of gravity in relation to its support base.
Accuracy	The ability to control movement in a given direction or at a given intensity.

Skills and definitions reproduced from Greg Glassman and staff, *CrossFit Training Guide*, 2010.

Table. Ten general physical skills as used by Glassman

- Type II_a fibers have a much lower level of aerobic endurance but perform well anaerobically and generate higher levels of peak power.
- Type II_x fibers are activated predominantly for highly explosive, short-duration activities.

In addition, training the metabolic pathways that deliver adenosine triphosphate (ATP), which fuels the muscles, is essential for maximizing athletic potential for tasks of different duration:

- The ATP-phosphocreatine system delivers immediate but short-term (≤ 10 seconds) energy for explosive movements.
- The glycolytic system delivers energy more slowly but in a more sustained fashion, energizing movements up to two minutes.
- The oxidative system delivers the slowest but most sustained energy. This system can fuel exercise for hours when trained properly.

Glassman has adopted a taxonomy with 10 general fitness domains, based on the work of coaches Jim Cawley and Bruce Evans, in which physical skills and training adaptation can be defined and measured. These ten skills are shown in the table.

In the PRT taxonomy used by FM 7-22, the overlapping components of training are "strength, endurance, and mobility."[9] Qualitative performance factors for mobility are agility, balance, coordination, flexibility, posture, stability, speed, and power. The doctrine further develops the components as muscular strength and muscular endurance; anaerobic endurance and aerobic endurance; and the performance factors of mobility—agility, balance, coordination, flexibility, posture, stability, speed, and power. This taxonomy bears some similarity to Glassman's, but since the nature of the model is qualitative, rather than quantitative, it provides little practical means for measurement. Glassman's model facilitates quantifying athletic performance.

The idea of modal domains includes types of training most likely to result in desired physical

adaptation, as well as those that exhibit a high degree of skill crossover from sport to sport. Modalities such as gymnastics, Olympic and power lifting, plyometrics (exercises involving repeated stretching and contraction), yoga, running, and rowing are examples of these modal domains. Therefore, we recognize that a soldier is fit insofar as he or she is able to produce power over different durations and in different modalities (referring to types of physical activities that are improved by exercise). For example, under this definition the soldier who practices weightlifting, trail running, and kayaking, and who demonstrates some gymnastic capability (the capability to perform a muscle-up, vault, or handstand, for example) is fitter and more combat-ready than a soldier who exclusively runs 50 miles per week and performs some push-ups. From an athletic perspective, a world-class decathlete (physically) is fitter and more combat-ready than a world-class triathlete.

What are functional movements? The term *functional movement* is another example of frequently used exercise terminology lacking a common definition. According to W. Larry Kenney, Jack Wilmore, and David Costill, functional movements—

- Incorporate combinations of joints and muscle systems for execution. They do not isolate single muscle groups.
- Begin proximally and culminate distally, from core (transverse abdominis, erector spinae, and associated musculature) to extremity.
- Stave off decrepitude (because regular functional movement through full range of motion is therapeutic).
- Are safe and within the ability of healthy human beings, when all points of performance are observed.
- Are replicated naturally and come from everyday human experience.[10]

Not teaching and learning how to perform functional movements correctly is to the detriment of a soldier's quality of life and ability to perform his or her job.

Examples of functional movements include the squat (the equivalent of standing from seated position), dead lift (the equivalent of picking up an object from the ground), and press (the equivalent of taking an object from shoulder level and placing it or handing it overhead). Sporting experience teaches that when correct points of safety performance are observed and trained, it is possible to move large loads quickly while staying injury free. We do soldiers an injustice (fail to empower them) by not teaching them correct execution of these fundamental human operations.

What is the best method for training soldiers for the rigors of combat? Research has shown conclusively that desired physical adaptation is elicited to a higher degree through PRT that combines modalities (e.g., strength and endurance training combined rather than just strength or just endurance training).[11] Moreover, in a 2012 study, Heinrich et al. reported that an active duty population responded more favorably to a program consisting of functional movements executed with a high degree of intensity compared to a sample conducting traditional training.[12] Statistically significant favorable adaptation relative to the traditional group included increased APFT push-up performance, decreased APFT two-mile run time, increased one-repetition maximum bench press, and increased flexibility.

