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VALIDATED PHYSICAL ABILITIES OF THE CALIFORNIA LAW ENFORCEMENT PATROL POSITION OF A LARGE SOUTHERN CALIFORNIA AGENCY

Disclaimer: The statements and opinions made here are those of the author only and are not in any way intended to necessarily reflect those of the Los Angeles Sheriff's Department (LASD), Human Performance Systems, NSCA, or California Commission on Peace Officers Standards and Training.

The previous *TSAC Report* article, "Occupationally Fit for Duty—What are the Physical Tasks of California Patrol Law Enforcement Officers?," explored research on physical tasks for law enforcement officers on a statewide basis. This article will explore this topic in three different areas. First, a review of the basic concepts of physical abilities as they apply to tactical athletes will form the basis for physical abilities applicable to California patrol law enforcement officers. Second, a more in-depth case study will illustrate a job analysis of a large southern California law enforcement agency that resulted in the identification and validation of occupational physical abilities. Input from subject matter experts on the level of importance of physical abilities of the patrol position was utilized. Lastly, implications for programming for this population will be discussed.

PHYSICAL ABILITIES

Physical abilities or constructs for a specific position or employment are observations of general physical performance. Identification of physical abilities that are job related is based on a job task analysis. In other words, a job task analysis is used to identify relevant physical abilities. The California Commission on Peace Officer Standards and Training (CA POST) conducted job and task analysis for California law enforcement officers assigned to patrol functions. These combined studies resulted in identification and validation of the types of physical abilities required of California peace officers assigned to patrol duties (3,7,11).

CA POST further defined physical fitness abilities as "components" in a 2015 student workbook for the Lifetime Fitness Learning Domain (2). These same terms can be interpreted as operative definitions for patrol-level law enforcement physical abilities (2):

- **Muscular strength:** The maximum force that a muscle can exert at one time (example assessments: one repetition maximum [1RM] bench press, 1RM squat).
- **Muscular endurance:** The ability of a muscle to do continuous work over an extended period of time (example assessment: maximum amount of push-ups in 1 – 2 min).
- **Power:** The ability of a muscle or muscle group to exert a maximum amount of force in the shortest period of time (example assessments: clean and press, vertical leap, and medicine ball put or throw).
- **Mobility:** The ease with which a joint or series of joints is able to move before being restricted by the surrounding structures. Joint mobility is determined by the ligaments, joint capsule, musculature, and size and shape of the bones within the joint.
- **Stability:** The ability of a joint or body region to withstand shock and movement without being dislocated or otherwise injured. Stability depends on a number of factors, including the strength of the ligaments that bind the bones together and the strength of muscles associated with the joint.
- **Flexibility:** The ability to move a body part (usually a joint or limb) through a full range of motion.
- **Acceleration and agility:** The ability to increase speed from static or after directional change, use quickness and readiness of movement, and change the position of the body with skill and control when faced with some sort of stimulus or opposing movement. Agility requires a combination of skills, such as coordination, speed, strength, and stamina. It is the union of dynamic balance under changing conditions and speed (example assessments: Illinois agility test and t-test).
- **Core:** The ability of the bodily region bounded by the abdominal wall, hips, glutes, lower back, and diaphragm to stabilize the body during movement (knees to mid-chest, front and back) (example assessment: abdominal curl-up).
- **Aerobic:** The ability of the heart, lungs, and blood vessels to deliver adequate amounts of oxygen and nutrients to working cells during prolonged physical activity—also known as aerobic fitness, cardiorespiratory fitness, and cardiopulmonary fitness (example assessments: beep test and 1.5-mi run).
- **Anaerobic:** Anaerobic training is shorter than aerobic training in duration (less than two minutes) and requires energy from anaerobic sources. Anaerobic energy sources enable the body to perform briefly near maximal muscular activity (example assessments: 40-yard dash and 300-m shuttle).

VALIDATED PHYSICAL ABILITIES OF THE CALIFORNIA LAW ENFORCEMENT PATROL POSITION OF A LARGE SOUTHERN CALIFORNIA AGENCY

CASE STUDY – JOB ANALYSIS AND RESULTING IDENTIFICATION OF PHYSICAL ABILITIES

The Los Angeles County Sheriff's Department (LASD) is the largest municipal sheriff's department in the world, with approximately 18,000 employees (about 9,000 sworn peace officers and 9,000 professional staff). The LASD provides law enforcement patrol services for over 40 of Los Angeles County's 88 incorporated cities, 90 unincorporated communities, 216 facilities, as well as various hospitals and clinics located throughout Los Angeles County. The LASD also provides police services to nine community college campuses, the Los Angeles Metropolitan Transit Authority, and 47 superior courts. Additionally, the LASD is responsible for the care and security of approximately 18,000 inmates on a daily basis in seven custody facilities, which include providing food and medical treatment (1). LASD deputies provide law enforcement services to over three million residents in an area covering more than 3,000 sq mi (8).

From 2007 – 2008, the LASD conducted a job analysis of the physical tasks of deputy sheriffs assigned to patrol operations. This study was similar in nature to the CA POST statewide analysis of California law enforcement patrol officer job demands and somewhat similar in process to the study methodology employed for the 2015 United States Army's task list Development of the Occupational Physical Assessment Test (OPAT) for Combat Arms Soldiers (10). The LASD patrol officer job analysis was completed by Human Performance Systems (HPS) and comprised of three main phases: task list development, a task inventory, and a physical demands/abilities inventory (6). All the steps followed industry standard processes for job analysis, evaluation, and validation (6).

PHASE ONE: TASK LIST DEVELOPMENT

The task list was developed via a preliminary review of known and listed job tasks, site visits, interviews with LASD patrol officers and subject matter experts (SME), observations, and ride-alongs. The patrol task list was finalized based on incumbent LASD SME input.

PHASE TWO: TASK INVENTORY

The task inventory was the next step with a goal of identifying essential physical tasks from LASD SME. The inventory included a physical task list, rating scales, and supplemental questions. A sample of 162 LASD patrol deputies used rating scales that addressed frequency, expectancy to perform, importance, and time spent on patrol deputy tasks. The sample of deputies had a mean age of 37.6 years (range = 27 – 56 years) and sample deputies worked in the patrol assignment for an average of 11.8 years (range = 1 – 25 years). Essential tasks were identified using an algorithm that included the frequency and importance of the tasks. Supplemental questions addressing ergonomic parameters related to task performance were also obtained in the task inventory.

PHASE THREE: PHYSICAL DEMANDS/ ABILITIES INVENTORY

The essential physical job tasks identified in phase two above were used to determine physical abilities required to perform essential tasks (third phase). A physical demands inventory (PDI) was used to link essential job tasks to essential physical abilities (6). This method provides a defensible approach in terms of the Equal Employment Opportunity Commission Uniform Guidelines of 1978 (5).

Physical tasks selected met the following criteria:

- The physical tasks had to have at least a moderate level of physical demand
- The physical task had to be representative of the patrol job and its unique factors
- The physical tasks needed to involve some physical ability (strength, endurance, power, aerobic or anaerobic capacity, etc.)

A mean rating of 3.5 or higher (on a 7-point scale) for the highest-rated one-half of the tasks was implemented as a decision rule to ensure inclusion of tasks where at least a moderate level of demand (importance) for the physical task existed. A mean rating of 3.5 or above indicated a moderate demand for the ability and a mean rating of below 3.5 indicated less of a demand for the ability (6). Table 1 lists the physical abilities along with mean ratings and standard deviations for LASD patrol-level tasks (6).

While aerobic capacity did not meet the above 3.5 mean rating rule, aerobic capacity was included based on past research related to the oxygen uptake required when pursuing and restraining individuals (6). Using the above data, a visualization of the LASD SME reported physical ability job demands of patrol deputies on a 1 – 7 scale can be found in Table 2.

The top four LASD SME rated physical abilities were:

- **Static strength (muscular strength):** single task, such as a lift, push, pull, or hold of objects over short time periods
- **Dynamic strength (muscular endurance):** repeated ability over a short time, such as a lift, push, or pull, as well as overcome resisting subject and/or over longer time periods
- **Anaerobic power:** 5 – 90 s of running to get to an emergency, assisting other deputies/pursuing fleeing suspects, running up/down stairs, and physically restraining a combative suspect after running
- **Explosive strength (power):** one second maximum force, leap, put, or throw (6)

The physical abilities of muscular strength and muscular endurance rated almost equally at a mean of 4.76 and 4.67, respectively, for the highest rated one-half of tasks. This means that LASD SMEs rated both muscular strength and muscular endurance as nearly equally important to accomplish validated patrol physical tasks.

LASD incumbents also responded to supplemental questions about working conditions and certain job tasks. While the supplemental questions provided in the 2007 – 2008 LASD study were not exactly the same as the three previous CA POST studies, a vast majority of the LASD incumbent responses further supported earlier CA POST data as to types of physical abilities, tasks, frequency, and criticality to the patrol officer position.

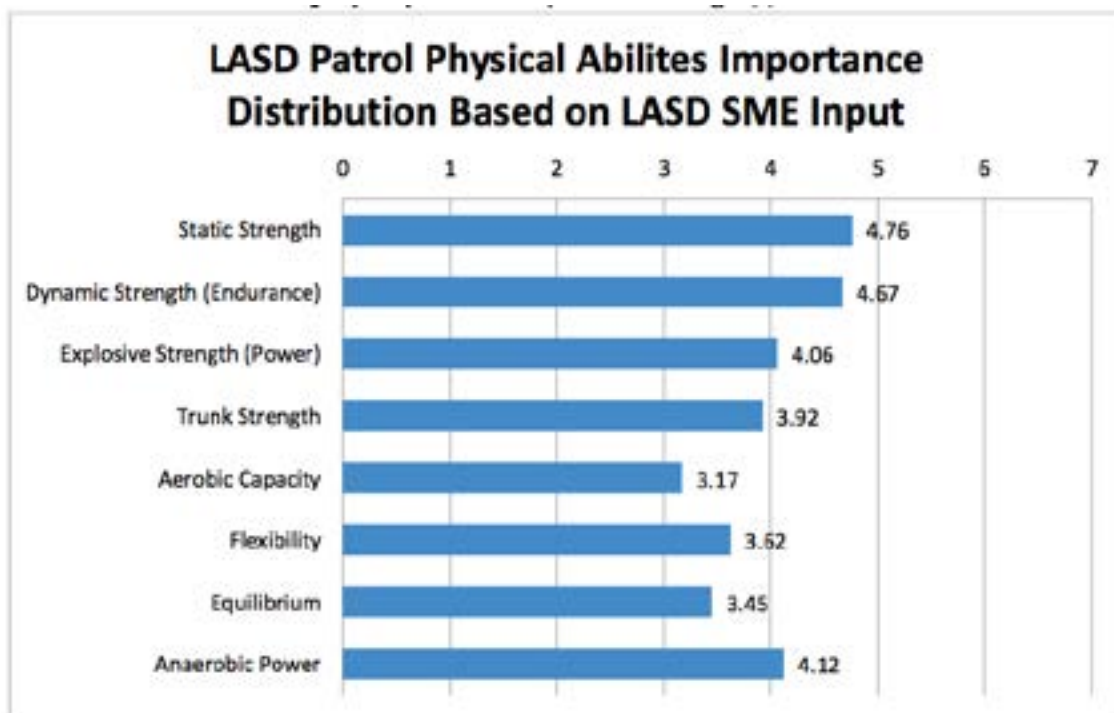
TABLE 1. LASD PATROL DEPUTY PHYSICAL ABILITY MEANS AND STANDARD DEVIATIONS FOR ALL TASKS (REPRINTED WITH PERMISSION FROM HUMAN PERFORMANCE SYSTEMS) (6)

Static strength (muscular strength)	4.76 (0.61)
Dynamic strength (muscular endurance)	4.67 (0.54)
Explosive strength (power)	4.06 (0.47)
Trunk strength (core strength)	3.92 (0.59)
Aerobic capacity	3.17 (0.65)
Flexibility	3.62 (0.20)
Equilibrium (stability), balance, or proprioception (example assessment: y balance test)	3.45 (0.33)
Anaerobic power	4.12 (0.73)

The physical abilities listed were the operative terms used for the LASD study as conducted by Human Performance Systems. Only mean ratings and standard deviations were available under agreement with HPS.

**SD = Standard deviation around the mean.*

TABLE 2. LASD PATROL DEPUTY PHYSICAL ABILITY MEAN RATINGS (6)



Scores in this table reflect the mean ratings by LASD SME of required LASD patrol physical abilities.

VALIDATED PHYSICAL ABILITIES OF THE CALIFORNIA LAW ENFORCEMENT PATROL POSITION OF A LARGE SOUTHERN CALIFORNIA AGENCY

CONSIDERATIONS FOR PROGRAMMING

High school, collegiate, and professional sport; military occupational specialty; and first responder roles all require the ability to perform physical actions. While a base level of physical ability is required across these aforementioned examples, certain jobs or roles within a given job may require a different distributions or ratios of a set of physical abilities. For example, while all football players require muscular strength, the strength and power needs and ratios differ between kicker and line positions or roles.

The same can be seen in military tactical athletes. While all combat personnel should be able to demonstrate basic levels of physical abilities, different roles likely demand a different distribution of physical abilities. For example, all military personnel require a measure of muscular strength and the ability to lift near maximal loads. Picking up an injured comrade, manipulation of heavy awkward equipment (e.g., bridging plates, mortar base plates, and tubes), and the ability to lift their own bodyweight when climbing and scaling (relative strength) serve as examples. Similarly, muscular endurance is vital for tasks that require multiple repetitions often with minimal rest. Examples of this include moving stores during a resupply task, area fortification (digging, setting up barriers, etc.), and mid- to long-term ruck marches to new positions.

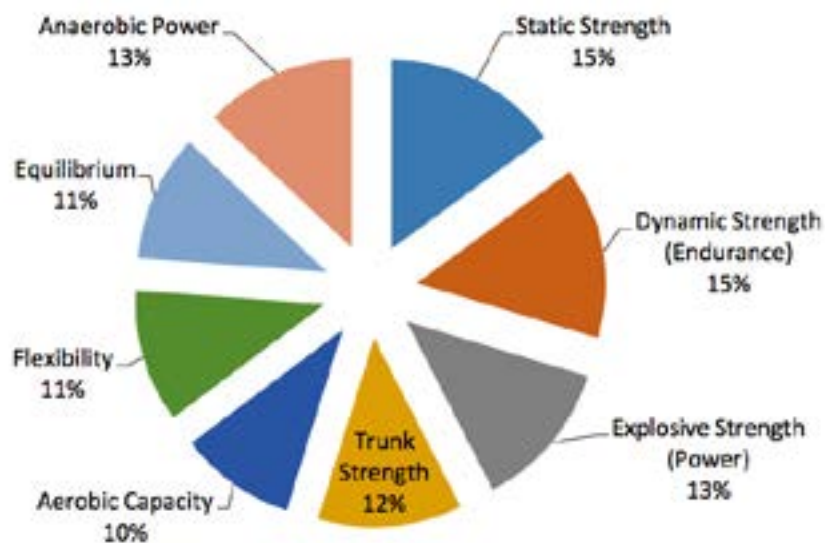
Generally, different military units can be expected to require a greater focus on one physical ability/characteristic over another. For instance, artillery and armored units may require greater elements of muscular strength as opposed to infantry and signal units, who may require greater levels of muscular endurance. Conversely, some units may require a similar distribution of both, like engineer units. Considering this, the relative requirements of

these characteristics can not only vary between units, but also within an individual units. For example, an infantry unit recon platoon requires muscular endurance for long duration lower limb loaded hiking to high points, while the same infantry unit's heavy weapons/anti-armor platoons require more muscular strength to carry very heavy weapons and ammunition for shorter distances.

Similarly, in law enforcement, this difference in occupational physical ability requirement can be seen in patrol, investigative (detective), Special Weapons and Tactics (SWAT), and other specialty positions. The LASD case study above provides a view of patrol-specific physical abilities informed by validated physical tasks. In the LASD study, static strength and dynamic strength were rated highly in the lifting, pushing, pulling, and holding-of-objects tasks. The tasks of lifting and carrying with assistance (not pulling or dragging) of resistive individuals, physically restraining a resistive subject with reasonable force without assistance, using a baton to defend against an attacking person, and physically restraining a subject after running, all received high mean ratings on the importance/demand scale. Both static strength and dynamic strength received high mean ratings for the listed activities.

In addition to the muscular strength and muscular endurance requirements of the LASD patrol assignment, the study also showed that anaerobic power is important to the essential physical tasks (6). The top anaerobic power events included running to get to an emergency, assisting other deputies/pursuing fleeing suspects, running up/down stairs, and physically restraining a combative suspect after running. Top explosive strength events in the LASD study included many of those listed in static and dynamic strength categories. Table 3 demonstrates the distribution or ratio of validated physical abilities of the patrol position from the LASD case study.

TABLE 3. LASD PATROL PHYSICAL ABILITIES IMPORTANCE DISTRIBUTION BASED ON LASD SME INPUT



While not specifically addressed individually as such in the LASD study, the three energy systems (phosphagen or adenosine triphosphate and phosphocreatine [ATP-PC], glycolytic, and oxidative) can be matched with SME identified patrol tasks along the lines of intensity and duration as seen in Table 4.

At times, incumbent officer identified essential physical tasks and ability ratings may not correspond to some training preferences or practices. As seen in *Self-Reported Physical Tasks and Exercise Training in Special Weapons and Tactics Teams*, incumbent officers rated power and strength (static strength) as the most important abilities for successful job performance. The same incumbent officers reported the top two areas of focus for their training programming as muscular endurance and cardiovascular/respiratory endurance (4). To increase the likelihood of improved physical occupational performance, physical training programming should be developed and implemented to mirror SME input for occupational abilities informed by validated physical tasks. To operate at the highest level possible, tactical athletes should train for the validated physical abilities applicable to their respective positions as identified by applicable SMEs.

QUESTIONS FOR FURTHER DISCUSSION

- Considering a specific population and the results of the job analysis, what are both the physical attributes that need to be trained along with the ratio for the job position?
- Using input from incumbent SMEs/respondents, what type of physical attribute or ability ratio is reflected in the physical demands of the tactical athlete position?

