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TABLE OF CONTENTS

04 TIRE FLIPPING—A METHOD OF ASSESSING FUNCTIONAL POWER OUTPUT FOR FIREFIGHTERS
DAVID CORNELL, MS, CSCS, KYLE EBERSOLE, PHD, LAT, AND JASON MIMS

08 TSAC RESEARCH REVIEW
ROD POPE, PHD

12 RUCK-BASED SELECTION TRAINING
THOMAS RADER, CSCS

20 THE IMPORTANCE OF PROPER MOVEMENT FOR MARINES—PART 2: THE SOLUTION
MATT ZUMMO, MS, USAW-1

24 REINTEGRATION CONSIDERATIONS FOR TACTICAL ATHLETES
SHANE IRVING

26 TACTICAL PROGRAMMING CONSIDERATIONS—PREPARING FOR THE ARMY PHYSICAL FITNESS TEST
MARK WALKER, MAED, CSCS

30 PERFORMANCE NUTRITION FOLLOWING AN INJURY—FROM PERSONAL EXPERIENCE
TRISHA STAVINOHA, MS, RD, CSSD, CSCS

32 UTILIZING THE PRIORITY TRAINING SYSTEM FOR FIRST RESPONDERS
BRYAN FASS, ATC, LAT, EMT-P, CSCS

34 RESISTANCE TRAINING TO IMPROVE PISTOL SHOOTING PERFORMANCE
KEITH CHITTENDEN, MS, CSCS,*D, TSAC-F,*D
The occupation of firefighting commonly requires repeated bouts of maximal effort. For example, firefighters must routinely generate enough power output to remove debris, lift heavy objects, or drag a hose (1,7). Previous research has also demonstrated that live fire suppression tasks require an average heart rate equivalent to 88% of an individual’s heart rate maximum (11,12). Furthermore, research has suggested that anaerobic power and ability is an important and vital component of firefighter performance (8,10,13).

Power output is mathematically derived from the equation:

\[
\text{Power} = \frac{\text{force} \times \text{displacement}}{\text{time}} \quad \text{or} \quad \text{Power} = \frac{\text{work}}{\text{time}}
\]

Common physiological assessments of anaerobic power output include the Wingate test (on a stationary bike), 40-yard dash, and vertical jump (6). However, these assessments are not necessarily feasible or cost efficient and may not be relevant to the tactical tasks associated with firefighting.

**TIRE FLIP**

“Tire flipping” is commonly utilized by strength and conditioning professionals as a way of developing the functional power necessary to meet the demands of an athlete’s given sport (4,9,14). Since it is similar to the movement of the deadlift, it is a straightforward and simple task for qualified (i.e., certified) tactical facilitators to teach and for tactical athletes to learn (4). The movement pattern utilized when flipping a tire is also similar to the movement required during firefighting, such as squatting to utilize lower and upper body strength to move objects quickly that are excessively large, awkwardly shaped, or unpredictable in nature (7). For example, firefighters may have to lift an unconscious person out of a house, remove fallen debris, or hold charged water hose lines. As such, the task of tire flipping is an alternative exercise modality that attempts to mimic the nature of many of these firefighting tasks.

This mode of exercise is rarely ever used to assess maximal power or strength output, such as commonly performed during other types of resistance training (e.g., power clean, squat, deadlift, etc.). This is an important consideration for tactical facilitators as without a measure of functional power there is no way of knowing if the training program being implemented has been effective for developing functional power output or not. Thus, this article will focus on how to assess functional power output among firefighters by utilizing the task of tire flipping.

**TIRE FLIPPING TIME**

Since power output is a method of quantifying the amount of work an individual can achieve over a period of time, a tactical facilitator can simply measure the amount of time it takes a tactical athlete to repeatedly flip a tire over a known distance. If the time it takes for a tactical athlete to flip a tire across this distance decreases over time, then the training program has been successful at increasing the functional power output for this individual. This strategy is similar to the measurement of a 40-yard dash time to assess horizontal power output (3). However, while this may be a beneficial and relevant assessment of power output in regards to a specific individual, it is difficult (if not impossible) to use this measure to compare across individuals due to variations in body mass. In other words, it is difficult to compare the tire flip time of an individual who weighs 115 kg (about 250 lb) with someone who weighs 70 kg (about 150 lb).