Recommendations

We therefore propose the following general guideline, consistent with Glassman: training that includes a wide variety of functional movements performed at a high degree of intensity across broad time and modal domains is the most effective way to increase a person's capacity to generate power.[13]

Specific recommendations for improving Army PRT protocols are—

- Adopt the Functional Movement Systems screening tools.
- Empower master fitness trainers.
- Keep PRT in its current format for basic combat training.
- Develop additional Army publications that concisely discuss practical application of the principles in FM 7-22.
- Revise the APFT.

Adopt the Functional Movement Systems screening tools at the unit level. One of the primary arguments against implementing the type of training we advocate here is based on concerns about high rates of musculoskeletal injuries. In general, however, many injuries can be avoided by ensuring soldiers use proper functional movements.

A company known as Functional Movement Systems, founded by Gray Cook, has developed

effective tools for evaluating movement. A significant predictive factor for musculoskeletal injuries, as demonstrated by Mr. Cook, is poor movement patterns. For individuals with no current pain or musculoskeletal injury, fitness professionals can administer the *Functional Movement Screen* (FMS), described as—

> a ranking and grading system that documents movement patterns that are key to normal function. By screening these patterns, the FMS readily identifies functional limitations and asymmetries. These are issues that can reduce the effects of functional training and physical conditioning and distort body awareness. The FMS generates the Functional Movement Screen Score, which is used to target problems and track progress. This scoring system is directly linked to the most beneficial corrective exercises to restore mechanically sound movement patterns.[14]

For individuals with pain or injury, a healthcare provider can administer a tool known as the *Selective Functional Movement Assessment*.

Scientific literature supporting the efficacy, accuracy, and reliability of these tools is large and continues to grow.[15] They are used by organizations such as the National Football League, USA Track & Field (the national governing body for track and field, long-distance running, and race walking in the United States), and over 20 professional sports teams and U.S. government and military organizations.[16] The FMS is inexpensive and easy to administer. It requires little more in terms of resources (time and personnel) than a standard unit-level APFT. Most important, it will provide commanders with quantifiable injury potential data that should result in better soldier care and outcomes.

The U.S. Army lacks a method for predicting the likelihood of injury even though the increased risk of musculoskeletal injuries is the leading argument against high-intensity workouts. In 2011, the Uniformed Services University Consortium for Health and Military Performance in collaboration with the American College of Sports Medicine released an executive summary detailing positive and negative characteristics of "extreme conditioning programs," finishing with qualified recommendations for their continued use by military populations.[17] The executive summary cited "an apparent disproportionate musculoskeletal injury risk from these demanding programs, particularly for novice participants, resulting in lost duty time, medical treatment and extensive rehabilitation."

Photo by Sgt. Quentin Johnson, 2nd BCT, 1st Cav. Div. PAO

U.S. Army Maj. Roger Miranda with the 1st Cavalry Division lifts a barbell while doing thrusters during the CrossFit Open competition at Fort Hood, Texas, 5 April 2013. The exercise, repeated several times, works muscles in the upper and lower body.

The FMS could be part of the solution to mitigating these injury concerns. All soldiers should be tested biannually (as with the APFT) to identify new or chronic dysfunctional movement patterns. Soldiers who test high for potential injury should be limited in the functional movements and intensities of functional movements they perform until corrective exercise results in an improved FMS score.

Empower master fitness trainers. The Army should empower master fitness trainers with the same level of education, responsibility, autonomy, and professional reward as drill sergeants and recruiters. The master fitness trainer program holds much untapped potential. Structured properly, used consistently, and empowered with adequate resources, it could help streamline and improve U.S. Army PRT. It should not supplant current NCO and officer responsibilities for planning and administering PRT programs. Rather, it should empower leaders and soldiers with information, coaching skills, and injury prevention techniques. As evidenced by the popularity of extreme conditioning programs (which could include CrossFit) and the explosion of functional fitness-type equipment (such as bumper plates, lifting platforms, kettlebells, medicine balls, and large pull-up cages) in military gyms, many soldiers already perform a variety of functional movements at high intensity; the master fitness trainer program could help ensure they do so safely.