- Considering a validated and reliable job analysis, what might be the implications for programming?
- For example, does the job analysis data from incumbent SMEs reflect a greater emphasis on muscular endurance or muscular strength? Or is it more of an equal distribution of strength, power, endurance, stability, agility, mobility, flexibility, or some other combination?
- How closely does current programming reflect current job demands?
- What might be some programming beliefs or preferences that tactical facilitators use to interpret findings?
- How might the preferences or experiences of tactical facilitators impact programming decisions and actions?

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TABLE 4. LASD PATROL PHYSICAL ABILITIES, ENERGY SYSTEMS, ESSENTIAL TASKS, INTENSITY, AND DURATION AS IDENTIFIED BY LASD SMES

ENERGY SYSTEM/PHYSICAL ABILITY	TASK	INTENSITY	DURATION
Phosphagen/basic strength and power	Lift heavy object		
	Push/pull/hold heavy object		
	Forcible entry	High	Short
	Majority of foot pursuit of subjects (< 50 yards) Majority of arrest and control events (< 30 s) Victim drag (0 – 35 ft)		
Glycolytic/muscular endurance	High risk event patrol load carriage (daily patrol load plus rifle vest, helmet, and M4 carbine)	Moderate	Moderate
	Arrest and control event (30 – 120 s) Victim drag (> 35 ft)		
Oxidative/aerobic endurance	Normal patrol load carriage (daily patrol load of 14 – 30 lb)		
	Crawling/search Directing traffic, security support, and crime scene investigations	Low	Long

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CONSIDERATIONS FOR RUCK INJURY PREVENTION IN THE LOW BACK

INTRODUCTION

Load carriage over long distances (rucking) is a common mission necessary task required of many tactical athletes. Rucking consists of carrying a loaded backpack, or ruck, often over rough terrain for extended periods of time (10). This is a common task required of ground-based conventional military troops, special operation troops, border patrol, and many other government agencies. For military personnel, rucking with heavy loads (> 22 kg) may result in musculoskeletal injuries to the low back (4,10,14). These heavy loads, often in conjunction with unpredictable terrain features, can result in a greater risk for acute and chronic injuries (10,14).

Within the United States military specifically, training related injuries are currently the leading cause for lack of mission readiness (20). Additionally, spine pain accounted for approximately one quarter of all musculoskeletal injuries that occurred during combat, with 75% of the pain originating from the lumbar spine (4). This risk for low back pain is further increased by rucking. Back related injuries were the second most reported injury (after foot blisters) suffered during load carriage events (10). Back injuries, such as a herniated disc, can produce extremely debilitating pain, lifelong discomfort, and increased medical and insurance costs (4). However, by introducing an injury prevention program specifically for the low back, ruck related injuries may be reduced in tactical athletes (3,9,12,19).

As with many other movement-based skills, a well-planned resistance training program may reduce the prevalence and severity of injuries and ultimately improve mission readiness (3,8,9,12,17). While an excellent and detailed periodized training program was laid out by Thomas Rader that included general injury prevention considerations, additional specific considerations for low back injuries were not mentioned (13). Therefore, the aim of this article is to provide an example of a resistance training-based injury prevention program specific to reducing the risk of low back injuries while rucking. While equipment set up (specific ruck sack configuration and load placement), foot care (blister prevention, nail care, etc.), and other injuries are also crucial factors in relation to rucking performance, they are outside the scope of this article.

CONSIDERATIONS FOR LOW BACK INJURY PREVENTION TRAINING

When implementing an injury prevention program for low back injuries and pain, local musculature endurance should be addressed prior to any heavier load resistance training or rucking (1,2,3,4,8,11). Individuals suffering from low back pain in relation to

lumbar injuries often present decreased strength and endurance in back extensor muscles (1,11). To address the muscular endurance of the local back extensors, a modified low-intensity version of the deadlift may be utilized. Exercises such as a modified kettlebell or dumbbell deadlift (Figure 1) are performed with the weight placed between the legs and just behind the knee. A modified kettlebell or dumbbell deadlift places the load just behind the line of the knee. This may allow the tactical athlete to perform the exercise with safely correct lumbar spine position, properly recruit the back extensors, and reinforce positive motor patterns. Other useful back extensor exercises that can be progressively increased in load as local endurance develops are the 45° back extension (Figure 2) and reverse hyperextensions (Figure 3). Additional attention should be made to spine position throughout the prior two exercises in order to avoid excessive hyperextension, which could lead to injury.

Core strength development may also assist in preventing ruck related back injuries by strengthening the trunk musculature to oppose spinal flexion and rotation (2,8). Abdominal trunk stability, support, and endurance may be achieved with anti-rotation and bracing exercises, such as the Pallof press and side planks (Figure 4) (2). Heavy single-arm farmer's carries (Figure 5) may also assist in strengthening the trunk support musculature without causing excessive lumbar spine flexion or rotation, provided the tactical athletes is well coached and utilizes the correct carrying techniques.

Gluteal muscle strengthening has also shown to increase lumbar spine stabilization and can be improved through hip extension and abduction exercises, such as monster walks and glute bridges (Figure 6) (8,19). Progression can then be made to exercises, such as hip thrusts, with higher loads. As local endurance improves, heavy compound movements may be introduced to develop total trunk and gluteal strength (1,19). Strengthening of the posterior chain through deadlift training may help increase spinal stability and protection from injury (3). However, progression should only gradually increase on the deadlift with correct form and posture being of the utmost importance to avoid risk of injury.

INTRODUCING AN INJURY PREVENTION PROGRAM

The structuring of a low back injury prevention program is going to vary based on the tactical athlete's individual training history and abilities. As stated above, achieving adequate local muscle endurance should take precedence over strength-based training when addressing low back injuries (1,11). Exercise selection for the endurance cycle should include exercises that activate the postural musculature, core stabilizers, and glutes (1,2,3,19).

CONSIDERATIONS FOR RUCK INJURY PREVENTION IN THE LOW BACK

Recommendations for the development of muscular endurance include 2 – 3 sets of 12 or more repetitions with loads ranging from 30 – 65% one repetition maximum (1RM) with rest intervals of approximately 30 s (7,16). Additionally, time ranges of 20 – 30 s may be appropriate when utilizing isometric core stabilization exercises (2,8). A sample endurance layout can be seen in Table 1.

Once adequate muscular endurance is achieved, progression to appropriate strength training may occur (1,11). In the event that the tactical athlete has already achieved adequate muscular endurance, they may progress onto strength-based training. However, it should be noted that muscular endurance should be maintained throughout the strength training cycle.

The strength training cycle should primarily focus on movements that will continue to engage the musculature targeted during the endurance cycle. However, intensity should be progressively increased to achieve improvements in strength (7). General recommendations of 2 – 6 sets of 6 or more repetitions are adequate so long as a load intensity of 65% of 1RM or more is utilized (7,16). Greater improvements in strength have been seen when intensity increases to 80% of 1RM or more (7,16). Rest periods may vary from 1 – 3 min between sets, so long as adequate rest is achieved to put forth maximal effort to each exercise (15). In addition, use of the repetitions in reserve rating of perceived exertion scale (RIR-RPE) to select appropriate training load in place of the percentage based method may prove beneficial to tactical athletes in an attempt to autoregulate training, as rates of recovery and adaptation may vary between individuals (6,18,21). RIR-RPE is based on a 10-point scale with a rating of 1 being little-to-no effort and 10 being an all-out maximal effort (21). A sample strength layout can be seen in Table 2.

If it is within the tactical athlete's control, injury prevention training should be conducted separate from ruck-based training. Approximately 48 – 72 hr of recovery should be allowed between resistance-based training and rucking to maximize recovery and minimize the risk of sustaining a low back injury (7).

CONCLUSION

Given the high prevalence of injuries that occur during rucking, implementing an injury prevention program is paramount (4,10,12,14,20). However, until wide scale adoption of injury prevention programs occurs, it is up to the individual tactical facilitators or the tactical athletes themselves to implement these programs. Thus, by disseminating information on proper injury prevention training methods and reducing the risk of ruck-related back injuries, improvements to overall mission readiness can be had with minimal lost training time.

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TABLE 1. SAMPLE ENDURANCE TRAINING CYCLE FOR LOW BACK INJURY PREVENTION

EXERCISE	SETS	REPETITIONS	INTENSITY	REST INTERVALS
Modified Dumbbell Deadlift	2 – 3	≥ 12	30 – 65%	30 s
Back Extension (45 degrees)	2 – 3	≥ 12	30 – 65%	30 s
Pallog Press	2 – 3	≥ 12	30 – 65%	30 s
Side Plank	2 – 3	20 – 30 s	-	30 s
Glute Bridge	2 – 3	20 – 30 s	-	30 s

TABLE 2. SAMPLE STRENGTH TRAINING CYCLE FOR LOW BACK INJURY PREVENTION

EXERCISE	SETS	REPETITIONS	INTENSITY	REST INTERVALS
Deadlift	2 – 6	≤ 6	≥ 80% or 8 RPE	1 – 3 min
Glute-Ham Raise	2 – 6	≤ 6	≥ 80% or 8 RPE	1 – 3 min
Hip Thrust	2 – 6	≤ 6	≥ 80% or 8 RPE	1 – 3 min
Single-Arm Farmer's Carry	2 – 6	25 m	-	1 – 3 min

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FIGURE 1. MODIFIED DUMBBELL DEADLIFT



FIGURE 2. BACK EXTENSION (45 DEGREES)



FIGURE 3. REVERSE HYPEREXTENSION



FIGURE 4. PALLOF PRESS (TOP) AND SIDE PLANK (BOTTOM)



FIGURE 5. SINGLE-ARM FARMER'S CARRY



FIGURE 6. MONSTER WALK (TOP) AND GLUTE BRIDGE (BOTTOM)



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POLARIZED ENDURANCE TRAINING (PET) FOR CARDIOVASCULAR ENDURANCE OPTIMIZATION

The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or as reflecting the views of the NSCA, Army, or the Department of Defense.

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This article will review the latest in cardiovascular endurance training to help the tactical athlete optimize performance while maximizing safety and longevity.

Reviewing traditional endurance training models show that there are frequently three different types of models employed: 1) threshold/race pace (5K+), 2) high-volume/low-intensity, 3) high-intensity interval training. Threshold training is characterized by increasing intensity to a “hard” pace (rating of perceived exertion [RPE] of 15 – 16 on 6 – 20 Borg scale, or about 75 – 80% VO₂max) and maintaining this pace for the duration of the workout while progressively increasing the pace each week in a linear periodization model (5). High-volume training is characterized by long workouts at a very light intensity (RPE of 9 – 10 on 6 – 20 Borg scale, or about 45 – 50% VO₂max). High-intensity interval

training is characterized by interval workouts at a “very hard” (RPE of 18 on 6 – 20 Borg scale, or at ≥ 90% VO₂max) pace often on consecutive days with little to no long slow distance workouts and recovery (5).

An emerging cardiovascular endurance training model is Polarized Endurance Training (PET), a training regimen characterized by an undulating non-linear periodization model where the majority of training time is spent in long slow distance workouts. The PET model includes specific high-intensity workouts separated by one or more long slow distance workouts, with the exercise intensity tightly controlled. This dichotomous two-zone training model rewards maximal effort with optimal recovery. PET workouts are performed by exercising at a “light” (zone 1) intensity, interspersed with high-intensity interval workouts, with intervals at “very hard” pace (zone 3) with 2 – 4 min of rest. PET is most often characterized and optimized by little to no training at “hard” or race pace (zone 2) in any of the workouts (2,11,15). There is a growing body of scientific evidence supporting the use of PETs in performance enhancement and injury reduction compared to the three other mentioned traditional endurance training models (5).

Understanding what each intensity zone of the PET model looks and feels like is critical to following PET programming. Table 1 has definitions for endurance exercise intensity zones.

TABLE 1. DEFINITIONS AND PARAMETERS FOR TRAINING MODELS

DEFINITIONS OF EACH TRAINING ZONE			
PERCEPTUAL AND PHYSIOLOGICAL MEASURES	ZONE 1	ZONE 2	ZONE 3
Heart Rate	< 140 bpm	140 – 175 bpm	> 175 bpm
RPE Scales	≤ somewhat hard	hard	≥ very hard
Ventilatory Threshold (VT)	≤ VT1	VT1 to VT2	≥ VT2
Talk Test (TT)	Full conversation/sing	Choppy conversation	Few words if any
Common Nomenclature	“Recovery pace”	“Race pace” (5K+)	“High-intensity interval”
PERCENT TIME SPENT IN EACH ZONE PER WEEK FOR TRAINING REGIMENS			
TRAINING MODELS	ZONE 1	ZONE 2	ZONE 3
Polarized	75 – 80%	0 – 10%	15 – 20%
Threshold (race pace)	50 – 60%	40 – 60%	0%
High Volume (low intensity)	100%	0%	0%
High-Intensity Interval	50%	0%	50%

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As described earlier, tactical athletes often have to “play catchup” with their fitness because of detraining occurring from operational missions, injuries, or time off from duty (4). PET training can also benefit well-trained individuals who often hit plateaus in their cardiovascular endurance performance as measured by maximal one or two-mile run time. However, this plateau may be more a function of a sub-optimal distribution of training intensity rather than reaching the top of an individual’s training potential. For example, high-intensity interval training (zone 3) may be a critical component to improving fitness levels quickly for a FFD test in already trained individuals (17). However, extensive time training at “hard” or race pace (zone 2) can nullify gains resulting in tactical athletes overtraining particularly in the immediate time leading up to their semi-annual FFD test (9). Proper physical readiness is required to reduce training injuries leading up to the tactical athlete’s FFD test. Simplifying exercise bouts into two training zones can lead to optimizing performance gains for the next test while minimizing risk of injury that may result due to overtraining. The actual fitness test, wherein athletes often reach maximal effort not encountered during typical physical readiness training sessions, may also result in injury. Therefore, tactical athletes should seek efficient and effective physiological training and testing techniques (18).

Much like strength training has defined training intensity by using a percentage of a one-repetition maximal lift or maximal repetitions for a given weight, endurance training has defined zones that can be used to optimize performance gains. In the past, a percentage of VO_2 max or percent maximal heart rate has been used to help set up these training zones. However, using percent maximal heart rate alone may not be the best option for prescribing exercise intensities because heart rate is controlled by several physiological systems, such as central motor drive, thermoregulation, blood volume, and blood pressure, and because important metabolic thresholds occur at different points relative to an individual’s maximal aerobic ability (1,14). Instead, anchoring training zones to physiological parameters related to metabolic demands, such as ventilatory thresholds or ideally blood lactate levels, have been shown to be more optimal (3,15). Although blood lactate monitoring might not be possible for many tactical athletes, employing RPE (muscle soreness, fatigue, and perspiration) and paying attention to ventilation rate (ventilatory threshold and breathlessness, as measured by the talk test), in conjunction with the utilization of a heart rate monitor, should be accurate enough to optimize an endurance training program (12,13,15).

STAYING WITHIN EXERCISE INTENSITY ZONES

The most difficult part about following a PET program may be in preventing intensity creeping up from zone 1 into zone 2 during long, slow distance workouts. This often occurs when platoons, squads or teams go for group runs where there are various

endurance ability group levels running together. Here, top runners might be working in zone 1, but 50% or more of the lower ability runners are pushed up into zone 2 and have a blunted adaptive response to the physical training session as they are running too hard on a day that was meant for slow recovery. Ideally, platoons/squads/teams should be split up into homogeneous ability groups (fast, moderate, and slow), based on their most recent cardiovascular endurance test (two-mile run) (7).

Below are two examples of how one might integrate several physiological variables to assess if they are within training zone 1.

In example one, a well-trained individual trying to conduct a zone 1 workout, finds his/her heart rate monitor reads 135 beats per minute (bpm), while the other physiological parameters indicate that he/she is breathing hard and not able to speak easily, sweating profusely, with some light muscle pain/burn/discomfort, and reports an RPE of 15 (hard) despite it being a temperate environment. Perhaps a heart rate of 135 bpm is zone 2 for this person. Most likely the individual needs to reduce the exercise intensity such that his/her heart rate averages 125 bpm during zone 1 training. This will provide an optimal recovery workout and may help avoid overtraining. Understanding that heart rate varies between tactical athletes for both relative and absolute training intensities, we can see how monitoring respiration and RPE can help to adjust training to the proper level for this individual.

In example two, a detrained individual coming back from an injury is performing a workout in zone 1. His/her heart rate monitor reads 145 bpm, but has the ability to converse easily, even joking about last night’s playoff game, is not sweating profusely or complaining of any muscular discomfort, and states they have an RPE of 9 despite it being a little warm out. This individual is most likely still in zone 1 and can continue training at the current pace.

The above two examples portray the complexity of maintaining zone 1 pace for rest/recovery days, especially in group training environments. However, high-intensity (zone 3) training may be more ideally suited for platoon and team based training. By definition, training in zone 3 is performing interval training where the intensity is well above race pace, and might be found approaching VO_2 max or higher (5). Sprinting/performing intervals for 5 s to as long as 5 min, with long rest periods of 1 – 8 min is ideal for these high-intensity workouts. Similar to zone 1 workouts, the most difficult part about zone 3 workouts, is staying out of zone 2. Dropping down into zone 2 can be a result of either lack of intrinsic motivation or insufficient recovery time between intervals (< 1 min), studies have reported optimal recovery to be around 2 min for high-intensity intervals (8,16). Both of these limitations regarding high-intensity intervals can be overcome by utilizing team-based training, where rest periods are enforced and

by making intervals fun, competitive, and rewarding, resulting in maximal/appropriate effort given in each interval.

