

Consortium for Health and Military Performance and American College of Sports Medicine Consensus Paper on Extreme Conditioning Programs in Military Personnel

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Abstract

A potential emerging problem associated with increasingly popularized extreme conditioning programs (ECPs) has been identified by the military and civilian communities. That is, there is an apparent disproportionate musculoskeletal injury risk from these demanding programs, particularly for novice participants, resulting in lost duty time, medical treatment, and extensive rehabilitation. This is a significant and costly concern for the military with regard to effectively maintaining operational readiness of the Force. While there are certain recognized positive aspects of ECPs that address a perceived and/or actual unfulfilled conditioning need for many individuals and military units, these programs have limitations and should be considered carefully. Moreover, certain distinctive characteristics of ECPs appear to violate recognized accepted standards for safely and appropriately developing muscular fitness and are not uniformly aligned with established and accepted training doctrine. Accordingly, practical solutions to improve ECP prescription and implementation and reduce injury risk are of paramount importance.

Introduction

Extreme conditioning programs (ECPs; *e.g.*, CrossFit, Insanity, Gym Jones™, and others) are characterized by high-volume aggressive training workouts that use a variety of high-intensity exercises and often timed maximal number of repetitions with short rest periods between sets. These recently well-marketed and popularized metabolically and physically demanding conditioning programs continue to generate growing interest and enthusiastic support among military and some civilian communities. The increasing acceptance is reinforced by widespread anecdotal reports of marked gains in physical fitness and performance. In addition, some Warfighters believe these programs contain functional training that directly translates into more effective performance on the battlefield. However, physicians and other primary care and rehabilitation providers have identified a potential emerging problem of disproportionate musculoskeletal injury risk, particularly for novice participants, associated with ECPs (13,16). Muscle strains, torn ligaments, stress fractures, and mild to severe cases of potentially life-threatening exertional rhabdomyolysis are reportedly occurring at increasing rates as the popularity of ECPs grows (4,27). These observations prompt several concerns and questions:

• Are ECPs and similar program designs problematic?
• Is the purported greater injury risk over traditional conditioning programs valid?

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- Are these programs measurably inconsistent with accepted industry standard guidelines for safe and appropriate exercise prescription and progression?
- Would a functional conditioning advantage of ECPs mitigate an increased occupational and operational threat?
- Are there other notable contributing factors that may unduly increase injury risk when indiscriminately participating in ECPs?

For the military, a higher incidence of musculoskeletal injuries resulting in lost duty time, medical treatment, and extensive rehabilitation is a significant and costly concern with regard to effectively maintaining physical and operational readiness of the Force. Unfortunately, to date, the short- and long-term physiological, functional, and readiness outcomes or safety of ECPs has not been carefully studied. Accordingly, the evidence-based, peer-reviewed literature does not yet support the efficacy for or clarify any notable injury risk potential with ECPs to validate or dismiss the claims, clinical observations, or media reports.

Methods and Approach

On September 13 and 14, 2010, a collaborative workshop, composed of the Consortium for Health and Military Performance (CHAMP), other members of the Department of Defense (DoD), and representatives of the American College of Sports Medicine (ACSM), was convened at the Uniformed Services University (USU) of the Health Sciences, Bethesda, MD. Participants discussed so-called high-intensity training (HIT) commercial programs, began a critical dialog on this important issue, developed initial consensus-based recommendations, and established research objectives to support eventual more comprehensive and definitive evidenced-based guidelines. These guidelines would serve to optimize the potential prescription and safe use of such program designs and reduce injury risk for those participating in these conditioning programs. Subject matter experts were assembled from the civilian sports medicine and research communities and joint representation from the Army, Navy, Air Force, Marines, and Coast Guard. The workshop was structured into four primary topic blocks: definition of HIT, guidelines for safe implementation of HIT programs: part 1, guidelines for safe implementation of HIT programs: part 2, and future research considerations. During the subsequent and final session of the workshop, all speakers and other attendees participated in discussions to determine a process and select key writers to develop a summary paper on the topic for distribution and publication. The “HIT” nomenclature was, by consensus, changed to “extreme conditioning programs” to more accurately describe the scope of conditioning programs being addressed.