To combat this dilemma, this measured tire flip time can be normalized by making it relative to an individual’s body mass (kg). This is essentially creating a ratio of tire flip time over bodyweight (s/kg). This is similar to methods commonly used to normalize an absolute maximal oxygen uptake value (L/min), by creating a relative absolute maximal oxygen uptake value (mL/kg/min) (2). This normalized tire flip time is now relative to the specific individual and can be used to compare multiple people. However, it must be noted that the tire being utilized should be the same diameter and weight among all individuals being compared.

**PREPARATION AND SAFETY CONSIDERATIONS**

The space required for the tire flipping test is minimal, such as 10 yards of flat ground. This could be indoors, such as in a gym or firehouse bay (Figure 1), or outdoors, such as in a parking lot. Either way, the same environment should be utilized if comparing longitudinal changes in tire flipping time. Besides the tire itself, the only other required equipment is a stopwatch to measure time and a scale to measure the weight of the individual. However, safety considerations such as body size, age, or gender must be taken into account, and thus, a lighter or heavier tire may be warranted on an individual basis.

Proper exercise technique (Figures 2 and 3) should be maintained throughout the entire test. This technique is similar to the deadlift (4,5). In brief, the tactical athlete should have a slightly wider than shoulder-width stance, a deep squat starting position, and a neutral back with shoulders back. In the days or weeks before completing test trials, the tactical facilitator should instruct proper exercise technique to the individual. In addition, at least one practice trial should be given before completing a test trial.
to ensure proper exercise technique. The tactical facilitator should always observe the administration of the test for improper technique. For example, not fully squatting down or having rounded shoulders are common causes of improper technique (Figure 4) (4). A faster tire flip time should never take precedence over proper exercise technique.

CONCLUSION
This proposed tire flipping test is designed to be a simple method that tactical facilitators can utilize to assess the functional power output of tactical athletes. In addition, software programs such as Microsoft Excel can help automate any normalization calculations. This allows for rapid feedback to the tactical athlete, tracking of individual training progress, and also expedites the creation of new individualized and occupational-specific training programs by the tactical facilitator.

REFERENCES

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FIGURE 1. TIRE FLIP SET-UP

FIGURE 2. PROPER TIRE FLIP TECHNIQUE

FIGURE 3. PROPER TIRE FLIP TECHNIQUE

FIGURE 4. IMPROPER TIRE FLIP TECHNIQUE
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This article is the second of a continuing series of tactical strength and conditioning (TSAC) research reviews. It is designed to bring awareness to new research findings of relevance to tactical strength and conditioning communities.

FATIGUE AND BALANCE CONTROL IN FIREFIGHTERS

The previous “TSAC Research Review” considered the effect of personal protective equipment (PPE) worn by firefighters on their mobility, levels of fatigue, balance, vision, injury risks, and occupational performance (6). This information was based on the findings of a recent study of firefighter self-reports of PPE and its perceived impacts (4). Self-reported information provided by tactical personnel can provide important insights, and can stimulate and guide further research and risk management efforts. However, it is valuable to complement and compare this kind of subjective information with objective measurements. With this in mind, a recent study by Pau and colleagues measured the postural balance control of Italian firefighters before and after simulated arduous firefighting and rescue activities (5). The purpose of the study was to determine the effect of job-related fatigue on firefighter balance control. In addition, they compared career firefighters with retained firefighters, the latter of which operated for considerably less days each year, on average (79 days vs. 266 days, respectively). The retained and career firefighters were, on average, similar in terms of body mass, height, body mass index (BMI), and weekly hours spent on physical training. However, the career firefighters were, on average, older (46 vs. 29 years of age, respectively) and had more years of service (21 vs. 6 years, respectively) than the retained firefighters.