The following are some example team workouts that can make these difficult workouts fun:

- **Relay Race:** Have 3 – 6 tactical athletes per team, where the interval length is about 45 s. The first to finish five rounds wins.
- **Chase Race:** Event time is two minutes in duration. The team is lined up from low to high ability runners and released in five-second intervals. If one catches/tags the person in front of them, the caught individual has to move his/her physical training (PT) belt from over the shoulder to around the waist. After three races the last tactical athlete with the belt over their shoulder wins. The key to setting this competition up is to give a favorable handicap to the lower ability runners, such that they have a real chance at outperforming the high ability runners, but make it close.
- **File Runs:** The whole team jogs easy in a line and the last person sprints from the back to the front of the line. Make sure the high ability runners slow down and keep the pace reasonable so that while the sprint portion of the interval is in zone 3, the jog/recovery portion stays in zone 1.
- **King of the Mountain Sprints:** Tactical athletes sprint uphill for 30 s and walk back down together. This exercise may also be broken up into ability groups. The individual that makes it the farthest up the hill in 10, 20, 30, 45, or 60 s is the “king of the mountain.” To increase the competitiveness and to push the lower and/or higher ability runners, staggered starting points on the hill and start/stop on a whistle could be included.

PLANNING THE WEEK

Table 2 is an example of how to potentially plan out two different weeks of training (one normal work week and one traditional Monday holiday week). It should be noted that this is a prototypical-training program, which should be adjusted for an individual’s or group’s ability level. In general, it is best to perform interval training when well rested. Tactical athletes should utilize zone 1 (long, slow distance) training as breaks between more intense interval days and resistance training. When ramping up to higher intensity workouts, tactical athletes can reduce injury risk through progressive overload, providing adequate rest days between high-intensity/high-impact workouts, proper footwear, and avoidance of high-mileage training (6).

SUMMARY

There is growing evidence that PET is a promising method for optimizing a tactical athlete’s cardiovascular system, preparing quickly and safely for FFD physical performance tests, allowing for a more full recovery during deployment and safer return to duty after injury or deployment fitness levels (3,9,10,15,17,19). The scope of this article does not fully discuss individual (e.g., fitness level, gender, age) and environmental (e.g., thermal, altitude) differences that shift the absolute training zones (e.g., speed, power) relative to maximal capacities. Because heart rate increases linearly with exercise intensity, general guidelines for heart rates to define training zones may not apply to very fit or unfit individuals. However, the use of the ventilatory thresholds, RPE, and the talk test allows for more individualized training zones based on those known individual and environmental differences. Staying within zone 1 is critical during long, slow distance workouts, as studies have shown blunted run time performance adaptations from performing too much training in zone 2. Individuals should use

TABLE 2. TWO EXAMPLE WEEKS OF POLARIZED ENDURANCE TRAINING (PET)

WEEK TYPE	MON	TUES	WED	THURS	FRI	SAT	SUN
Typical	Zone 3 intervals (4 sets, 1 min exercise, 3 min rest)	Zone 1 LSD (20 min)	Strength training (2 sets, 8 – 12 reps, 8 exercises)	Zone 3 intervals (9 sets, 0.5 min exercise, 2 min rest)	Zone 1 LSD (25 min) and dynamic stretching	Strength training (2 sets, 8 – 12 reps, 8 exercises)	Recreational
Holiday	Off	Zone 3 intervals (6 sets, 1 min exercise, 3 min rest) and strength training (2 sets, 8 – 12 reps, 8 exercises)	Zone 1 LSD (25 min) and dynamic stretching	Zone 1 LSD (30 min)	Zone 3 intervals (10 sets, 0.5 min exercise, 2 min rest)	Strength training (3 sets, 8 – 12 reps, 8 exercises)	Recreational

Long, slow distance (LSD) workout intensities are conducted in zone 1 and are listed in minutes. Interval workouts are delineated by sets, time spent in zone 3 (exercise interval length in min), followed by the rest interval time spent in zone 1 (rest length in min).

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both physiological and performance measures, such as speed, perceived exertion, heart rate monitors, and ventilation rate or talk test to prevent the intensity increasing from zone 1 to zone 2. Thus, platoon/group/team runs for zone 1 training must be paced such that all runners are in zone 1. Additionally for zone 3 training, utilizing supportive team environments can facilitate motivation and effort during the high-intensity intervals and provide enforcement of an approximately two-minute recovery between intervals. When ramping up to the next endurance FFD tests or return to duty remember: “enjoy zone 1, avoid zone 2, and get after it in zone 3,” (5).

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BUILDING STRENGTH IN THE FIRE ACADEMY— SAMPLE TRAINING PROGRAM FROM PERSONAL PERSPECTIVE

“Hey, recruit! Go do push-ups until you’re tired.” For a long time, this is how we checked the physical training (PT) box at our fire academy, and I am certain we were not the only ones. Formation runs and calisthenics have historically been the foundation of basic PT across the entire tactical spectrum. Recently, at least in the northern Virginia area, many programs have shifted to a functional training model intended to more closely resemble the metabolic demands of operating at a fire. Bodyweight exercises and other low-intensity, high-volume work in circuit style training is the new norm. While these are an improvement over the classic model, it still leaves a programming void in developing the strength and movement mechanics these tactical athletes need to perform their jobs well and safely.

INJURY REDUCTION

Fire departments attract all sorts of people. Our most recent academy class was composed of Division I athletes, fitness enthusiasts, reformed cubicle dwellers, technology professionals, and everyone in between. Most of our candidates, regardless of their physical condition, have never had formalized strength coaching. These individuals have likely never been taught the proper mechanics of movement or performing lifting tasks: both key components of successful firefighting. Over the course of a normal 24-hr shift, a firefighter may be called upon to lift several obese patients from the floor, force entry through locked doors with hand tools, lift and place 80+ lb extension ladders, and use heavy hydraulic tools to cut open a wrecked car. All of these complex movements, especially if performed incorrectly and/or repeatedly, can result in serious injury. Firefighters must be trained on the proper body mechanics to do their job duties safely and effectively, and the academic areas of the course do not cover it adequately.

The bodyweight and low-intensity “functional” training programs fall short in both teaching and reinforcing proper mechanics. With minimal loads, athletes can sometimes get by without using proper technique and never notice that something is not right. However, that is typically not the case when attempting to pick up a 400-lb patient from the ground. Through a proper resistance training progression, we can first teach the movements and then program increased intensity as the athletes become stronger and more competent with the techniques. The result is stronger athletes with a lower risk of musculoskeletal injuries throughout their careers, which are an all-too-frequent occurrence (2).

STRENGTH DEVELOPMENT

Firefighters do not need a powerlifting total of 1,500 lb and to be able to run 1.5 mi in 9 min to be good at firefighting. In fact, at some point they may reach a point of diminishing returns if too much progress is made in any one training discipline; the training must match the demands of the job. (2) Squatting 900 lb is great, but firefighters who can do that may not necessarily be able to advance a charged hose to the second floor of a house with the required quickness. Alternatively, elite endurance athletes with less muscle mass and fewer type 2 muscle fibers may struggle to breach a heavy metal door with hand tools in full personal protective equipment (PPE). Ultimately, firefighting requires a high level of strength; that is, strength relative to the body mass of the tactical athlete in turnout gear and to the strength demands of the job functions. Firefighters must be able to manipulate themselves, a victim, and a complement of tools over, around, up, down, and through whatever obstacles are encountered in a burning building. They additionally must be able to accomplish the basic job functions of positioning ladders, stretching hoses, using hand tools, and maneuvering other heavy equipment. For these reasons, firefighters must acquire adequate levels of muscular strength. This strength cannot be gained from low-intensity, high-volume circuit training (2).

CAREER FITNESS

Recruits are only recruits for so long. In our department, the academy is about six months in duration. After that, they are released into the field and much of their physical training is left up to them. Our goal is for the academy experience to give them the skills to visit their local gym on off-duty days or use the facilities at work in a safe and effective manner. A strength training program may be able to improve body composition and abilities, as well as provide a sense of pride in their accomplishments. Our intention is for this to carry the recruits into the field ready, able, and willing to continue their development. Through education on resistance training fundamentals and practice, we set our new hires up for a career of successful strength and conditioning development.

BUILDING STRENGTH IN THE FIRE ACADEMY— SAMPLE TRAINING PROGRAM FROM PERSONAL PERSPECTIVE

THE PROGRAM

The fire academy, as it is organized in ours and many other jurisdictions, lends itself well to a comprehensive strength and conditioning program. Below is an outline of the way in which we have chosen to attack it. This is just a framework and it should be understood that the key component of any program for a recruit academy is flexibility. Unexpected events arise and the PT schedule is often the first piece of the day to be affected.

The academic curriculum first covers the EMT course, which is much less physically demanding than the later firefighting portion. Given the amount of time we have with the recruits and our assumption that each is beginning with a training age of zero, this facilitates a linear periodization model where the beginning of the live fire portion in the final month of the fire class serves as the in-season phase. Since many of our hires have no resistance training experience and low relative strength, we begin by developing general strength and conditioning with basic barbell movements (e.g., bench, squat, deadlift) and interval running. Then, as the academy continues, we develop more “metabolically specific” firefighting adaptations.

Our academy is designed to handle 32 recruits in each class, but our physical training staff and gym facility are not. To work around this, we split the class into two “platoons,” each with its own programming schedule. Platoon 1 and Platoon 2 use the weight room on an alternating “A/B” schedule for much of the academy. Days not in the weight room are spent performing anaerobic conditioning, interval running, or recovery/mobility activities.

The six-month academy is broken into six mesocycles ranging from 2 – 6 weeks in length. The recruit academy is held five days a week and PT is performed each morning. Although we have a dedicated block for PT each day, time is still extremely valuable in the academy and our sessions must be both effective and efficient. We aim for 60 – 75 min per session.

WARM-UPS, CORE WORK, AND MOBILITY DAYS

Each session begins with a general dynamic warm-up followed by a shorter specific movement preparation tailored to the training for the day. Generally, skips, jumps, and crawls will be followed by exercises such as kettlebell swings and goblet squats for a deadlift day. We lead warm-ups for the first couple weeks, but after that we will transfer the responsibility to the recruits.

We follow a similar model with the core work days. Our intention is to engage the recruits’ minds with leadership roles in the workouts. We want them to understand why certain things are done, not just how to follow the whiteboard. A popular core workout is one where the recruits each take turns calling out an exercise and a number of repetitions for a few rotations through the group.

Mobility days start with the same dynamic warm-up, followed by a light jog or row. The recruits then proceed through several rounds of stretching, foam rolling, accessory muscle work (e.g., neck, rotator cuff, grip strength, hip flexor), and end with a cooldown.

PHASE 1: INTRODUCTION (TWO WEEKS)

The first two weeks of PT are spent in an introduction phase where recruits learn the mechanics of our big three lifts: the bench press, back squat, and deadlift. The loading is minimal and many movements are accomplished with bodyweight, kettlebells, or an unloaded barbell. We focus on mechanics, mobility, establishing a work ethic, and determining the experience level of each recruit. We also perform a movement screening based on firefighting requirements, rather than use the generic Functional Movement Screening™ (FMS). Our evaluation is equal parts assessment and education. We want to identify baseline movement deficiencies, but also begin the process of demonstrating and teaching good technique. Each portion is demonstrated with coaching cues, and the recruits complete the movement for assessment. Our evaluation includes: pro agility drill, 20 in. step drop, push-up, lunge, shoulder extension and flexion, hip flexion, firefighting search posture, core stability, and lifting mechanics.

TESTING (ONE WEEK)

Week three consists of one-repetition maximum (1RM) testing for the bench press, back squat, and deadlift. Despite varying opinions on the 1RM, we have had great success and no injuries using it. We carefully monitor the assessment, have more than enough spotters, and only let the recruits attempt lifts they can accomplish with sound mechanics. We use the strength training results for programming and this gives us an opportunity to examine the exercise mechanics of the recruits under load. Cardiovascular conditioning is tested with our monthly physical fitness test (PFT), which includes an 800-m run, timed push-ups, timed sit-ups, and max effort pull-ups.

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PHASE 2: MUSCULAR ENDURANCE AND HYPERTROPHY (FOUR WEEKS)

With phase two, we begin the resistance training programming with the goal of adaptations in muscular endurance and hypertrophy. Each week has two resistance training days and a day for each of the following: 400-m interval running, mobility training, and high-intensity interval training (HIIT).

TABLE 1. EXAMPLE OF PHASE 2 MICROCYCLES IN A FIREFIGHTER ACADEMY PHYSICAL TRAINING PROGRAM

PHASE 2	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Platoon 1	Resistance training	Recovery	Resistance training	Anaerobic conditioning	High-intensity interval training
	Back squats Bench presses Core training	Mobility day	Deadlifts Pull-ups Core training	5 x 400 m with 400-m recoveries	Varied circuit training For example, a workout might look like: 5 rounds in bodyweight and 5 rounds in PPE and SCBA: Start from prone 5-m move 12 step-ups (20 in.) 5-m move 10 prone to kettlebell over head 5-m move 15 kettlebell swings
Platoon 2	Anaerobic conditioning	Resistance training	Recovery	Resistance training	High-intensity interval training
	5 x 400 m with 400-m recoveries	Back squats Bench presses Core training	Mobility day	Deadlifts Pull-ups Core training	Varied circuit training For example, a quick workout might look like: 8 rounds in bodyweight and 8 rounds in PPE and SCBA: (30 s on/15 s off) Push-ups Bodyweight squats Planks Kettlebell swings

Resistance training protocols:

- Week 1: 3 x 10 at 67% 1RM with 90 s rest
- Week 2: 3 x 12 at 67% 1RM with 90 s rest
- Week 3: 3 x 10 at 70% 1RM with 60 s rest
- Week 4: 3 x 12 at 70% 1RM with 60 s rest

BUILDING STRENGTH IN THE FIRE ACADEMY— SAMPLE TRAINING PROGRAM FROM PERSONAL PERSPECTIVE

PHASE 3: STRENGTH TRANSITION (FOUR WEEKS)

The third phase seeks to balance the hypertrophy work with initiation of basic strength development. For this we use the 5 x 5 protocol 2 – 3 days per week. The other days consist of interval running or rowing, agility and simple plyometrics, and mobility.

TABLE 2. EXAMPLE OF PHASE 3 MICROCYCLES IN A FIREFIGHTER ACADEMY PHYSICAL TRAINING PROGRAM

PHASE 3A – WEEKS 1 AND 3	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Platoon 1	Resistance training	Total rest	Resistance training	Anaerobic conditioning	Resistance training
	Bench presses Back squats Core training	Mobility day	Deadlifts Pull-ups Core training	Run intervals 6,1,1,2,2,3,3,3,2,2,1,1,6 (min off, min on, etc.)	Back squats Bench presses (85% of Monday loading)
Platoon 2	Anaerobic conditioning	Resistance training	Total rest	Resistance training	Anaerobic conditioning
	Run intervals 6,1,1,2,2,3,3,3,2,2,1,1,6 (min off, min on, etc.)	Bench presses Back squats Core training	Mobility day	Deadlifts Pull-ups Core training	Agility and simple plyometrics 800-m
PHASE 3B – WEEKS 2 AND 4	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Platoon 1	Anaerobic conditioning	Resistance training	Total rest	Resistance training	Anaerobic conditioning
	Run intervals 6,1,1,2,2,3,3,3,2,2,1,1,6 (min off, min on, etc.)	Bench presses Back squats Core training	Mobility day	Deadlifts Pull-ups Core training	Agility and simple plyometrics 800-m
Platoon 2	Resistance training	Total rest	Resistance training	Anaerobic conditioning	Resistance training
	Bench presses Back squats Core training	Mobility day	Deadlifts Pull-ups Core training	Run intervals 6,1,1,2,2,3,3,3,2,2,1,1,6 (min off, min on, etc.)	Back squats Bench presses (85% of Monday loading)

Resistance training protocols:

- Week 1: 5 x 5 at 75% 1RM and 2 min rest
- Week 2: 5 x 5 at 80% 1RM and 2 min rest
- Week 3: 5 x 5 at 80% 1RM and 2 min rest
- Week 4: 5 x 5 at 85% 1RM and 2 min rest

PHASE 4: STRENGTH AND POWER DEVELOPMENT (TWO WEEKS)

The resistance training protocols in phase four shift to adaptations in absolute strength, and plyometrics are programmed with much greater frequency. Each resistance training day includes a main/core lift, accessory exercises for that lift, and complementary plyometrics. We perform the big lifts first, followed by the accessory lifts, and then the plyometrics. For instance, the squat day may include back squats, step-ups, explosive lunges, and broad jumps.

PHASE 5: PEAK STRENGTH AND POWER (TWO WEEKS)

Phase five will be the last before the hardest physical portion of the academy (in-season), so the resistance training intensity will peak during this cycle. We use the same resistance training schedule as the fourth phase and will still include the accessory lifts and plyometrics with each session. The loading goals are 100% and above of their 1RM results from the testing in the first phase. At this point in the program, recruits should have made substantial strength gains, particularly those who had not previously been on a strength training program. Increases of 5%, 10%, and 20% or more of their former 1RM are very likely to occur at this point.

PHASE 6: MAINTENANCE/IN-SEASON (SIX WEEKS)

Phase six comes in as the live fire portion of the academy begins. Live burn evolutions, a week of firefighter survival, a week of technical rescue classes, and a 24-hr training day serve as the in-season portion of the academy for our recruits. In this phase, the PT schedule becomes extremely fluid and we are lucky to get the recruits into the gym three days per week. We aim for at least one resistance training day, an interval training day in full PPE and self-contained breathing apparatus (SCBA), and a mobility day. We also do sport-specific practice for their upcoming work performance evaluation. Recruits are also encouraged to focus on mobility during any downtime throughout the day, although by this portion of the academy there is usually not much time available.