Results

Positive Characteristics of ECPs

ECPs are multifaceted, circuit training-like fitness programs using varying forms of resistance training and challenging running intervals and repeated body weight exercises, including plyometrics. The focus is on relatively high-intensity metabolic conditioning — meaning that the exercises impose a moderate to a high demand on the

cardiovascular system and energy metabolism of the active muscle fibers to meet with the muscles’ repeated high-energy requirements. Accordingly, certain aspects of body composition (*e.g.*, reduction in body fat) and some physical fitness components (*e.g.*, local muscle endurance and cardiovascular capacity) may be measurably enhanced. There is also an emphasis on supposed “functional” fitness — namely, the ability to repeatedly perform, under highly fatiguing conditions, a variety of multijoint and total body movements in multiple anatomical planes. Some programs additionally put an emphasis on core strength training. For many Warfighters, the demanding exercise pace, overall difficulty, and perceived potential for “getting ripped” are appealing, exciting, motivating, and appear to target a niche of otherwise unmet training needs and desires. That is, more than just increasing physical fitness and work capacity, the assortment of specific exercises and challenging repetitions arguably addresses a broad range of “in-theater,” real-world operational physical activities and demands and psychological discipline that Warfighters believe will elevate combat readiness. When performed in group settings, ECPs also can promote unit camaraderie and teamwork.

Negative Characteristics of ECPs

Certain distinctive characteristics of ECPs appear to particularly violate recognized accepted standards for developing muscular fitness. For example, repeatedly performing maximal timed exercise repetitions without adequate rest intervals between sets fails to adhere to appropriate and safe training guidelines. This training paradigm, when coupled with insufficient recovery time between high-volume training sessions, can readily prompt earlier fatigue, additional oxidative stress, less resistance to subsequent exercise strain, greater perception of effort, and unsafe movement execution leading to acute injury, especially with multijoint exercises that demand precise technique (*e.g.*, power cleans) or other advanced exercises requiring considerable skill, balance, and strength (*e.g.*, kettle bells, suspended rings, or hand-stand pushups). Overuse, overreaching, and overtraining are parallel risks. Moreover, a clear approach for initiating an ECP and safely building up to higher levels progressively, in many instances, is not well defined for the novice participant. In the beginning stages and throughout the program, in the absence of individual fitness- and experience-based guidelines, Warfighters can arbitrarily do as much as they want and *feel* they should. Consequently, recurrent unplanned overreaching can easily occur and result in marked deterioration of expected performance gains. That is, those who are new to an ECP may do too much too soon; and even more experienced participants often end up performing advanced exercises with excessive fatigue and undue injury risk. Exercise sessions also can be very competitive, where Warfighters seek peer approval by attempting to “keep up” with others who may be more fit and stronger. Thus, individuals are often encouraged to push themselves unknowingly to excess, with a greater potential for concomitant injury. It is difficult for a competitive Warfighter to “scale back” because of an inherent desire to be part of the team and reluctance to do less than their peers. Individual and more appropriate pacing and progression, though vital for effective fitness development,

are commonly perceived as showing weakness. All of these contributing factors, if unchecked, could arguably lead to undue overload, poor body control, and loss of safe exercise performance, which, alone or in combination, might notably exacerbate and augment musculoskeletal injury risk (8,11–13,16,27).

The Services have recommended training programs that embrace and adhere to scientifically based training guidelines (see below) incorporating appropriate whole-body functional training. Notably, Warfighters need sufficient metabolic conditioning *and* ample strength, power, and endurance training and cardiorespiratory fitness to be mission ready. Whereas ECPs can be very effective in enhancing certain aspects of fitness and operational readiness, these programs are not sufficiently inclusive of all conditioning and training needs. Even safely implemented and performed ECPs provide only a portion of what should be a more diverse and well-balanced conditioning program, especially for those in a less trained state. Accordingly, any ECP should be considered, at best, to be complementary to and carefully integrated with other conditioning programs already in place.