Drill sergeant and recruiting positions are benchmarks in an NCO's career progression. They are considered a stepping stone for promotion, so those positions are highly desirable. Commanders must recommend an NCO for drill sergeant or recruiting school by name; without the commander's recommendation, the NCO cannot compete for the position. Master fitness trainer positions should be elevated to similar status.

The master fitness trainer course is four weeks long; it should be expanded to at least 12 weeks to adequately prepare NCOs for their future positions. At a minimum, basics of exercise physiology, sports psychology, and biomechanics should be covered. Master fitness trainers should receive training from USA Weightlifting (Olympic) coaches, strength and conditioning specialists certified through the National Strength and Conditioning Association, and other strength, conditioning, and coaching professionals on the fundamentals of functional movements. Examples of movements to study include the squat, dead lift, and press; their variations and progressions; and lifts of increasing complexity such as the clean, jerk, and snatch. Master fitness trainers should learn to teach a variety of plyometric, kettlebell, barbell, and gymnastic techniques. They should learn how to improve a soldier's running or swimming form and learn how to scale back any workout for which a soldier is not ready. Master fitness trainers should receive FMS certification. They should leave their master fitness trainer course ready to act as athletic coaches, administering their unit's PRT program. They should be empowered to recommend FMS training for members of their unit who could assist with screenings. Commanders should be viewed as athletic directors providing general guidance, but the PRT administrators should be the master fitness trainers.

Master fitness trainers should be supplied to units in sufficient numbers to implement a three- to four-week introductory program for soldiers newly arrived at their unit. They should provide FMS testing, teach functional movement techniques, instruct a gradual progression of exercise intensity, and evaluate soldier fitness levels. Master fitness trainers should be empowered to scale back intensity and complexity for soldiers who are not maintaining pace with the group, who are exhibiting poor movement techniques, or who are otherwise at risk for injury. In this way, novice soldier-athletes whose weak performance is due to undiagnosed injuries, poor functional movement, or insufficient fitness levels will be cared for instead of being pushed to the point of injury. They should feel less pressure to keep pace with the group before they are physically ready.

The Army should designate several levels of the master fitness trainer program. Much as the Modern Army Combatives Program certifies soldiers in levels I through IV, the master fitness trainer program should provide advanced schooling, certifying soldiers in increasingly complex techniques and greater levels of scientific knowledge. For example, master fitness trainer levels I through III should be established, corresponding to the platoon, company, and battalion levels. The Army should form a partnership with the National Strength and Conditioning Association so that soldiers who complete level III training could concurrently become certified strength and conditioning specialists. In other words, the level III course should include the National Strength and Conditioning Association's certification training and examination. If the master fitness trainer graduates were certified strength and conditioning specialists, they could correctly and confidently advise battalion commanders on PRT techniques and programs.

Soldiers should be recommended by their commanders to attend master fitness trainer level I much as they are recommended for drill sergeant and recruiter school. Selected soldiers should have high general technical scores, display a predisposition and passion for physical fitness, and be open minded and willing to learn.

Keep physical readiness training in its current format for basic combat training. The current PRT program is sufficient for basic combat training. Many soldiers enter the military with no background in physical training. The program provides a gentle, progressive stimulus that most new recruits can handle, and according to Knapik et al, it produces desired adaptation within the eight-week basic combat training period.[18] It is appropriate for the time constraints of basic combat training, and in a repetitive environment such as basic, it is relatively simple for drill sergeants to administer. Upon completion of PRT at basic combat training, new soldiers can go to their units prepared to participate in appropriate advanced training, to improve fitness through their unit's introductory program under a certified master fitness trainer.