TABLE 3. EXAMPLE OF PHASE 4 MICROCYCLES IN A FIREFIGHTER ACADEMY PHYSICAL TRAINING PROGRAM

Platoon 1 and 2	Resistance training	Anaerobic conditioning	Resistance training	Recovery	Resistance training
	Back squats	800-m intervals	Bench presses	Mobility day	Deadlifts

Resistance training protocols:

Week 1: 5 x 3 at 90% 1RM and full recovery

Week 2: 6 x 2 at 95% 1RM and full recovery

TABLE 4. EXAMPLE OF PHASE 5 MICROCYCLES IN A FIREFIGHTER ACADEMY PHYSICAL TRAINING PROGRAM

Platoon 1 and 2	Resistance training	Anaerobic conditioning	Resistance training	Recovery	Resistance training
	Back squats	800-m intervals	Bench presses	Mobility day	Deadlifts

Resistance training protocols:

Week 1: 4 x 2 at 100% 1RM and full recovery

Week 2: 3 x 2 at 105+%* 1RM and full recovery

**105+% 1RM indicates that recruits should now be capable of exceeding their 1RM as tested during Phase 1.*

BUILDING STRENGTH IN THE FIRE ACADEMY— SAMPLE TRAINING PROGRAM FROM PERSONAL PERSPECTIVE

IT HAS WORKED FOR US

We have had a lot of advantages in redefining our approach to PT. We had the support of the training division leadership, adequate funding to purchase necessary equipment, and a rapidly growing department that is hiring and training nearly 60 members annually. We took the gifts we were given and ran with them, completely re-outfitting our facility to support a strength and conditioning program and rethinking the way physical training would be presented in the academy. We removed the malicious undertones of morning PT and redefined it as a part of the recruits' overall training—not just a tertiary part of academy life. The goal of each training day is to make them as physically fit for firefighting as we can, and for them to enjoy doing it.

This program has produced incredible results for our department. Our main department metric for measuring firefighter fitness, the work performance evaluation, is a 10-station test in full PPE and SCBA gear. The minimum passing time for the test is 10:47 and our last academy had a 100% pass rate with an average time of less than six minutes. We have seen impressive gains in 1RMs and steady improvement in PFT scores. Our recruits graduate motivated and in-shape. We have also not had any reportable injuries as a direct result of the strength and conditioning program.

CONCLUSION

Firefighting is physically demanding and for a long time we have done a poor job preparing our people for its challenges. Injury prevention, education, and the ability to do the job well are all the reasons why we should be starting at the basic training level with strength and conditioning. Through a well-designed resistance training program, recruits can gain the movement skills, confidence to exercise, and foundational strength/physiological adaptations that they need for a long and healthy career.

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TSAC RESEARCH REVIEW

MILITARY POLICE, BOTH TRANSIT POLICE AND SPECIAL OPERATIONS POLICE, LOSE PHYSICAL FITNESS OVER TIME IN SERVICE

Jarbas Rállison Domingos-Gomes and colleagues recently published results of a study in which they examined and compared the health-related physical fitness (HRPF) of 22 transit police personnel and 25 special operations police personnel from the Brazil Military Police (3). The study also assessed the impact of time in service on HRPF of both groups (3).

The transit police and special operations police differed significantly only in relation to flexibility, measured with a sit-and-reach test, which was 22% greater in the special operations police (3). They were similar in terms of dynamic strength, localized muscle endurance, maximum 20-m shuttle run speed and relative $VO_2\text{max}$, with the latter averaging a very reasonable 43 – 46 ml/kg/min (3). Both groups were typically overweight, based on average body mass index (BMI) measurement of 27 – 28 kg/m² (3). They also had an average waist circumference of 93 cm and an average body fat percentage of 20 – 21% (3).

Notably, in both groups, there were moderate correlations between length of service and measures of HRPF, including waist circumference, body fat percentage, dynamic strength, localized muscle endurance, and relative $VO_2\text{max}$ (3). As length of service increased, each of these indicators of HRPF deteriorated (3). Additionally, all of these changes in HRPF were more pronounced in the transit police group (3).

The authors concluded that the more significant deterioration in HRPF measures over time observed in transit police may be due to differences in activity levels related to the respective occupational roles (3). In particular, they suggested that transit police may spend more time in sedentary activities compared to the special operations police. They additionally noted reductions in HRPF levels give rise to a heightened injury risk, which may reduce efficiency and professional performance in the job, both of which are concerns of particular importance to police officers who have been in the job longer (3). Their recommendation was the implementation of a physical training program designed to improve HRPF and hence occupational performance in these military police (3). For the tactical facilitator, this study serves as a reminder of the importance of why personnel need to maintain their fitness levels through regular and appropriately designed exercise, across their career-span.

ARMY 1-1-1 FITNESS ASSESSMENT RESULTS HAVE UTILITY FOR ESTIMATING RISKS OF ACUTE AND OVERUSE INJURIES IN TRAINEES

JoEllen Sefton and colleagues, discussed the challenges for personnel readiness that musculoskeletal injuries (MSI) create for military forces in a recent research publication (5). They also noted that, while a range of screening methods are being developed to help identify military trainees at greater risk of MSI so that they can receive tailored preparatory exercise interventions, many of these screening tests require specialized personnel, systems, or equipment to be implemented (5). Sefton and colleagues therefore sought to examine whether the United States Army 1-1-1 fitness assessment could be used as a MSI screening tool, noting that this test is comprised of maximum push-ups in one minute, maximum sit-ups in one minute, and time required to run one mile (5). It can also be implemented without any specialized equipment, systems, or personnel (5).

The results of the study by Sefton and colleagues, which involved 1,788 male Army trainees undertaking one of several training programs, indicated that overuse injury risk increased in Army trainees as their one-mile run time increased (5). Furthermore, acute injury risk increased with one-mile run time and with decreasing scores on a FitSum, which is the sum of maximum push-ups in 1 min and maximum sit-ups in 1 min (5). While they acknowledge that these findings were mostly not unexpected, Sefton and colleagues took the application of these results a step further, creating a Microsoft Excel® spreadsheet (which can be found as supplementary material at: <http://dx.doi.org/10.4085/1062-6050-51.9.09.S1>) to automate the calculation of risk scores (or probabilities) for both acute and overuse MSIs in Army trainees from a number of different training programs (5).

A note of caution is warranted here, as the authors note that the probabilities of any individual trainee with specific Army 1-1-1 test scores suffering an overuse or acute MSI are influenced by the training program they are undertaking (5). Additionally, different training programs have different overall rates of injury (5). In this instance, the authors determined the MSI risks for each of several different training programs, but it should be noted that other programs may have different rates of injury to those observed by Sefton and colleagues and this might impact on the accuracy of any risk estimates based on the spreadsheet (5).

Nevertheless, this article and the supplementary spreadsheet constitute a good practical example of how statistical modelling can be utilized to develop simple screening tools to use in the field to assess risks of MSI (5). In addition, where training programs

and populations are similar to those described by Sefton and colleagues, the MSI risks predicted by their spreadsheet based on Army 1-1-1 test results may be reasonably good estimates of actual MSI risks (5). Perhaps of greatest importance for the tactical facilitator, this article provides further evidence that adequate aerobic fitness and muscular endurance are essential in the quest to reduce injury risks in tactical athletes, and this should provide further impetus for well-designed strength and conditioning programs that are tailored to the individual and their assessed conditioning deficiencies (5).

HEAT EXPOSURE AND DEHYDRATION: WHICH HAS THE GREATEST IMPACTS ON CORE TEMPERATURE, MOOD, AND VISUAL VIGILANCE?

In a recent study, Elizabeth Adams and colleagues sought to disentangle the effects of heat exposure and dehydration on core temperature, mood, and visual vigilance (1). They began by noting that because heat exposure and dehydration often coincide, it can be difficult to ascertain which variable has the greatest impact on core temperature, mood, and vigilance during tasks like load carriage (1).

To address this issue, they conducted a study involving 12 male participants who each completed four 90-min load carriage trials on a treadmill with a rucksack weighing 45 lb and speed of walking set to achieve a workload of approximately 50% of VO_{2max} with a 5% gradient (1). The first of these trials (T1) was conducted in a euhydrated state (normal level of body water content) and in temperate ambient conditions (approximately 18 degrees centigrade and 50% relative humidity), so there was no dehydration and no heat exposure (1). A second trial (T2) was conducted in which the participants were in a hypohydrated (reduced hydration) state, but again not exposed to heat (1). In the third trial (T3), they were not hypohydrated (normal level of body water content) but they were exposed to hot ambient conditions (approximately 34 degrees centigrade and 45% relative humidity) (1). In the fourth trial (T4), they were exposed to both the hypohydration and the hot ambient conditions (1).

Both the dehydration in T2 and the heat exposure in T3 resulted, on average, in a slightly higher core body temperature (0.39 and 0.36 degrees Celsius rises, respectively) than occurred in the least stressful scenario, T1 (1). Therefore, individually, dehydration and heat exposure had similar, small effects on core temperature (4). However, when both dehydration and heat exposure occurred together in T4, the core temperature increase was greater, reaching around 1.1 degrees Celsius higher than the core temperature in T1 (1). Heart rates also reached their highest levels in T4, in fact 15 – 20 beats per minute (bpm) higher than in the other trials (1).

The combination of heat exposure and dehydration in T4 also elicited much greater negative mood effects than the other trials,

including feelings of fatigue and higher scores in respect to measures of confusion-bewilderment and depression-dejection, particularly (1). The average negative mood effect score in T4 was twice as great as in T3, where the participants were exposed to heat alone, and 10 times as high as in T2 and T1 (1). However, despite these mood and core temperature changes, visual vigilance was unaffected in T2 and T4 when compared to T1 (1).

On this basis, it is fair to say that when carrying loads, tactical athletes are exposed to heat and dehydration at the same time. When this occurs, they will be far more affected by core body temperature rises, feelings of fatigue, negative and demotivating moods, and increases in heart rate than when they are exposed to heat or dehydration alone, or neither. Nevertheless, in the case of mood effects, heat exposure alone was observed in this study to have a greater impact than dehydration alone (1). Adams and colleagues note that changes in core body temperature can give rise to heat illness, and that changes in mood can affect occupational performance (1). Increases in heart rate also signify greater workloads for the cardiorespiratory system, meaning the activity being performed will be less easily sustained.

All of this information is valuable to the tactical facilitator, who can encourage tactical athletes undertaking load carriage and other tactical tasks to ensure they maintain adequate hydration when exercising in hotter conditions. Using this information, they can also monitor personnel in hot conditions in order to identify any readily detectable early warning signs of heat stress, like heart rate increases and negative mood effects. Furthermore, tactical athletes can potentially be taught to recognize some of these early warning signs themselves and self-regulate both their levels of hydration and their exercise intensity and continuance in order to manage the associated risks. Importantly, Adams and colleagues also found that tactical athletes who were dehydrated when carrying loads in hot conditions had a much stronger sense of thirst than those who were well hydrated in hot conditions (1). This is reassuring, as it means that thirst, as well as increases in fatigue, heart rate, and negative mood effects, can warn tactical athletes that they need to drink.

SPECIAL WARFARE COMBATANT-CRAFT CREWMAN EXHIBIT SIMILAR POSTURAL STABILITY WHETHER WEARING TACTICAL GEAR OR NOT

Paul Morgan and colleagues recently published the results of a study of eight United States Naval Special Warfare Combatant-Craft Crewmen, comparing the postural stability (or balance) of crewmen wearing tactical gear weighing around 22 kg to crewmen not wearing any tactical gear. The authors note that these crewmen “perform special missions on small, high-speed water craft on ocean and small river water systems for insertions and extraction of Special Operations Forces,” (4). On this basis, the authors note that balance ability is important to these crewmen (4).

Interestingly, what they found in their small-scale randomized crossover trial was that the postural stability of these crewmen did not change, regardless of whether they were wearing tactical gear or not (4). The research team hypothesized that this might be because the crewmen were well adapted to wearing the tactical gear and keeping their balance (or good postural control) while on the constantly-moving platform of the water craft they operate. The authors also acknowledged that the small number of participants in their study may have obscured any differences that might have been detected in a larger sample of participants (4). However, these interesting results certainly warrant further research in larger samples of crewmen, as the authors suggest (4).

For the tactical facilitator, these results and results of future studies in this area are interesting, as they may mean that if tactical athletes regularly train for balance when wearing tactical gear, they may develop better balance for when they are required to operate in that gear. The specificity in such a training approach may help to reduce the balance impairments associated with wearing tactical gear that Morgan and colleagues identified have been observed in soldiers carrying loads, for example (4).

AEROBIC FITNESS AND VENTILATORY THRESHOLDS AFFECT PROFESSIONAL FIREFIGHTERS' EASE OF TASK PERFORMANCE AND AIR DEPLETION RATES

Stephanie Windisch and colleagues recently published a study that examined whether greater levels of physical fitness helped to reduce the time firefighters require to complete a series of tasks, the cardiorespiratory strain they experience from completing the tasks, and the amount of air they deplete from their self-contained breathing apparatus (SCBA) (6). The study involved 41 professional firefighters who participated in fitness testing and a simulated series of firefighter tasks (20-m ladder climb, 200-m treadmill walk, pulling a wire rope hoist 15 times, and crawling 50 m in an orientation section) (6). Their performance was evaluated by recording the time to complete the series of tasks, their mean heart rate throughout, and the volume of air depleted from their SCBA (6). These performance measures were combined to form a "time-strain-air depletion" (TSA) score, which summarized their overall performance on the tasks (6).

Three factors predicted individual firefighter performance during the tasks, as assessed by the TSA score (6). The first factor was the VO_2 peak the firefighters were able to achieve on a maximal incremental treadmill test (6). The second factor was the total time they were able to operate below their ventilator threshold, which was assessed via heart rate monitoring (6). The third factor was their average breathing rate during the series of tasks (6).

Bringing all of these factors together; the authors noted that firefighters who exhibited greater aerobic fitness were able to operate longer at a comfortable and sustainable workload (6). Additionally, they were able to keep their heart and breathing rates at a lower level while performing at an enhanced level (6).

Specifically, they completed the series of simulated firefighting tasks quicker, with less cardiorespiratory strain and with lower rates of air depletion (6).

In practical terms, this means that, after finishing the series of assigned tasks, firefighters with these specific enhanced fitness attributes retained more air in their SCBA than others (who performed less well) and were exposed for less time to the range of hazards and risks that might have been present in the task setting. Conceivably, this would mean that these better-conditioned firefighters would also have been more capable to continue with further tasks than their less fit counterparts and would have been exposed to less risk from cardiorespiratory strain and contextual exposure.

Of note for the tactical facilitator, the authors commented that the firefighters in their study reached their ventilatory threshold at around 50% of their VO_2 peak and that this is a relatively low level (6). With this in mind, they suggested that firefighters like those in their study may benefit from more endurance training to potentially increase their ventilatory threshold relative to their VO_2 peak (6). Doing this would enable the firefighters to perform higher workloads aerobically with greater sustainability, thus reducing their cardiorespiratory strain and SCBA air depletion rates in any given firefighting task. The authors also noted that the firefighters' ability to work sustainably and without excessive cardiorespiratory strain can be readily assessed in the field by monitoring heart rates, time to completion, and amount of air depletion during a standardized, simulated firefighting exercise, such as the series of tasks described in their study (6). They further noted that a TSA score can be calculated by summing the average heart rate, time to complete, the task and amount of air depleted during a standardized simulation exercise (6). This TSA score can then be used as a basis for assessing changes in firefighters in occupational performance capacity; for example, after a conditioning program incorporating endurance training.

AEROBIC FITNESS DOES NOT INFLUENCE FIREFIGHTER ERROR RATES IN A BALANCE TEST BUT DOES AFFECT SELF-SELECTED SPEED OF TEST COMPLETION, BOTH BEFORE AND AFTER A LIVE FIRE SUPPRESSION TASK

Similar to the study by Windisch and colleagues, a recent study by Deanna Colburn and colleagues also investigated the impacts of aerobic fitness on firefighter performance (2). However, this study's main focus of performance was the rate of stepping errors and speed of completion during a balance test conducted before and after a live fire suppression activity (2).

Twenty-four firefighters of varying aerobic fitness levels participated in this study, and underwent a balance test involving walking forwards and backwards across a beam while in full protective gear, including SCBA (2). They undertook this test before and after a 20-min live fire suppression activity and were

instructed to complete the balance test as quickly as possible without making stepping errors (2). The time taken to complete the task was measured with a stopwatch and errors were monitored and recorded (2).

Rates of stepping errors, such as stepping off the balance beam accidentally, were similar, regardless of level of fitness (2). However, firefighters who were less fit selected a speed at which they undertook the balance test that was slower than that adopted by fitter firefighters (6). This finding is clearly consistent with the findings of Windisch and colleagues, who also observed that firefighters who were less aerobically-fit took longer to complete a series of simulated firefighting tasks (6). However, Colburn and colleagues suggest that this strategy of less fit firefighters slowing down their speed of movement may be protective, to prevent them from losing balance and stepping where they should not. The authors do, however, acknowledge that further research is needed to further test that hypothesis (2).

For the tactical facilitator, the information from this study by Colburn and colleagues adds another perspective to that provided by Windisch and colleagues, by suggesting that less fit firefighters do not just work more slowly to make their workload sustainable for their level of aerobic fitness, but may also work more slowly to prevent stepping and balance errors related to their lower levels of fitness and capacity to move precisely at speed (2,6). On this basis, efforts to build the aerobic fitness of firefighters in occupationally-relevant ways while simultaneously developing their balance, agility, and speed of movement in safe ways may pay dividends for their performance and safety on the job.

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THE OFTEN FORGOTTEN EXERCISE—ISOMETRICS

When thinking of setting up an exercise routine to promote strength, normally weight lifting or calisthenics are looked at to meet these goals. Both are tried and true programs and give excellent results when applied in a consistent manner. But there is another form of strength training which is often overlooked—**isometrics**. Isometrics, like dynamic lifting movements, can also create the desired results when applied correctly or incorporated with other strength and power programs. But what really makes them unique is they can be performed almost anywhere, typically require no equipment, and they tend to not cause a lot of sweating since muscles not moving are able to keep internal temperature down.

Isometric exercises are a great addition for tactical athletes. They provide a feasible way to exercise for military personnel, first responders, police officers, or anyone working long irregular hours with no access to a fitness facility. Research has shown that many military and police officers do not get to return to a station to secure their weapon to exercise because they are on patrol, standby, or on desk duty (18,19). Because more traditional avenues to develop strength require a place or equipment, many military and police officers have to do their training while off duty so they can maintain a degree of regular fitness. This can create even more stress since it may mean they will have even less free time for personal use (18,19).