Other Considerations, Concerns, and Resources

What other factors potentially contribute to the purported increasing injury rate associated with, or are contraindications for, participating in ECPs? In addition to performing their occupational and operational duties, Service members have to regularly participate in myriad training activities aimed at improving and solidifying mission-essential tasks, battle drills, and Warfighter resilience. These can include running, jumping, bounding, high/low crawling, climbing, and repeated pushing, pulling, lifting, squatting, lunging, rolling, and changing direction. Training and operational tasks also may include extended ambulatory activity over difficult terrain with heavy external loads near or exceeding 100 lbs at various times. Moreover, other conditioning activities often are mandated as part of the daily routine, with supplemental distance running being a common emphasis and method of choice by military leadership for improving and maintaining fitness, as well as fostering unit camaraderie. Regular running alone, especially on less-than-desirable surfaces or with novice runners, can readily increase musculoskeletal injury risk, if the distance and frequency are excessive (9,15). However, even combining an appropriate and safe running routine or other moderate conditioning activities with regular ECP participation and occupational and other duty-related physical activities appreciably can overload and fatigue a Warfighter. As a result, overuse- and overtraining-related injury and other clinical risks concomitantly increase. This underscores the importance and value of all conditioning being administered and overseen by a qualified on-site coach or trainer who has a day-to-day appreciation for and considers individual and unit demands and status. Furthermore, units do not always have the appropriate and recommended equipment and space for doing commercial off-the-shelf ECPs. Thus, Warfighters often improvise by using other available devices, materials, and areas not designed for effective and safe exercise. These less-than-desirable conditions

add to the potential increased risk for injury. In addition, during extended training and deployments, Warfighters are often required to tolerate and expected to perform satisfactorily under extraordinary circumstances and conditions including environmental extremes (heat, cold, altitude), lack of sleep, and suboptimal nutrition (lack of calories and key macronutrients and micronutrients), with great psychological stress superimposed (17,18). Accordingly, they need to be prepared to respond to and withstand a variety of unforeseen demands and not be overtrained or unduly fatigued.

As with *any* conditioning program, certain medical status and other health-related factors warrant reduced physical activity and should preclude ECP participation altogether. Especially with the high-intensity and physically demanding characteristics of ECPs, special consideration of health status is essential prior to participating in such conditioning programs. Current or recent illness, especially if it involves gastrointestinal distress (*e.g.*, vomiting, diarrhea) and/or fever, should be sufficient reason to suspend or substantially modify one's overall and, in particular, supplemental conditioning routines. High-intensity workouts after excessive alcohol consumption also should be strongly discouraged, given alcohol's residual effects on neuromuscular control and hydration status (24). Other notable clinical conditions that potentially increase the risks of ECPs include, for example, cardiovascular disease (including hypertension) (23), a recent bout of exertional heat illness (*i.e.*, heat exhaustion and exertional muscle cramps or heatstroke) (20), or a previous episode of exertional rhabdomyolysis (19). Sick cell trait also should be considered as a possible contributing clinical risk/complicating factor for ECP participation (3,5,6). A Warfighter with a traumatic brain injury (including concussion) who is not completely recovered and reconditioned should avoid vigorous exertion (14). In addition, a recent musculoskeletal injury, use of various medications that may impair balance, neurological disorders (including recurrent headaches), and sleep deprivation also should limit or preclude Warfighters from participating in any ECP or other conditioning program.

What are some recognized and recommended published resources from established organizations that provide guidelines for safe and effective exercise prescription for planning military physical readiness training, especially when considering or implementing ECPs? A Joint Services Physical Training Injury Prevention Working Group, composed of DoD and civilian injury prevention and fitness experts, was created in 2004 under the Military Training Task Force of the Defense Safety Oversight Council to evaluate current military physical training injury prevention programs and policies and to develop comprehensive, evidenced-based guidelines on the prevention of physical training-related injuries for the military (7). This resulted in a thorough review of 40 possible interventions/actions. Although 23 popular training-related injury prevention strategies were identified as not having sufficient evidence of efficacy, overtraining prevention was highlighted by this group as a key evidence-based priority for preventing musculoskeletal injuries. This has particular relevance, especially when considering adding an ECP to a unit's already-demanding daily schedule of occupational and operational

Table 1.
Services' policies and guidelines for planning and implementing military physical readiness training.