The investigators asked each firefighter to stand still for 30 s on a pressure platform while wearing usual PPE weighing 21.5 kg and looking at a fixed point, straight ahead. The platform measured postural sway front-to-back and side-to-side by assessing movements in the center of foot pressure. The speed of postural sway in each direction and the size of the sway area were then calculated, and further analysis assessed the level of complexity, or irregularity, in the postural sway that occurred. Each firefighter was assessed twice in this way (once before they completed simulated arduous firefighting and rescue activities, and once after they completed these activities, at which time they were observed to be at least somewhat fatigued). The simulated firefighting and rescue activities included:

1. Unrolling and connecting a 20-m fire hose
2. Donning and wearing a self-contained breathing apparatus (SCBA)
3. Climbing two flights of stairs in a fire training tower
4. Hoisting the fire hose from ground level to the second-level window using a rope
5. Lowering the fire hose again
6. Descending the stairs to ground level and taking off the SCBA
7. Carrying a 25-kg mannequin for 40 m

This sequence of tasks was completed at the firefighter’s self-selected pace, which was based on efficiency and safety considerations.

The two groups of firefighters exhibited very similar levels of postural balance control prior to the simulated arduous firefighting and rescue activities, but it was noted that the career firefighters exhibited greater complexity (irregularity) of postural sway prior to the arduous activities than the retained firefighters. The authors noted that this greater complexity in postural sway observed in the career firefighters may indicate enhanced postural balance abilities due to age and experience, such that their postural control systems were more adaptive to operational requirements (5).

Both groups of firefighters exhibited substantial degradation in their balance control following the simulated arduous firefighting and rescue activities, with speed of postural sway increasing on average 16 – 30%, indicating greater difficulty controlling balance. In addition, the complexity (irregularity) of postural sway reduced in both groups once they were fatigued, but much more in the retained firefighter group, indicating a lower level of postural adaptability post-fatigue when compared to the career firefighters.

The findings of this study reinforce the critical importance of optimal strength and conditioning in firefighters to reduce the effects of fatigue and its effects on balance control in the context of often-arduous job demands. It is clear from the findings that once firefighters are fatigued their balance control, which is so crucial to operating safely in required PPE, is markedly impaired. Their findings also suggests that more regular and longer term practice of firefighting and rescue tasks, often involving wearing PPE, could be responsible for greater adaptability in balance control in the experienced career firefighters.
The implications of these findings for the tactical facilitator would seem to be threefold:

1. Achievement of levels of strength and conditioning sufficient to delay the development of fatigue in firefighters while performing job tasks will enable them to retain better balance control.

2. Specific dynamic balance control exercises, particularly those that simulate the operational environment, include wearing of simulated or actual PPE, and manipulating equipment similar to what is used on the job, may be useful. Such exercises are likely to help firefighters develop more adaptive balance control and should be routinely integrated into training programs—further guidance in this regard was provided in the previous “TSAC Research Review” (6).

3. The balance control of part-time firefighters is likely to be enhanced by regular practice of simulated job tasks while wearing simulated or actual PPE and manipulating loads that simulate key equipment.

The challenge for tactical facilitators is to develop structured strength and conditioning programs that consider these requirements and are efficient and effective to conduct. Additional difficulty comes in when they consider and control for individual differences in fitness levels, individual injury risks, and individual training needs and goals.

**IMPACT OF OFFICER PHYSICAL FITNESS ON OUTCOMES WHEN ARRESTING STRUGGLING SUBJECTS**

While we could make assumptions about the need for police officers to be physically fit in order to be effective in arresting struggling subjects, it has been difficult to estimate just how important physical fitness might be, given that other factors like skill level and experience are probably also important. To address this knowledge gap, Dillern and colleagues recently quantified the extent that the outcome of efforts to arrest a real struggling subject is associated with the physical fitness of police officers (1). Their study involved 19 police graduate students, who had completed three years of training at the Norwegian Police University College, including mandatory courses in physical training and arrest handling. The simulated subjects for arrest (opponents) were other students. They played this role in separate arrest handling tests including a one-on-one take-down, two-on-one take-down, self-defence-struggle involving gaining control of an attacking opponent, and self-defence-strangleholds involving releasing themselves from four different strangleholds applied by an opponent. During the tests, they were assessed on a scale of 0 – 60 by two experienced assessors, and all tests were performed without any sort of weapon or aid. Each arrest handling test progressed in level of difficulty until the participant was assessed as being no longer effective, and the level they achieved determined their score. The scores achieved by each participant in all four arrest handling tests were combined to provide an overall “arrest handling index.” The authors then correlated physical fitness index and arrest handling index, and also examined the correlations between each of these indexes and age, height, body mass, and BMI.