Unfortunately, many discount isometrics and never try incorporating them due to misconceptions regarding how they work. Common misconceptions seen in literature are that they are joint angle specific so they do not help with athletic performance or they do not train muscle endurance or muscle strength. Other misconceptions are that isometrics will not create muscle hypertrophy or muscle power, as well as that they can increase blood pressure to dangerous levels. And we still find people stating they should not be used with young children or the elderly. This is a basic list, but there are published studies out there which help to clear these misconceptions. Of course, isometrics are not an end-all exercise, just like no one exercise is, instead they should be seen as another tool to help maintain strength, speed, and general health.

First and foremost for most strength and conditioning programs is strength and muscle gain; studies have shown that isometrics increase strength and muscle size (2,4,5,9). As far as being joint angle specific, studies have shown the strength increase can extend to approximately 20% in each direction of the held position (5,10). So, if an isometric contraction were to be held at the maximum range of motion (ROM), mid ROM, and minimum ROM of a given muscle joint, then training can be developed through most of a full ROM (4,9). Additionally, there are now studies

showing that different joint angles recruit different muscle fibers to varying degrees of intensity (11). Since there is a difference in muscle recruitment, isometrics can be a good tool to use at these different angles to help influence higher gains in these fibers which are being recruited less (10,15). Other studies have shown that isometrics can also help with speed and power, and may even be safer than plyometric training, yet instill many of the same results (5).

Another area which gets a lot of criticism for isometrics is how they can be dangerous due to how they increase blood pressure. While it is true blood pressure will increase while doing them, blood pressure also increases to higher levels when doing any explosive exercise such as intervals and high-intensity interval training (HIIT) training. But what is unique for isometrics and HIIT training is that they are showing these exercises can actually reduce resting blood pressure (7,14). In fact, isometric studies looking at blood pressure show regular isometric exercise can reduce blood pressure by an average of 10 mcg, which is more than HIIT training (7,14). In terms of elderly using isometric training, studies show that they are having the same effect with increasing muscle strength and reducing blood pressure (3,7,8).

Before implementing isometric exercises, there are a few terms and tips that are useful to know. Firstly, there are two commonly used terms to describe the type of isometric hold being performed: static and yielding holds. A static hold consists of performing the contraction against an immovable object, such as a fixed wall or machine. The yielding hold is performed by holding a contraction against an object that can move, such as holding a weight at a static point and then relaxing. Yielding holds can be a good way to do holds at a lower than maximum contraction. The following exercises are examples of yielding holds. Another factor to consider is the duration of the hold itself. Typically, isometric holds vary from 5 – 20 s in duration, with the explosive holds only being 3 s. As with any exercise, it is recommended to begin at a lower level and work up to a higher level. For strength development, it is recommended to start with 2 – 3 sets of 4 – 10 s at approximately 70% maximal intensity. This is a good way to start to get familiar with the exercises, then the intensity can be increased accordingly. For leg exercises, it may be difficult to see change using only the yielding holds, so whenever possible, static holds may be more beneficial in these instances.

It is also important to remember to breathe during an isometric hold to avoid doing the Valsalva maneuver, which can potentially negatively affect blood pressure, among other aspects. Oftentimes when performing maximum contractions, it is natural for the tactical athlete to hold their breath; similar to trying to pick up a very heavy weight from the floor, for example. By remembering

to breathe during a maximal lift, these forces can be reduced and it can help make the movement safer (11). Because isometrics are joint angle and fiber length dominant, it is recommended to try the exercises at different ROM to maximize development of the muscles involved. Lastly, because isometrics are done by contracting the muscle at maximum or near maximum force, it is recommended to not perform them on any injured joint or muscle unless a qualified medical doctor has given clearance to do so. Isometrics are used in physical therapy for many injuries, but these are adjusted accordingly per the injury. So like any exercise routine, if there is a preexisting injury or a medical condition which limits strenuous physical activity, it is always recommended to consult with a qualified medical doctor prior to exercise.

The following are 12 isometric exercises that can be used to help maintain or develop strength. Each exercise should be performed for 4 – 10 s of 2 – 3 sets. Force should be below maximum until a level of the tactical athlete is comfortable with the movement. At that point, the tactical facilitator may begin to experiment with maximum contractions, different ROM angles, and more repetitions or sets. The tactical facilitator can also experiment by doing these exercises as a yielding hold then as a static hold to see how this changes the intensity of the exercise itself.

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THE OFTEN FORGOTTEN EXERCISE—ISOMETRICS



FIGURE 1. CLOSE CHEST PRESS: PUSH HANDS TOGETHER AND KEEP HANDS CLOSE TO CHEST.



FIGURE 2. CLOSE CHEST PULL: GRASP HANDS TOGETHER AND PULL HANDS APART WHILE KEEPING THEM CLOSE TO THE CHEST.



FIGURE 3. EXTENDED CHEST PRESS: KEEP ARMS EXTENDED AND PUSH HANDS TOGETHER.



FIGURE 4. EXTENDED CHEST PULL: KEEP ARMS EXTENDED AND PULL HANDS APART (THIS ONE PUTS A LOT OF FORCE ON THE SCAPULAE, SO BE SURE TO GET USED TO IT BEFORE MAXING OUT).



FIGURE 5. OVERHEAD PRESS: PUSH HANDS TOGETHER WHILE REMEMBERING TO BREATHE.



FIGURE 6. OVERHEAD EXTENSION: GRASP HANDS AND PULL HANDS APART WHILE REMEMBERING TO BREATHE.



FIGURE 7. BICEPS CURL: FLEX THE BICEPS WHILE KEEPING THE ELBOW AT ABOUT 90 DEGREES AND STATIONARY.



FIGURE 8. TRICEPS EXTENSION: FLEX THE TRICEPS WHILE KEEPING THE ELBOW AT ABOUT 90 DEGREES AND STATIONARY.



FIGURE 9. STOMACH PUSH-OUT: PUSH STOMACH OUT AND HOLD IT THERE.



FIGURE 10. STOMACH DRAW-IN: PULL STOMACH MUSCLES IN AS FAR AS POSSIBLE. THIS EXERCISE CAN HELP TACTICAL ATHLETES TO TIGHTEN UP ABDOMINALS.



FIGURE 11. WALL SITTING: WITH THE KNEES AT 90-DEGREE ANGLES AND THE BACK NEUTRAL, FLEX THE QUADRICEPS AND PUSH BACK INTO THE WALL AND HOLD. UNLIKE A SIMPLE KNEE EXTENSION WHEN SITTING ON A MACHINE, THIS EXERCISE WORKS THE LEGS MORE BY HAVING THEM PUSH INTO THE WALL.



FIGURE 12. SINGLE-LEG WALL SITTING: WITH THE SINGLE KNEE AT A 90-DEGREE ANGLE AND THE BACK NEUTRAL, HOLD AND PUSH INTO THE WALL. GOOD FORM REQUIRES HAVING THE GLUTES, LOWER/UPPER BACK, AND SHOULDERS AGAINST THE WALL. PLACE ONE FOOT BEHIND THE OTHER TO HELP KEEP BALANCED AND UPRIGHT, BUT DO NOT PUSH WITH THE OTHER LEG. THIS MOVEMENT SHOULD LOAD THE ENTIRE FRONT LEG AND NOT THE BACK.

LEARNING TO FAIL—A PREREQUISITE FOR SUCCESS IN MISSION CRITICAL TEAMS—PART 1

INTRODUCTION

In some organizations, there appears to be the capacity to celebrate failure. Oftentimes, people even wear their failure as a badge of honor. Moreover, in some organizations, one may be more likely to be offered a higher salary if their last venture was a failure than if it was a success. The common saying to support this concept is to “fail fast” in order to move on to the next thing.

This article proposes that fostering a capacity to accept failure in training will be a necessary prerequisite to enhance capability and ensure future mission success. This article will begin by defining the current environment and discussing the emerging problem sets which face mission critical teams (MCT). This article will outline potential equities of embracing a postmodern philosophy of failure and risk, and bring awareness to the barriers which may inhibit this progress. Future directions will include a discussion of concepts and processes which may serve as a potential catalyst for philosophical and cultural change within training paradigms in MCT training and performance.

For the purposes of this article, a MCT can be defined as a small integrated group (4 – 12 individuals) of indigenously trained and educated experts that leverage tools and technology to resolve complex adaptive problems in an immersive, but constrained, temporal environment. For example, in a historical military context, MCTs often took the form of unconventional commando units which were capable of rapidly adapting to the emergent complex adaptive problem sets that were associated with small wars. Today, MCTs could be seen as tactical organizations such as the military Special Forces (SF), Special Weapons and Tactics (SWAT), law enforcement, fire and emergency crews, surgical teams, or helicopter paramedics. All of these groups demand high levels of reliability, skills, and techniques, and if failure occurs, the consequences can be catastrophic.

THE EMERGING PROBLEM SET

The vision of the geospatial landscape increasingly shared among MCTs is characterized by volatility, uncertainty, complexity, and ambiguity. These organizations are increasingly operating in close contact with one another, and are following a similar path of transformation into the 21st century. This space expands to include the broader contexts of political, economic, social, ecological, demographic, legal, normative, diplomatic, and technological fields. For example, in the case of international and domestic acts of terrorism, adversaries may employ complexity, ambiguity, and asymmetry to prevent, deter, and complicate outside intervention. Moreover, adversaries may use any device (e.g., information

warfare, the United Nations [UN] legalist paradigm tendencies, provocation attacks, human shields) to fetter MCT capability.

Gone is the reassurance and safety of a well-known, predictable, and easily-templated enemy or scenario. This has increasingly been evident to the military. For instance, defeating armed forces may be less significant than affecting opponents’ will and resolve. The focus on humanitarian and reconstruction requirements as part of stabilization operations will likely increase. The use of commercial weapon systems, off-the-shelf, and novel technologies may grow. Additionally, the time-frame for procurement of new equipment may be drastically reduced in a bid to remain technically current and relevant. Importantly, the use of non-scripted strategies and tactics to overcome problems, especially in a networked environment, will likely gain in importance. A consequence will increasingly see commanders and leaders at all levels and individuals be networked, both in a technological and social sense (13).

In 1933, George Patton stated that “wars may be fought with weapons but they are won by men,” (6). While he may not have conceptualized the relevance to the future MCT capability, his quote may be more resonant today than it was during World War II. Success in future MCT mission profiles will increasingly rely on the cognitive resources and resilience of the individual. It is in this cognitive space, often in the midst of potential mission failure and an exploitable present, that one must be familiar with training of MCT personnel to produce workable solutions.

FAILURE AND INSECURITY IN MODERN COMPLEX PROBLEMS

More germane, being comfortable with uncertainty, knowing the limits of what science says, and understanding the worth of failure are all valuable tools that may improve people’s lives. These expressions are consistent with existential approaches of identifying meaning in adverse situations (5). Historically, the human psyche has had difficulty acknowledging life as an insecure and fleeting existence, as humankind inherently tries to secure ourselves in an uncertain world.

Given this landscape, emerging problems sets encountered by MCT will likely evolve and be solved by personnel who are mindful and comfortable of their unsafe and insecure environment. The “punctuated equilibrium” model, which argues that technological discontinuities (e.g., technological, social, and environmental) periodically arise to interrupt larger periods of relative stability, is no longer valid to provide lasting security in world-wide event cycles (7). Moreover, harnessing the disruptive element no longer

leads to equilibrium and stabilization. Even when problems of uncertainty and complexity can be solved, there is still the issue of prioritization in order to make things safe and secure (2).

The modern definition of the words “safe” and “secure” are almost identical to their ancient Latin root of “salvus,” which meant and still means “free from hurt or damage, unharmed, from fears or anxieties, untroubled, undisturbed, peaceful,” (16). However, this is a state of being that most humans can never actually achieve. Similarly, SF personnel cannot be free from harm or damage, either physically or psychologically. The so-called “security” achieved in some mission profiles, is itself, an artificial reality that is created to allow functioning in an uncertain world. It is suggested that the acceptance of failure and human error speaks to a personal acceptance of this insecurity—a philosophy that members of specialist tactical communities should embrace and develop.

TOLERANCE OF FAILURE AND RISK

Donald Rumsfeld, United States Secretary of Defense, once stated that “we have to put aside the comfortable ways of thinking and planning, take risks and try new things so that we can prepare our forces to deter and defeat adversaries that have not yet emerged to challenge us,” (15).

In 1611, Randle Cotgrave published a French and English dictionary which used the same definition of risk that existed throughout the previous millennia: “Risque: peril, jeopardy, danger, hazard, chance, adventure,” (3). Cotgrave’s definition describes the historical relationship people have had with risk (3). The risk was something that one interacts with, something that might cause harm, something random, and something that one chooses to interact with (2). Then in 1656, only two years after the discovery of the Probability Theory, Thomas Blount published the Glossographia, the first English dictionary, which included the etymology of each word (1). In it, he defined risk in this way: “risk (risque): peril, jeopardy, danger, hazard, chance,” (1). For reasons that may never be known, Blount removes the word “adventure.” This is important because the word “adventure” means: “to dare,” (16). In an SF environment, adventure shares a close relationship with potential for failure. Blount, by removing the word “adventure,” set the conditions for Western society to become passive recipients of risk. Over 200 years later, the Oxford English Dictionary, selected the Blount definition of risk for its new dictionary, and in doing so, it cemented the idea that risk is the potential for loss in Western society (16).

However, over 400 years later, the “equilibrium” of social and political stability continues to be punctuated. There is not always a clear battlefield or a clear enemy. The complexity and speed of emerging problems continues to require the use of MCTs to solve, stabilize, and shape these high-consequence problem sets. The world recognized that it needed special individuals in

the military who were willing to adventure and were prepared to be daring. It was the first real signal that our relationship with risk had fundamentally changed, however it has not changed completely. Unfortunately, the true essence of risk continues to permeate through business and society. Planners in the training of MCTs have not been immune to such mindsets, where attempts to embrace “adventure” and accept high levels of risk continue to be lost in a politically cautious environment. However, to make a change, whether by evolution or by leaping to new concepts, methods, or technologies, it often involves a high degree of risk (10).

To enhance capability, MCTs should reflect on the historical origins of the word “adventure,” accept risk as a prerequisite of tactical flexibility, and oftentimes accept failure. Planners, tactical facilitators, and leaders alike must continue to remind themselves and their organizations of the importance of acceptance of risk beyond the conventional norm. The current institutional paradigms, perhaps born from the past few years of increased instability around the world, must again shift from potential losses back to evolving capability by reorientating a culture which aligns with the 2009 International Standards Organization definition of risk: “the effect of uncertainty upon objectives,” (14).

AN ENTREPRENEURIAL SPIRIT

“This [SOF] established a tradition that has continued to the present of independent forces working flexibly under conditions of great complexity, danger, and uncertainty, exercising innovative and sometimes entrepreneurial leadership,” (12).

Given the choice between success and failure, the human condition tends to have a rather strong bias for the former and an equally strong wish to avoid the pain of the latter. But what if failure is actually a prerequisite to success? Moreover, what if solutions to complex asymmetric problems require a continuous learning loop in an atmosphere of failure?

The word “failure” comes from the middle of the 17th century from several sources: originally as “failer,” in the senses “non-occurrence” and “cessation of supply,” from Anglo-Norman French the word “failer,” and from the Old French “faillie” (16). The noun “failure” is conceptualized in various contexts such as a lack of success, an unsuccessful person or thing, the neglect or omission of required action, or the condition or fact of not achieving the desired end or ends (16). Unfortunately, these traditional definitions have come to shape the majority of people’s attitudes, beliefs, and subsequent behaviors. Non-entrepreneurs might have a tendency to define it negatively as something to be avoided at all costs.

However, to the entrepreneur, failure may be any one of the following positive experiences: a prerequisite to success, a chanced discovery, a profound teacher, a future value-adder, a

provider of new directions, an enhanced motivator, a path to achievement, and even as a relieving liberator (4). Acknowledging the complex and uncertain environment which many MCT personnel will face, it is proposed that these same entrepreneurial positive attributions can serve as seminal foundations necessary for capability development.

The “entrepreneurial spirit” embraces this realization through disciplined thinking, action, and experience, while acknowledging that the debilitating fear of being wrong or failing limits the opportunity for growth and success. MCT personnel are required to act contrary to fear of what they might lose. In doing so, they accept that in preparing to deal with a complex environment, there must be discovery and “adventure,” and a little respite from mistakes. Thus, MCTs should understand that when fear of failure or of high-risk rules occurs, mission success can be compromised.

EQUITIES OF FAILURE

Henry Ford stated that “life is a series of experiences, each of which makes us stronger even though it is hard to realize this. For the world was built to develop character, and we must learn that the setbacks and griefs which we endure help us in our marching onward,” (11).

The ratio between academic papers on post-traumatic stress disorder (PTSD) or other combat-orientated pathology compared to positive adaptation to military-related stress is approximately 50:1 (8). Unfortunately, the majority of the literature has remained transfixed towards a deprivation or treating of “ill behavior” approach. While important, this approach is only half-way complete. Recent Mental Health data in the Australian Defence Force (ADF) states that SF personnel consistently show lower rates of pathology than regular ADF forces – despite completing the most number of deployments and being subjected to arguable the most traumatic exposure in Iraq and Afghanistan during the past decade (9). Underreporting is often offered as a reason for such trends, yet this reason overlooks an obvious feature of many MCT personnel—selection. Most MCT personnel and support staff comprise generally of a predominantly young, physically and psychologically robust population who undergo rigorous selection processes which serve as protective factors, which aid to mitigate potential pathology (9).

The environment of failure and uncertainty are common aspects on any selection course around the world. For example, in SFs, an applicant must continually wrestle with these demons of insecurity and become comfortable in this environment if he or she is to prevail in the midst of uncertainty. However, his or her ability and cognitive capacity to withstand this mental load, which is often in the presence of significant fatigue, may be neglected once they are “qualified” as an operator. Psychological resilience may not even be challenged on operations due to an over-familiarity with problem sets. However, not unlike physical attributes, which need to be continually nourished, cognitive skills and psychological

resilience to stressors degrade during periods of insufficient stimulation and failure-free training environment.