Develop additional Army publications that concisely discuss practical application of the principles in FM 7-22. The Army needs to develop subordinate publications that explain specific techniques for conducting training. Those publications should define for soldiers and commanders the functional movements, their progressions, and increasing levels of complexity that result in the ability to express power across broad time and modal domains. The publications should provide more precise sample programming for NCOs and officers responsible for planning PRT sessions and give guidance on the relationship and responsibilities of the master fitness trainer and the unit leadership.

FM 7-22 ties progression and phasing of PRT to basic combat training in the ARFORGEN rotational

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Sgt. 1st Class Montrell Kea and his teammates push a light medium tactical vehicle across the battalion motorpool as part of the leader physical training challenge at Fort Bragg, N.C., 27 March 2012. This training event brought the battalion's senior noncommissioned officers and commissioned officers together to foster teamwork and camaraderie.

cycle. As discussed earlier, this sometimes is impractical.[19] Instead, basing unit PRT schedules around a five-month time span followed by a two-week break provides a reasonable period for training and improving, with a built-in rest and decompression period. Soldiers earn two and a half days of leave every month—this equals 30 days of leave at year's end. Units routinely take two weeks of leave during the summer and two weeks of leave over the winter holiday. Granted, one unavoidable feature of military service is the occasionally unpredictable nature of day-to-day tasks. Sometimes training time or facilities simply are not available. Between these training breaks and numerous three- and four-day federal holidays, soldiers can find time for rest and recuperation, whether for soreness, injury, or general weariness.

Revise the Army Physical Fitness Test. One unresolved topic not updated by FM 7-22 in 2012, and currently under research, is the APFT. In 2012, the Army scrapped a new version of the APFT that had been the result of over two years of research and testing for a more combat-appropriate test.[20] Testing soldiers' ability to produce power across time and modal domains need not be difficult. Well-designed workouts such as a CrossFit workout known as "Helen" can serve as fitness tests. This workout calls for the athlete to complete three rounds of the following, in order, as fast as possible: 400-meter run, 21 repetitions of 55-pound kettlebell swing, and 12 pull-ups. Used as a test, it measures soldiers' ability to move loads (their body weight and a 55-pound kettlebell) over various distances as fast as possible. It involves running, moving weight from the ground to overhead, and pull-ups. These activities are applicable to combat scenarios. The workout can be scaled in intensity to meet different needs. For instance, a soldier could increase or decrease the number of rounds, increase or decrease distance, decrease kettlebell weight, or decrease the number or type of pull-ups. This is simply one example; there are many workouts like this already developed that would adequately test soldiers' power-generation capacity.

Conclusion

These recommendations stem from direct experience with military units and the profession of arms. They are not all-encompassing, nor are they complete as individual plans. They constitute, however, a starting point for discussing improvements in Army PRT. These principles are rooted in exercise physiology, biomechanics, and accepted professional physical training techniques. The Army teaches leaders to constantly ask the question, "Are we doing the best we can?" The new PRT doctrine was a good start. These recommendations could lead to the next evolution in the process of fielding the most well-trained, physically fit army in the world.

What has been lacking in the military fitness discussion is a bridge between the scientific and military communities that could help the Army define key physical fitness terms and propose methods for safe, effective PRT implementation by soldiers at the unit level. By providing analysis, discussion, and recommendations for these issues, this paper seeks to open doors to new possibilities for improving soldier battlefield physical readiness and quality of life.

Varied functional movements executed at high intensity best provide the required and desired stimulus to increase a soldier's power production across broad time and modal domains. Implementation of the Functional Movement Systems is clinically proven to predict injury potential in soldiers. It would help leaders and master fitness trainers prevent unnecessary injuries and improve soldiers' professional experience as well as unit readiness. The master fitness trainer program holds immense potential; it must be harnessed, appropriately structured, and properly empowered in order to fully exploit that potential.

The views expressed in this article do not necessarily reflect the opinion of Indiana University, the United States Military Academy, or the United States Army. They are solely the opinions and recommendations of the authors.

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