Service Branch	Resource	Additional Information
Army	Army Training Circular — TC 3-22.20: Army Physical Readiness Training (August 2010)	Provides policy and procedural guidance for the execution of the Army Physical Readiness Training System. See also, Army Physical Fitness School in Fort Jackson, SC: http://www.jackson.army.mil/!2009_pages/dbct/pf.html
Air Force	Air Force Instruction — AFI 36-2905: Air Force Guidance Memorandum on Fitness Program (December 2010)	Provides policy changes to the Air Force Fitness Program, as well as procedural guidance for executing the program
Marine Corps	Marine Corps Order — MCO 6100.13: Marine Corps Physical Fitness Program (August 2008)	Provides policy and procedural guidance for implementing the Marine Corps Physical Fitness Program, including both combat and physical fitness
Navy	Policy and Procedural Guidance Instruction — OPNAVINST 6110.1H: Navy Physical Readiness Program (August 2005)	The Navy has recently developed a new training program — the Navy Operational Fitness and Fueling Series — which was designed to provide the Navy with performance training resources for all Navy personnel

activities and training. With regard to the individual Services, each one has its own program and guidelines (Table 1).

ACSM has published two particularly relevant positions stands — 1) Progression models in resistance training for healthy adults (2) and 2) Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise (10) — that also have been endorsed by the National Strength and Conditioning Association (NSCA). These are especially helpful not only for planning military physical readiness training that uses resistance training but also when addressing a more broad scope of desired overall fitness goals. In addition, ACSM's general principles of exercise prescription is an industry standard for developing safe and effective exercise prescription guidelines (26). The NSCA also has two pertinent position stands — 1) Basic guidelines for the resistance training of athletes (22) and 2) Explosive exercise and training (25). Both of these resources provide detailed guidance on progressive overload, training specificity, periodization, and injury risk reduction through the use of correct exercise and lifting techniques. Using such guidelines can help fitness leaders ensure optimal, safe, and progressive development of physical and functional readiness. For quick reference, Table 2 provides general recommendations for physical activity that will help healthy adults achieve and maintain general health and fitness, based on the 2008 *Physical Activity Guidelines for Americans* (1). Table 3 outlines more specific guidelines for developing and maintaining muscular fitness, based on the ACSM and NSCA recognized and recommended resources.

The Way Ahead

Program Design, Risk Management, and Certification

The physical and psychological readiness expectations and demands on Warfighters are extensive and variable, given the variety of multiple challenging tasks that must be performed repeatedly and oftentimes under extreme and stressful situations and environmental conditions. Accordingly, physical conditioning must sufficiently address lower and upper body strength, power, and endurance, mobility,

and agility, as well as improve overall cardiorespiratory and recovery capacities. However, an *effective* and *safe* conditioning regimen must consist of incremental, *progressive* introduction of exercises and workloads based on fitness and specific conditioning needs and limitations of the *individual*, as well as desired training goals of the unit. Each exercise set and session should be varied and administered in such a way to avoid excessive overload and fatigue, noting that not all individuals can tolerate the same workout program nor do they progress at the same rate with neuromuscular and other conditioning adaptations. This also will allow maintaining biomechanical control to minimize poor exercise technique-related injury risk. Moreover, the program periodicity should follow a schedule of planned exercise routines with deliberate and sufficient rest and recovery periods between sets, activities, sessions, days, and training cycles, so the Warfighter's body can resist excessive

Table 2.
Physical activity rationale and types of exercises and related recommended amount/frequency for healthy adults (1).