APPRAISAL OF STRESS AND FAILURE

Over the past several years there has been a shift in how stress is defined, from a stimulus-response definition towards a more transactional paradigm, which suggests that stress is being defined as the individual’s perception of the balance or transaction between the demands and abilities in coping with them. That is, the demands of a particular mission/problem profile evoke an appraisal process, either positive or negative, by an operator that can potentially affect individual or team performance. Given that any member of an MCT could be required to make strategic decisions in mission settings, perceived stress can potentially have a significant impact on the decision-making processes.

CONCLUSION

The “so what” for MCTs is that personnel will be required to become comfortable in stressful situations and move past current comfort zone. This must go beyond stressors inflicted on them during their selection course. It should firstly involve education regarding the biopsychosocial elements of stress. Secondly, MCT personnel will need to increase their mindfulness of common cognitive appraisal processes and their effects. Third, MCT personnel will need to be exposed to increasing complexity and failure in simulated problem sets which evoke a strong sense of emotional stress—commonly associated with the negative appraisal, external locus of control, and paralysis.

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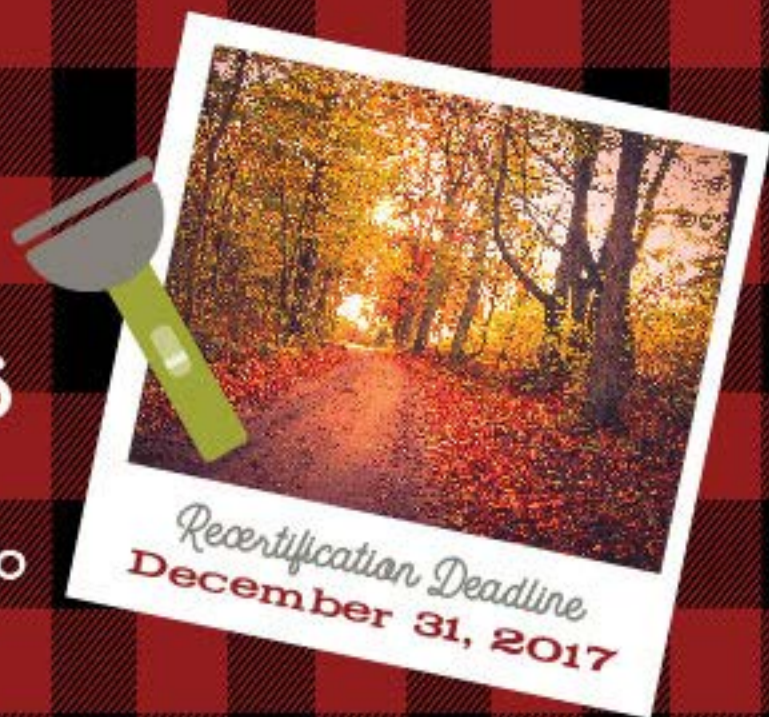
ABOUT THE AUTHOR

Scott Gayton has over 20 years of service in the Australian Army. His roles and experience include being a former infantry sniper, reconnaissance operator, and physical training instructor. In more recent years, he has fulfilled the role of an Army psychologist, where he served for the Australian Special Forces and was heavily involved in complex training design and the clinical care of operators. Gayton has also deployed on numerous overseas operations to the Middle East. Gayton completed his PhD in the area of mission critical teams, specifically looking at character, leadership, and performance, and he continues research collaboration with the Tactical Research Unit.

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A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

In the last *TSAC Report* (Issue 45), Soika and Nowels provided a well-defined overview of the United States Army Occupational Physical Assessment Test (OPAT) (12). The OPAT, and other physical assessments such as the Fire Service Candidate Physical Ability Test (CPAT) and tests administered to public safety personnel in Canada, are comprised of a myriad of physical tests that assess muscular strength, power, endurance, and anaerobic and aerobic capacity (6,7). For some candidates, especially those that are re-testing, selecting strength and conditioning strategies to improve performance in 6 – 8 weeks may remain unclear. The purpose of this article is to provide a six-week, non-linear exercise program for improvements in general physical preparedness prior to taking an occupational physical assessment test.

Surpassing the minimal standards of many occupational physical assessments may require demonstrable muscular power, strength, endurance, and aerobic capacity (1,4,9). Considerations for the strength and conditioning program include the loading scheme (sets and percentage of 1-repetition maximum [1RM]), aerobic conditioning, plyometric exercise, and recovery.

A combination of strength and ballistic-style exercise can provide the required stimulus for neuromuscular adaptations leading to strength and power improvement (2). For example, Mangine et al. found that the addition of ballistic exercise (two upper body and one lower body) to an eight-week strength training program improved jump squat power (+478W) pre- to post-training versus strength training alone (-397W) (8). Improvements in jump squat power may translate to improvements in long jump performance (a test administered on the OPAT) and vertical jump assessment. Mangine et al. also reported that bench press 1RM strength was significantly greater at post-training (interaction $p=0.04$) in the combined strength and ballistic training group (+12.1% pre- to post-) versus the strength training only group (+7.4% pre- to post-) (8).

Heavy strength training alone has also been found to improve strength and power. A previous study by Ronnestad et al. found that seven weeks of heavy strength training improved four-bounce jump test, squat jump, loaded (20, 35, and 50 kg) squat jump peak power, and sprint time (30 – 40 m, and 0 – 40 m) when compared to results of a combined strength and plyometric training program conducted among pre-season professional soccer players (11). Although this study utilized elite soccer players as its study population, it demonstrates the efficacy of heavy strength training for improving speed and lower body power, which are often

required in many occupational fitness assessments. Resistance training intensity likely has a strong relationship with both strength and power development. This was observed previously by comparing a strength training program targeting repetition failure (RF) (4 sets x 6 reps) performed three times a week for six weeks to a non-repetition failure (NF) strength training program (8 sets x 3 reps) (3). The RF group had a two-fold greater increase in the 6RM bench press at post-training compared to NF (3). Furthermore, in the bench throw test at post-training, the RF group generated, on average, 18.8 Watts more force than the NF group.

To minimize time constraints while maximizing the training effect, this sample program utilizes high-intensity interval training (HIIT) as the primary stimulus for anaerobic and aerobic conditioning. HIIT training involves short, intense bursts of exercise (> 90% heart rate maximum [HRmax]) followed by brief rest intervals. Because interval training can be more time efficient than traditional steady state aerobic exercise, this paradigm appears to be gaining interest among military leaders (5). More information regarding HIIT can be found in the “NSCA’s Essentials of Tactical Strength and Conditioning” (10).

In addition to exercise selection and intensity, the program’s frequency and temporal patterns can impact the training effect. For example, Soldberg et al. found positive outcomes with both linear and non-linear periodization (13). They highlighted the importance of providing individual feedback (i.e., motivation) during workout sessions, as well as block training that is customized to the work schedule, as important contributors to outcome improvements.

The following six-week strength and conditioning program can be used to improve strength, power, endurance, and aerobic and anaerobic capacity, which are the components of fitness often evaluated by tactical fitness assessments (15). Dynamic warm-ups can be found in Table 1 and Figures 1 and 2. Table 2 contains exercises for the core. Tables 3 – 6 contain sample programs for days 1 through 4, while the remaining figures contain examples for the exercises on days 1 – 4, respectively. The training is conducted in intense bouts (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax). The program includes cycling and running alternated on different days. For example, HIIT cycling on day 1 entails 6 sets of 6-s intense bouts of pedaling (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax) between each set. The examples of foam roller exercises

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

are intended to aid upper and lower flexibility by way of self-myofascial release (14).

In summary, this article provides a sample six-week, non-linear program for improving muscular strength, power, endurance, anaerobic and aerobic capacity. However, this is not a “one-size fits all” program, and manipulation of the program variables may be warranted for some individuals. Furthermore, proper supervision and exercise technique is required to mitigate the risk for injury.

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TABLE 1. DYNAMIC WARM-UPS

A	High knee walks Cradle walks Walking lunges Lateral squats Scorpions
B	High knee skips Cariocas Ladder drills Spidermans Inchworms

TABLE 2. CORE EXERCISES

A	MB (1 – 3 kg) sit-up throws MB (1 – 3kg) overhead throw downs Front/side plank
B	MB (1 – 3 kg) side throws MB (1 – 3 kg) reverse overhead throws Supermans

TABLE 3. SAMPLE WORKOUT—DAY 1

Dynamic Warm-Up	B	B	B	B	B	B
Core	A	A	A	A	A	A
Incline DB Chest Presses	3 x 6 – 8	3 x 6 – 8	3 x 6 – 8	4 x 4 – 6	4 x 4 – 6	4 x 4 – 6
MB Chest Passes	1 – 3 kg 3 x 5	1 – 3 kg 3 x 5	1 – 3 kg 3 x 5	1 – 3 kg 4 x 4	1 – 3 kg 4 x 4	1 – 3 kg 5 x 3
Close-Grip Bench Presses	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10	4 x 6 – 8	4 x 6 – 8	4 x 6 – 8
Barbell Rows	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10	4 x 6 – 8	4 x 6 – 8	5 x 4 – 6
Pull-Ups	2 x 6 – 10	2 x 10 – 12	3 x 6 – 10	3 x 6 – 10	3 x 6 – 10	3 x 6 – 10
Biceps Curls	2 x 10 – 12	2 x 10 – 12	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10
Triceps Pushdowns	2 x 10 – 12	2 x 10 – 12	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10	3 x 8 – 10
HIIT Cycling	6 s x 6	6 s x 6	6 s x 6	6 s x 7	6 s x 7	6 s x 8
Rope Stretch						

The HIIT is conducted in intense bouts (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax). For example, HIIT cycling on Day 1 entails 6 sets of 6-s intense bouts of pedaling (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax) between each set until week 4. Interset rest periods should be 1 – 3 min.

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

TABLE 4. SAMPLE WORKOUT—DAY 2

Dynamic Warm-Up	A	A	A	A	A	A
Deadlifts	3 x 6 – 8	3 x 6 – 8	4 x 6 – 8	4 x 6 – 8	5 x 3 – 5	5 x 3 – 5
Jump Squats	3 x 8	3 x 8	4 x 5	4 x 5	5 x 4	5 x 4
DB Lunges	2 x 8 – 10	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	3 x 6 – 8
Leg Curls	2 x 8 – 10	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	3 x 6 – 8
Leg Extensions	2 x 8 – 10	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	3 x 6 – 8
Shoulder Presses	2 x 8 – 10	2 x 8 – 10	2 x 8 – 10	3 x 8 – 10	3 x 8 – 10	3 x 6 – 8
Barbell Shrugs	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	4 x 4 – 6	4 x 4 – 6
Core	B	B	B	B	B	B
HIIT Running	10 s x 4	10 s x 4	10 s x 4	10 s x 5	10 s x 5	10 s x 6
Foam Roll						

The HIIT is conducted in intense bouts (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax). Interset rest periods should be 1 – 3 min.

TABLE 5. SAMPLE WORKOUT—DAY 3

Dynamic Warm-Up	B	B	B	B	B	B
Core	A	A	A	A	A	A
Flat Bench Presses	2 x 8 – 10	2 x 8 – 10	3 x 8 – 10	4 x 6 – 8	4 x 6 – 8	5 x 4 – 6
Push-Ups	2 x fail	2 x fail	3 x fail	4 x fail	4 x fail	5 x fail
Dips	2 x 8 – 10	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	4 x 4 – 6
Pulldowns	2 x 8 – 10	2 x 8 – 10	3 x 8 – 10	3 x 8 – 10	4 x 6 – 8	4 x 6 – 8
Single-Arm DB Rows	2 x 8 – 10	2 x 8 – 10	3 x 6 – 8	3 x 6 – 8	3 x 6 – 8	4 x 6 – 8
HIIT Cycling	10 s x 3	10 s x 3	10 s x 3	10 s x 4	10 s x 4	10 s x 5
Rope Stretch						

The HIIT is conducted in intense bouts (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax). Interset rest periods should be 1 – 3 min.

TABLE 6. SAMPLE WORKOUT—DAY 4

EXERCISE	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
Dynamic Warm-Up	A	A	A	A	A	A
Front Squats	2 x 10 – 12	2 x 10 – 12	3 x 8 – 10	4 x 6 – 8	4 x 6 – 8	4 x 6 – 8
Box Jumps	3 x 5	3 x 5	3 x 5	4 x 4	5 x 3	5 x 3
High Pulls	2 x 5	2 x 5	3 x 4	3 x 4	4 x 3	4 x 3
Push Presses	2 x 5	2 x 5	3 x 4	3 x 4	4 x 3	4 x 3
Core	B	B	B	B	B	B
HIIT Running	10 s x 4	10 s x 4	10 s x 4	10 s x 5	10 s x 5	10 s x 6
Foam Roll						

The HIIT is conducted in intense bouts (> 90% HRmax) followed by 2 min of active recovery (50 – 60% HRmax). Interset rest periods should be 1 – 3 min.



FIGURE 1. HIGH KNEE WALK



FIGURE 2. CRADLE WALK



FIGURE 3. WALKING LUNGE

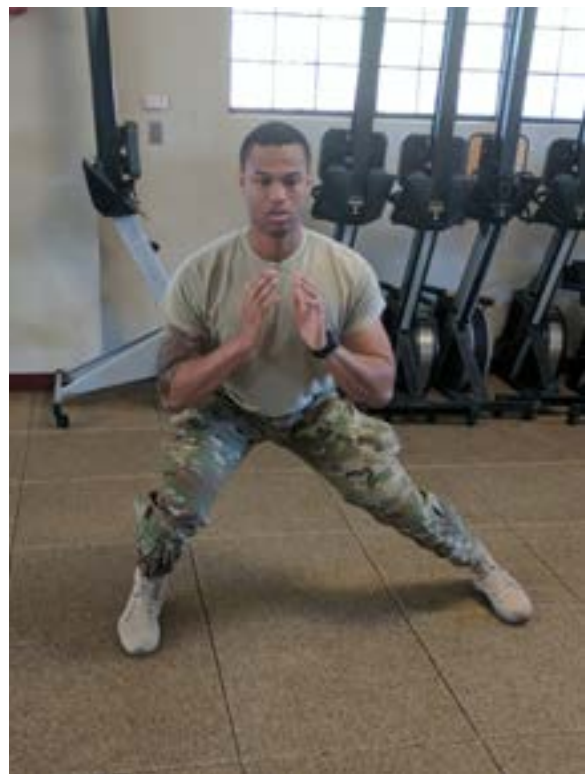


FIGURE 4. LATERAL SQUAT

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT



FIGURE 5. SCORPION

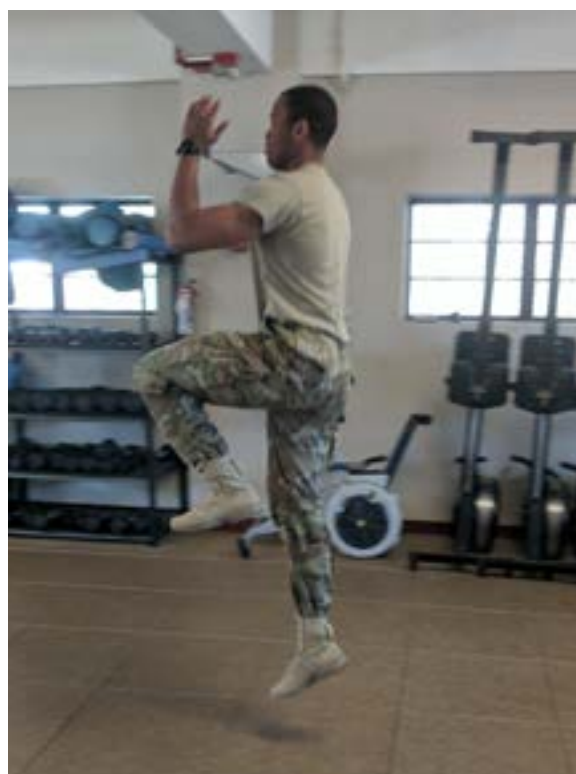


FIGURE 6. HIGH KNEE SKIP



FIGURE 7. CARIOCA

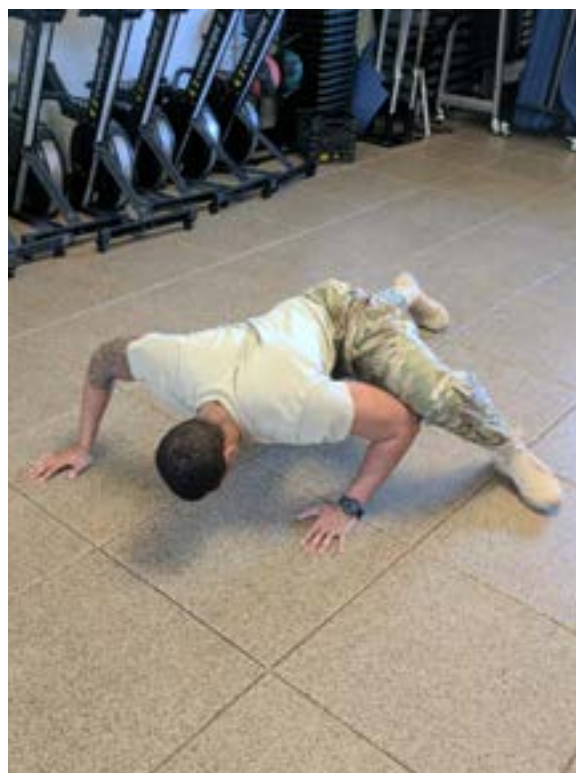


FIGURE 8. SPIDERMAN



FIGURE 9. INCHWORM - START



FIGURE 10. INCHWORM - END



FIGURE 11. SIT-UP THROW - START

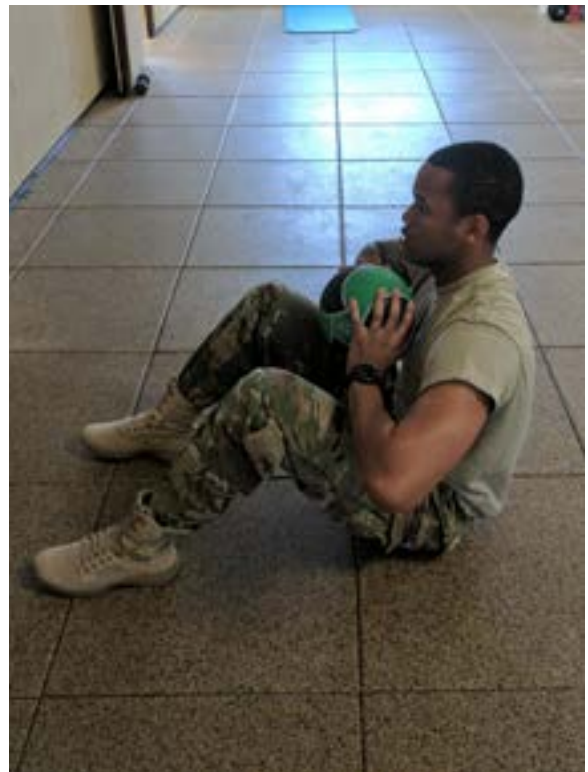


FIGURE 12. SIT-UP THROW - MIDDLE

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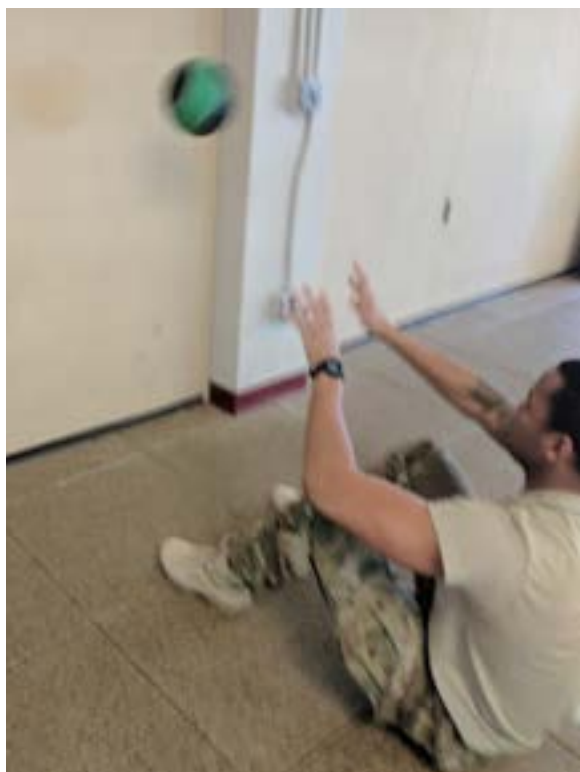


FIGURE 13. SIT-UP THROW - END

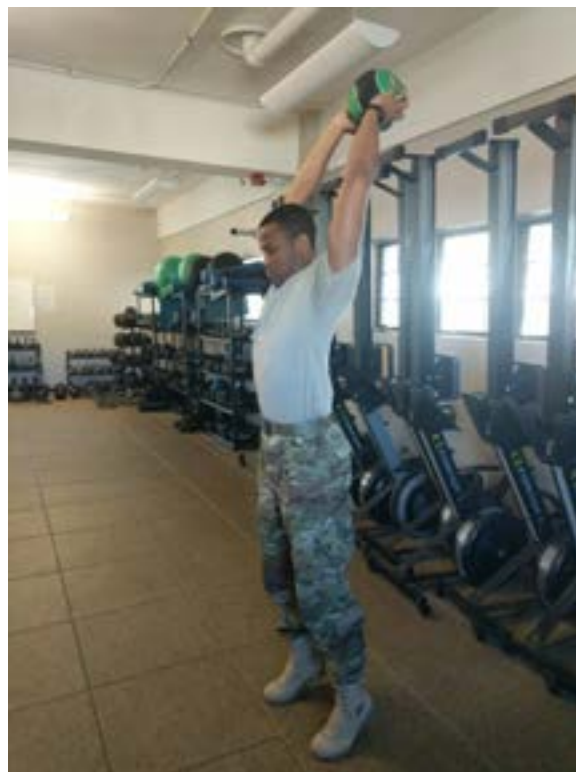


FIGURE 14. OVERHEAD THROW DOWN - START

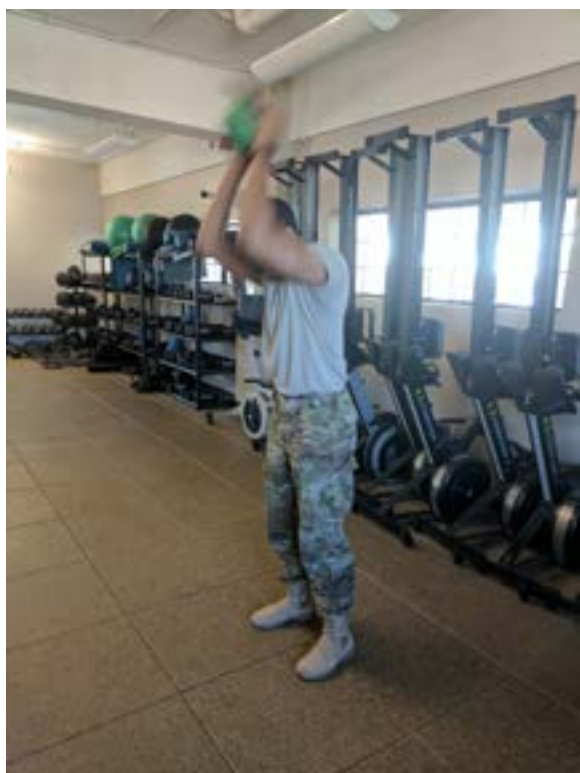


FIGURE 15. OVERHEAD THROW DOWN - END



FIGURE 16. FRONT PLANK



FIGURE 17. SIDE PLANK

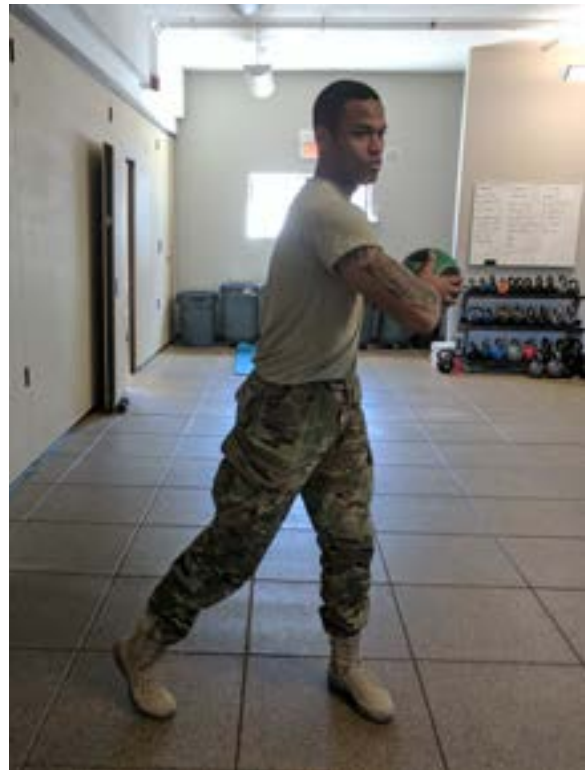


FIGURE 18. SIDE THROW – START



FIGURE 19. SIDE THROW – END

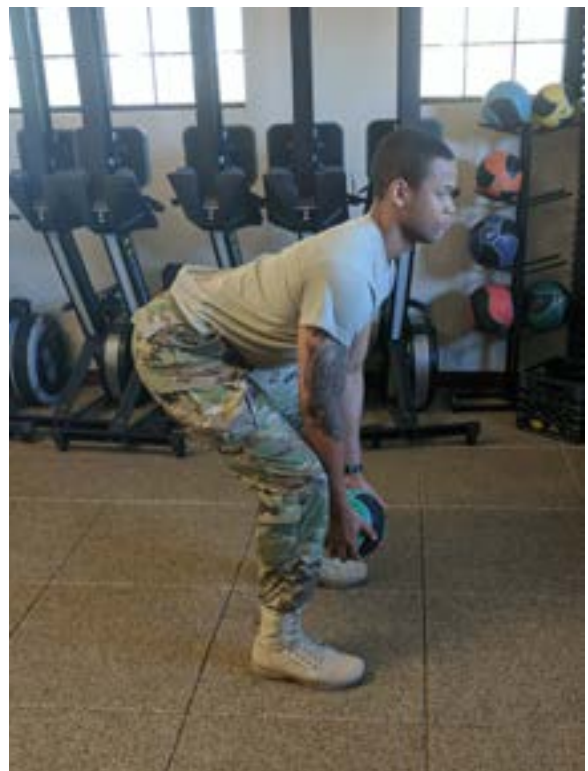


FIGURE 20. REVERSE OVERHEAD THROW – START

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

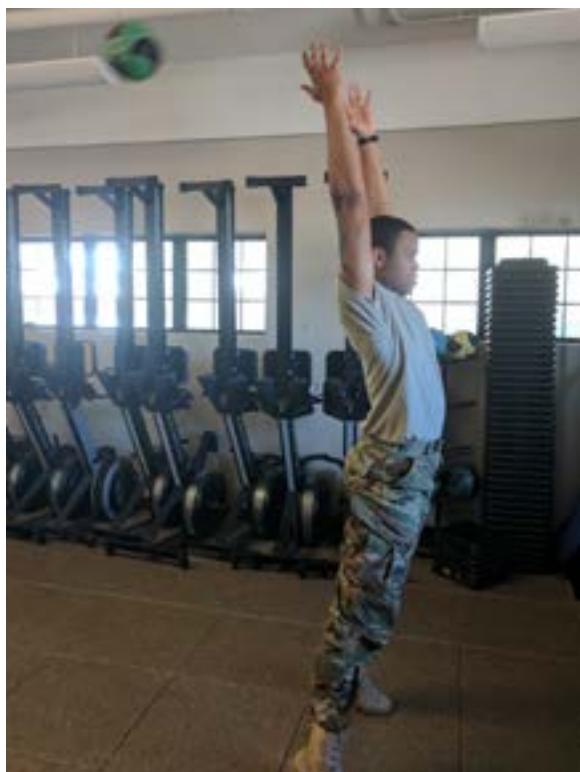


FIGURE 21. REVERSE OVERHEAD THROW – END

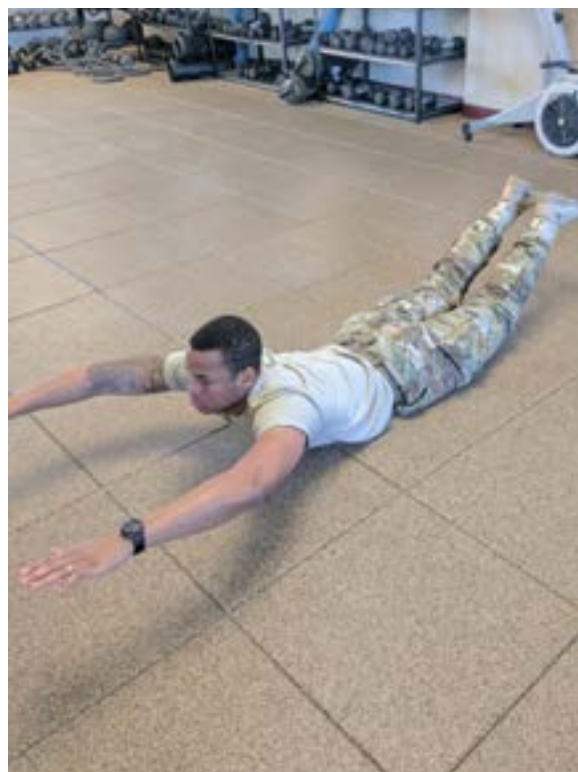


FIGURE 22. SUPERMAN



FIGURE 23. INCLINE DB CHEST PRESS – START



FIGURE 24. INCLINE DB CHEST PRESS – END



FIGURE 25. MB CHEST PASS – START

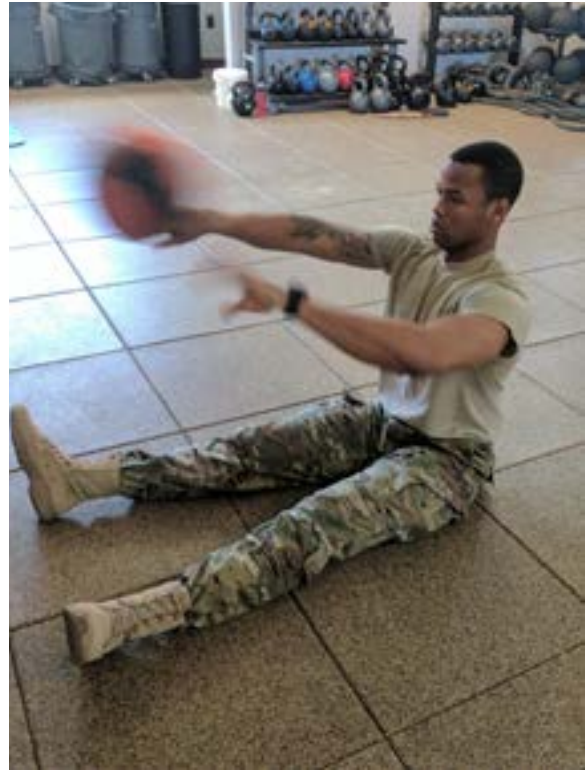


FIGURE 26. MB CHEST PASS – END



FIGURE 27. BARBELL ROW

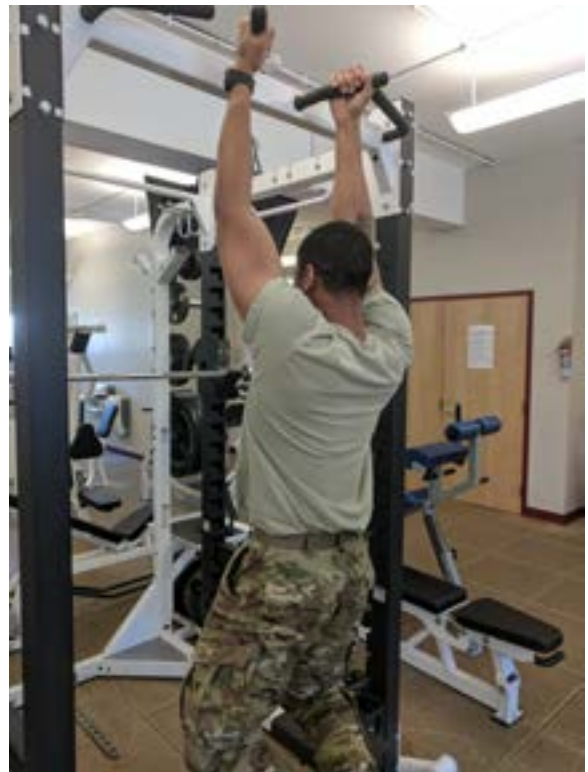


FIGURE 28. PULL-UP – START

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT



FIGURE 29. PULL-UP - END

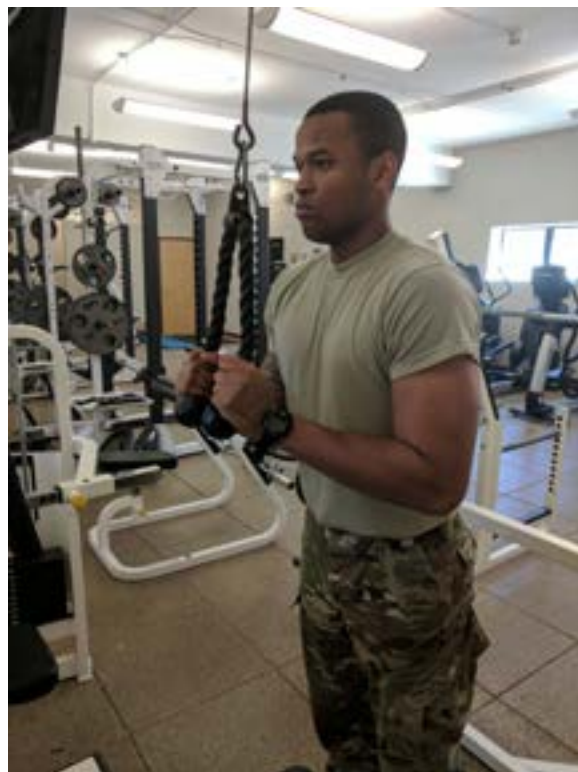


FIGURE 30. TRICEPS PUSHDOWN - START

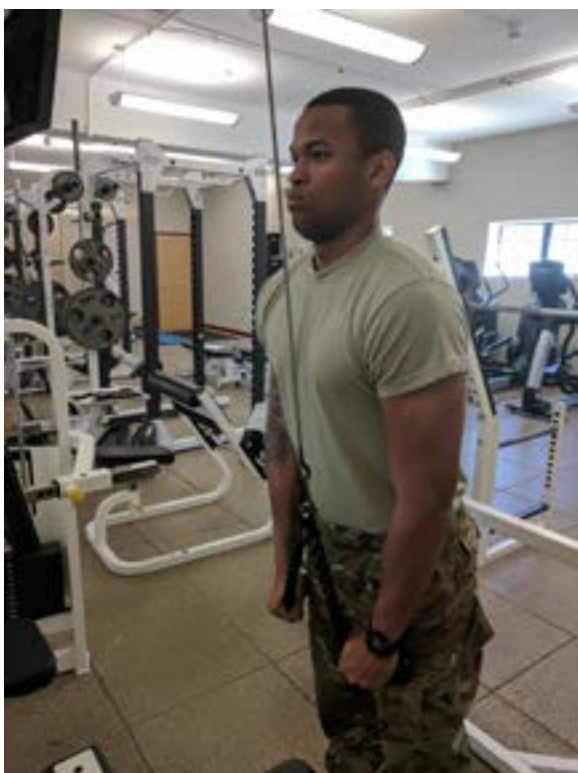


FIGURE 31. TRICEPS PUSHDOWN - END



FIGURE 32. DEADLIFT - START



FIGURE 33. DEADLIFT - END

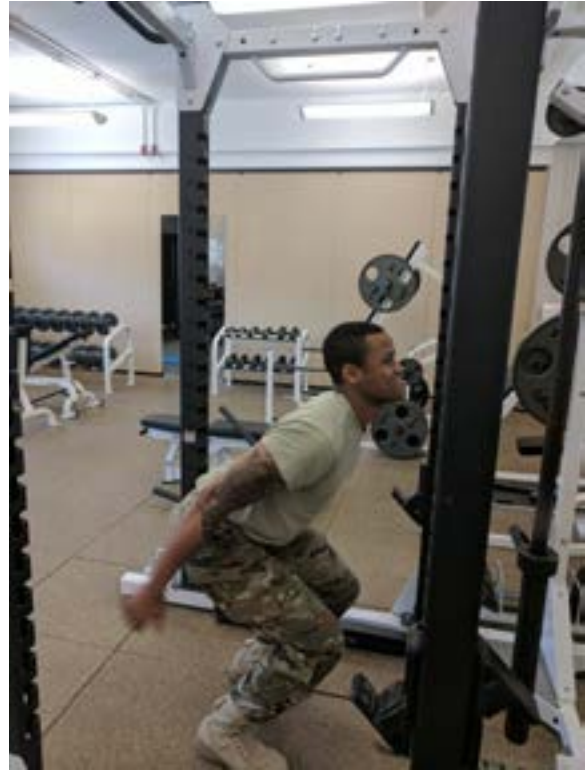


FIGURE 34. JUMP SQUAT - START



FIGURE 35. JUMP SQUAT - END

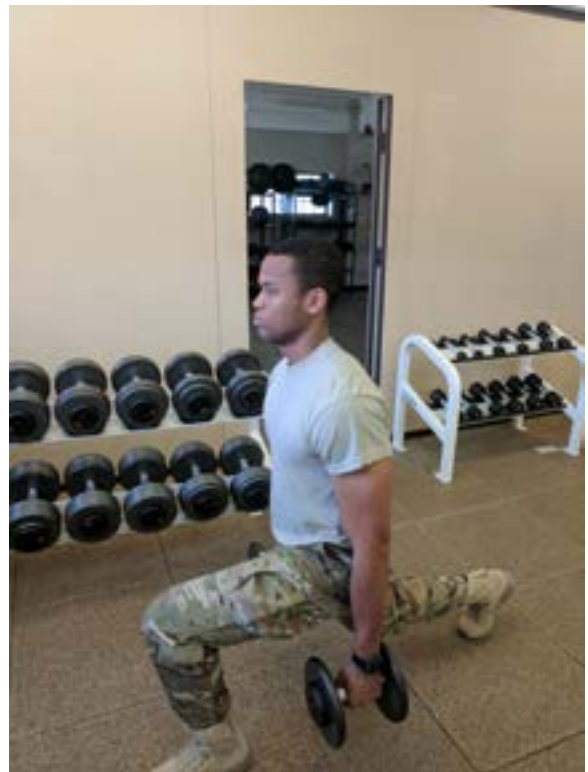


FIGURE 36. DB LUNGE

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

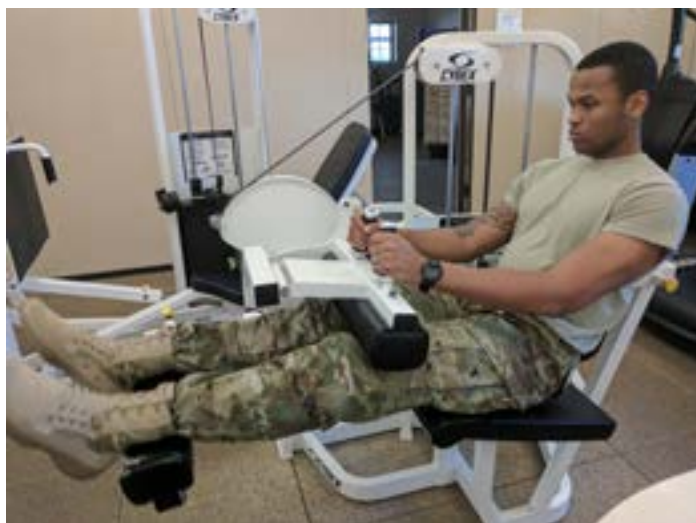