Rationale and Types of Exercises	Amount/Frequency
To improve and maintain health, regularly participate in moderate- or vigorous-intensity aerobic physical activity	150 min (2 h 30 min) a week of moderate-intensity or 75 min (1 h 15 min) a week of vigorous-intensity physical activity
For additional and more enhanced health and fitness benefits, include more and varied types of moderate- and/or vigorous-intensity aerobic physical activity	300 min (5 h) a week of moderate-intensity or 150 min a week of vigorous-intensity physical activity (or an equivalent combination of moderate- and vigorous-intensity activity)
Include muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups	Two or more days a week

Table 3.
Resistance training guidelines for developing and maintaining muscular fitness (2,10,22,26).

Acute Program Variables	Recommendations
Frequency	Resistance training of each major muscle group on 2 to 3 d·wk ⁻¹ , with at least 48 h separating each exercise training session, for the same muscle group(s).
Types of exercises	Multijoint exercises affecting more than one muscle group and targeting agonist and antagonist muscle groups. Single-joint exercises targeting major muscle groups may also be included.
Volume of exercise (repetitions and sets)	Each muscle group should be trained for a total of two to four sets of 8 to 12 repetitions per set, with a rest interval of 2 to 3 min between sets, to improve muscular fitness. For older (≥65 years) or deconditioned individuals, one or more sets of 10 to 15 repetitions of moderate-intensity (<i>i.e.</i> , 60% to 70% of 1-repetition maximum) resistance exercise is recommended.
Exercise technique	Professional (recognized certification) instructions on resistance training techniques are recommended. Proper resistance exercise techniques employ controlled movements through the full range of motion and include concentric and eccentric muscle actions. Failure to sustain technique increases risk of injury.
Progression/maintenance	The progressive overload principle should be always adhered to. This principle is achieved by incrementally adding greater resistance, performing more repetitions (not more than 12), or training more frequently. For maintenance, there is no need to progressively overload muscles.

strain and positively adapt in the most efficient, effective, and safe way.

Motivation to participate and the need to build confidence must be appreciated and recognized as cornerstones of any effective conditioning program. But until more definitive information is available regarding ECPs, military and medical personnel at all levels, including those most closely involved with unit physical fitness training, should deliberately employ thoughtful risk management strategies and be prudent in providing support or resources for any physical fitness training or commercial programs not aligned with military and other recognized standards and guidelines for physical training and exercise prescription. Military leaders and training personnel also should be strongly advised to consider the rigor of a unit's daily occupational and operational training, combined with medical, external, and environmental risk factors. This will ensure that planning for physical readiness training does not

unduly conflict with other injury risk magnifying factors. One approach for effective planning is to use a risk assessment process to address potential threats. The Army's composite risk management process, as per Army Field Manual (FM 5-19; July 2006), has five clearly defined steps: 1) identify hazards, 2) assess hazards and determine risk, 3) develop controls and make risk decisions, 4) implement controls, and 5) supervise and evaluate. For example, extensive military training and same-day exhaustive physical training or fitness testing should be avoided, as this increases risk and demands a number of controls to overcome the consequent potential negative effects.

Properly educating Warfighters is critical, so they better appreciate the importance of exercise progression and the long-term dangers and personal/personnel costs of overexertion. Careful monitoring and accurate injury reporting also are important. This is reinforced by requiring certification from recognized nonprofit certifying organizations (*e.g.*, ACSM, NSCA) for all authorized physical fitness trainers (*e.g.*, a commercial certificate of a course completion alone would be insufficient). Such mandatory accepted certification would better ensure a widespread comparable foundation in exercise, nutrition, and performance enhancement and the knowledge to identify potentially problematic conditioning programs. Qualified fitness trainers also are better equipped to more appropriately design, individualize, implement, and oversee an effective progressive and periodic program. Comprehensive education on appropriate conditioning practices, clearly defined pathways for safe and suitable implementation and monitoring, and required recognized certifications for those responsible for unit physical readiness training and in charge of administering conditioning programs for the armed services' Warfighters would serve the military well.