FIGURE 37. LEG CURL - START



FIGURE 38. LEG CURL - END



FIGURE 39. LEG EXTENSION - START

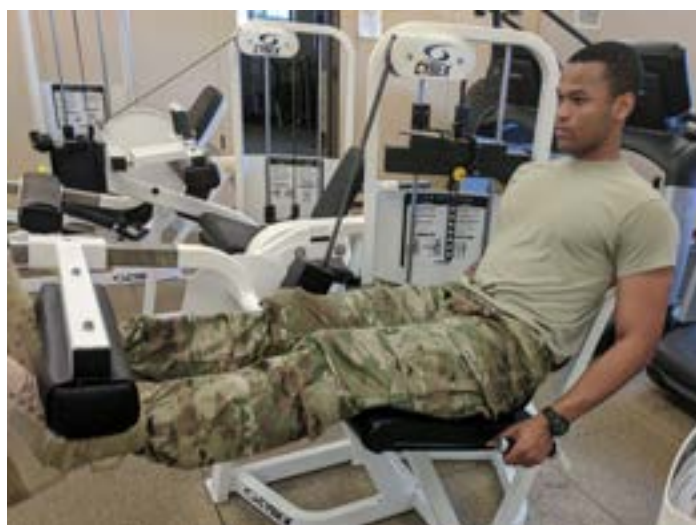


FIGURE 40. LEG EXTENSION - END

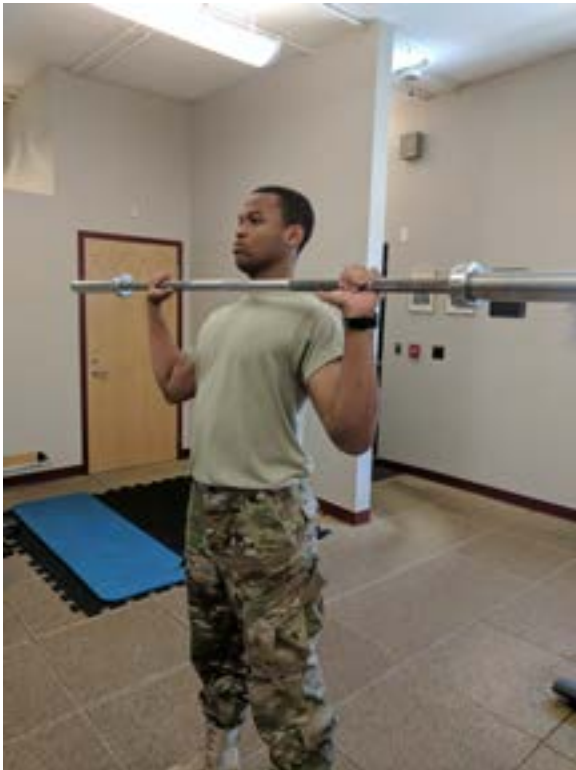


FIGURE 41. SHOULDER PRESS – START



FIGURE 42. SHOULDER PRESS – END



FIGURE 43. PUSH-UP – START



FIGURE 44. PUSH-UP – END

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT



FIGURE 45. DIP - START

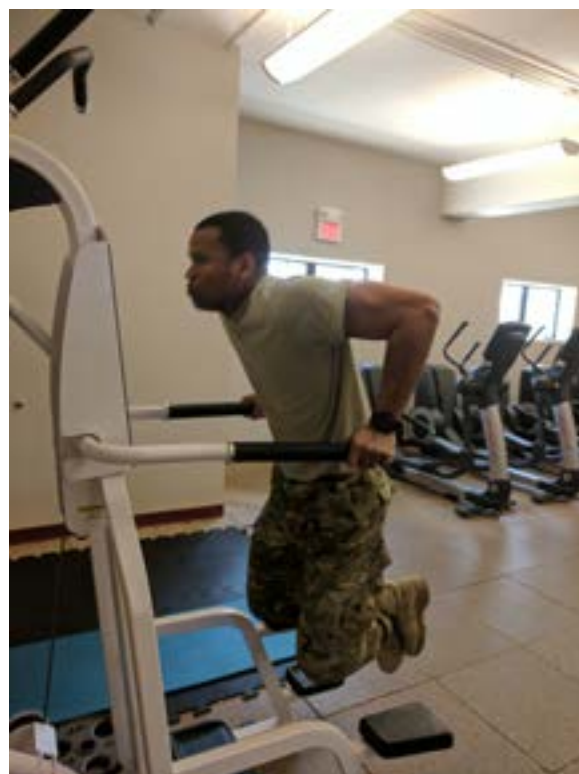


FIGURE 46. DIP - END



FIGURE 47. PULLDOWN - START



FIGURE 48. PULLDOWN - END



FIGURE 49. SINGLE-ARM DB ROW – START

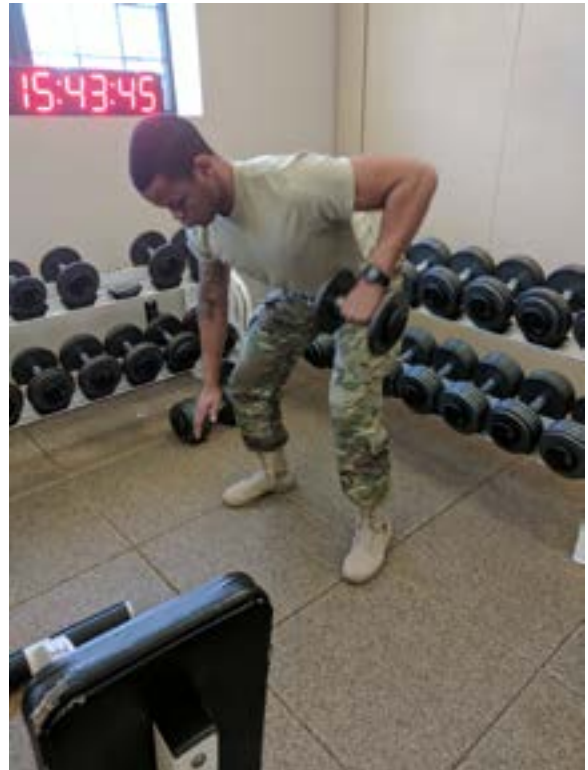


FIGURE 50. SINGLE-ARM DB ROW – END

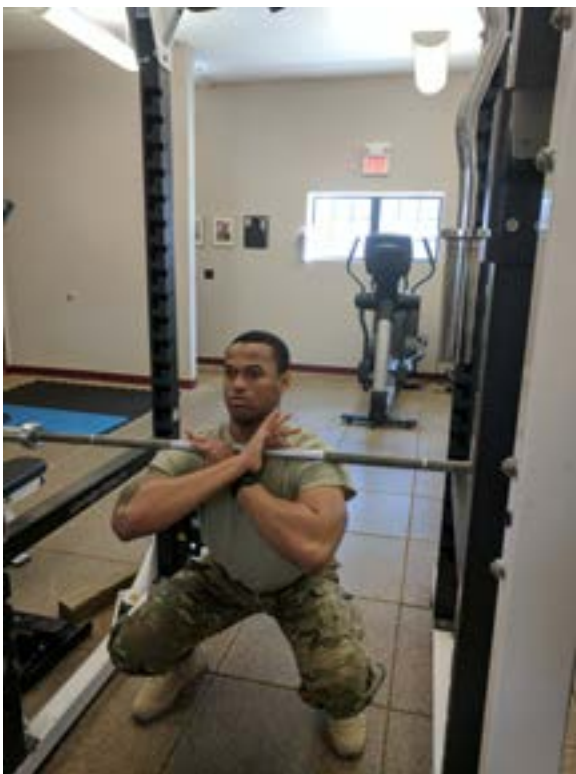


FIGURE 51. FRONT SQUAT

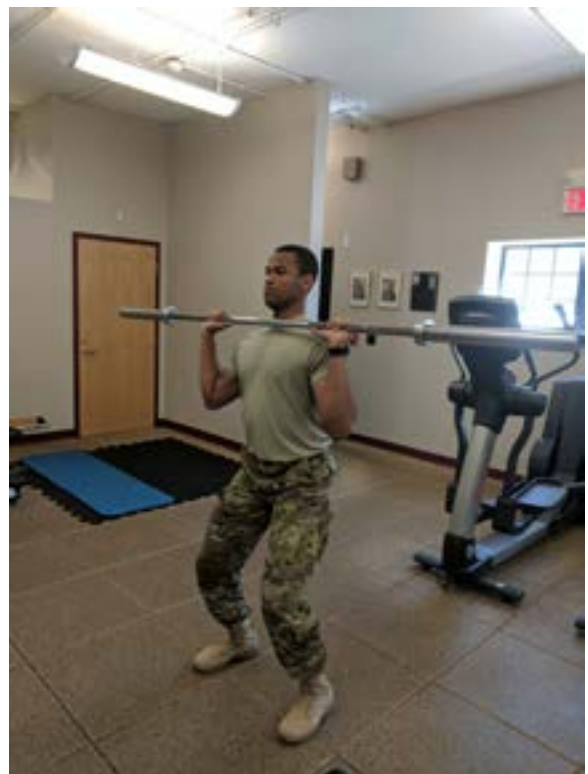


FIGURE 52. PUSH PRESS – START

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT

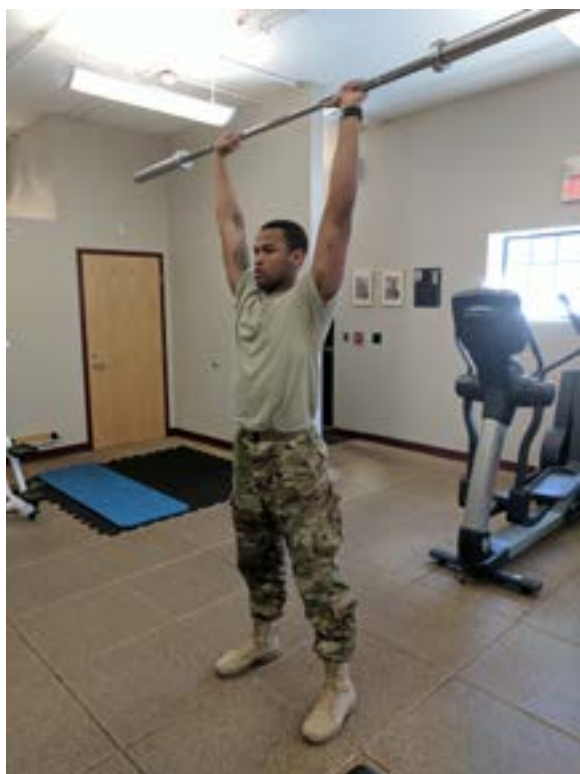


FIGURE 53. PUSH PRESS - END

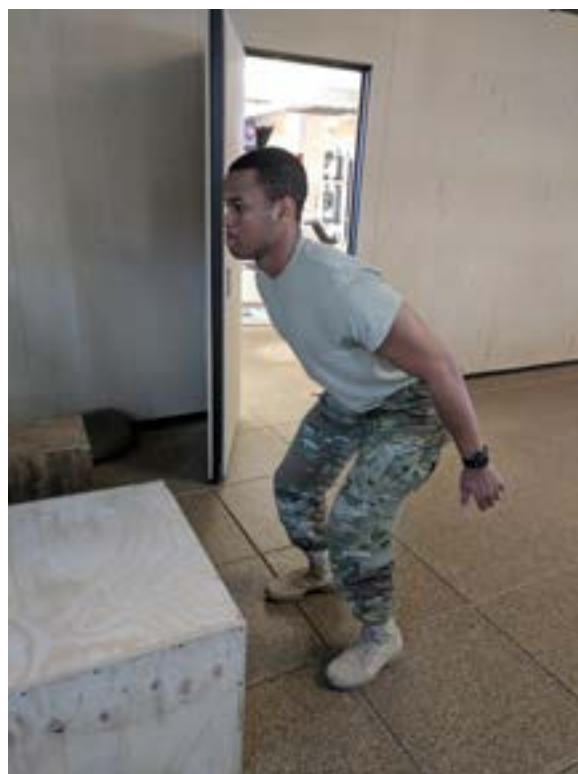


FIGURE 54. BOX JUMP - START

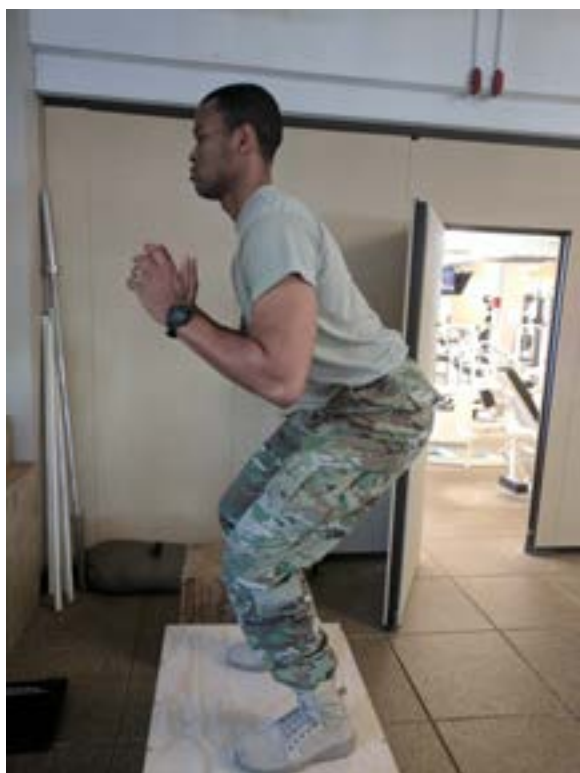


FIGURE 55. BOX JUMP - END



FIGURE 56. HIGH PULL - START



FIGURE 57. HIGH PULL - END



FIGURE 58. FOAM ROLLING - CALVES



FIGURE 59. FOAM ROLLING - HAMSTRINGS



FIGURE 60. FOAM ROLLING - ADDUCTORS

A SAMPLE SIX-WEEK EXERCISE PROGRAM TO IMPROVE GENERAL PHYSICAL PREPAREDNESS FOR AN OCCUPATIONAL PHYSICAL ASSESSMENT



FIGURE 61. FOAM ROLLING – GLUTEALS



FIGURE 62. FOAM ROLLING – LATS



FIGURE 63. FOAM ROLLING – BACK



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