Recommendations

It is important to recognize and appreciate the positive aspects of ECPs and that ECPs address a widespread perceived and/or actual unfulfilled conditioning need for many individuals and military units. Thus, ECPs are likely to remain on the landscape of available and promoted physical conditioning options. Therefore, practical solutions to effectively improve ECP implementation and reduce injury risk are of paramount importance. This can begin with better functional and fitness screening and stratification for injury risk for all Warfighters prior to participation in any ECP (21). Moreover, appropriate provisions and program modifications to reduce injury risk, as well as regular careful monitoring and accurate injury reporting, are essential. To this end, recommendations to improve efficacy and safety of ECPs are as follows:

- Conduct regular careful inspections of designated exercise equipment and areas to evaluate safety and efficacy of planned exercise within the existing environment.
- Introduce ECPs to new participants gradually with a specific, stepwise progression (acclimation) to exercise intensity, duration, and advanced exercises.
- Individualize supplemental conditioning programs (particularly ECPs) based on fitness, training goals, and job-specific functional needs and demands, while limiting full

participation in ECPs to those already very fit and healthy. Anyone with a clinical condition or health status that would contraindicate participating in ECPs or other high-intensity physical activities should not be allowed to participate until medically cleared.

- Ensure suitable rest periods (adequate duration and frequency) between sets of exercise and include regularly planned days of reduced or no supplemental conditioning, especially just before or after exhaustive military training, to optimize recovery, promote positive training adaptations, and minimize excessive fatigue. In addition, planned appropriate variation and periodicity throughout each training cycle are imperative.

- Discourage Warfighters from using caffeine and/or other stimulants that mask fatigue so they can endure excessive supplemental workouts and exceed appropriate workloads.

- Monitor closely for the emergence of overtraining signs and symptoms such as unusual fatigue and/or muscle soreness, musculoskeletal injuries, and rhabdomyolysis, and promptly refer for immediate medical evaluation with obvious indications of muscle breakdown, such as dark brown urine or severe muscle pain.

- Examine profile rates and other indicators of reduced performance capacity (*e.g.*, fitness test results, run times, persistent fatigue, and excessive muscle soreness) to provide insights into evolving overtraining.

Importantly, new research is critical to affirm or negate the purported undue injury risk from participating in ECPs and to clarify other modifiable contributing factors. Research and education priorities should include the following:

- Collecting comprehensive prospective injury surveillance data with broad representation from around the world from those participating in ECPs, including surrounding circumstances, potential contributing factors (*e.g.*, training status, fatigue, environment, nutrition/hydration), and impact on combat readiness for each injury;

- Assessing the physiological demands and biomechanical stresses of various ECPs and similar workout designs, as well as the efficacy and magnitudes of increase (or decrease) in key performance metrics (*e.g.*, functional strength, power, and endurance, agility, mobility); and

- Promoting evidence-based conditioning programs that are safe, effective, *and* attractive to Warfighters, so operational readiness is optimized and musculoskeletal injury risk is minimized.

Conclusions

Many strengths and weaknesses are inherent to ECPs. However, a measurable and costly increase in injury risk could arise when ECPs are performed inappropriately, with an anticipated consequent reduction in individual and unit operational and combat readiness when one or more injuries are sustained. Warfighters should approach and participate in any ECP with prudence, recognizing the limitations and challenges. Although innovative approaches

to military physical training should be encouraged, it is critical for these approaches to be consistent with accepted exercise prescription guidelines. Military leaders should ensure that their unit's physical training program is aligned with their Service's established and accepted training doctrine, as well as with position statements from recognized authoritative relevant organizations. Military leadership, in collaboration with health care providers and other scientifically trained clinical and fitness support personnel, also should responsibly, objectively, and comprehensively monitor and evaluate ECPs and all other conditioning programs to determine their strong points and pitfalls. The aim is to ultimately endorse, refine, or develop new safe, effective, *and* attractive, evidence-based conditioning strategies and programs for all personnel to meet their occupational and operational demands and expectations.

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