The physical fitness index explained about 30% of the variance in the arrest handling index. This level of correlation is quite high given that there are other factors, including skill level and level of experience, which could be expected to impact upon arrest handling performance. The other findings worth noting were that:

- Physical fitness in these police graduate students declined with age, with age explaining 29% of the physical fitness index in these participants;
- Arrest index also declined with age, quite likely due to the decline in physical fitness observed in older participants (20% explained variance); and
- Neither height nor body mass of the participants were significantly correlated with the arrest handling index.

Although we cannot say for certain with this type of study design, which assessed levels of association between factors and outcomes rather than whether specific factors caused the outcome of interest, these findings do suggest that higher levels of physical fitness make police officers substantially more effective when arresting a struggling subject. The results also suggest that the bodyweight and height (or stature) of police officers are much less important than physical fitness in determining effectiveness of police officers when arresting a struggling subject. Finally, the results indicate that particular attention should be paid to building and maintaining the physical fitness of older police officers, so that they can remain effective when arresting struggling subjects.

These findings constitute useful motivational material, in that tactical facilitators working with police officers can highlight the strong links between physical fitness and the effectiveness of police officers in arresting and defending themselves against a struggling or resisting subject. This may be a means of further motivating police officers to train and maintain high levels of fitness. Tactical facilitators can also use these results to dismiss
the notions that stature or body mass of police officers will compensate for inadequate fitness when arresting a struggling subject. Finally, tactical facilitators can highlight the fact that older police officers need to pay additional attention to maintaining adequate levels of physical fitness to enable them to be effective when arresting a struggling subject. As further motivation, the tactical facilitator might like to point out to any older police officers who resist their strength and conditioning advice that older firefighters seem to be able to maintain similar levels of physical fitness to those of younger firefighters, indicating that there is no good reason that older police officers cannot do the same (5).

It should also be noted that the index of physical fitness used in this study was found to be well correlated with effectiveness when arresting a struggling subject and was based on assessments of strength for both pushing and pulling, explosive actions of the lower limbs, and aerobic fitness. The authors noted that these were deliberate inclusions in the overall physical fitness index, based on perceived fitness attributes typically required when arresting a struggling subject. Tactical facilitators may wish to consider these specific aspects of strength and conditioning when working with police officers to build their physical capacity to handle an arrest of a struggling subject as they are indeed important in determining outcomes in what could be considered to be a very dangerous situation.

PREDICTORS OF PHYSICAL PERFORMANCE IN WOMEN UNDERTAKING MILITARY-RELEVANT LIFTING AND LOAD CARRIAGE TASKS

With opportunities increasing for women to serve in combat roles, a clear understanding of the physical conditioning requirements for women in these roles is critical. A recent study by Dunn-Lewis and colleagues has provided useful information in this regard (3). In this study, 123 untrained women were assessed on a range of anthropometric and physical fitness tests. These included measures of height, weight, thigh muscle cross-sectional area, 1RM bench press, 1RM squat, 1RM high pull, 1RM box lift, maximum push-ups in 2 min, 2-mi run, squat endurance, and loaded jump power. In addition, they were assessed on two military-relevant occupational tasks:

- A repetitive box lift task (RBLT), which requires lifting boxes weighing 20.45 kg onto simulated cargo truck trays that were 1.32 m above the ground and 2.4 m apart. They did this repeatedly for 10 min, with the number of repetitions achieved being recorded.

- A load-bearing task assessed by carrying a 34.1-kg rucksack across a 2-mi distance for time.

The authors then employed correlation and regression analyses to determine which of the anthropometric and physical fitness factors predicted scores on the two military-relevant load carriage tasks in the participating women (3).

The results of these analyses revealed that scores on all of the measured anthropometric and physical fitness factors were correlated with scores on the military-relevant load carriage tasks. However, those factors most important in determining repetitive box lift performance (and thus being significant contributors to the final regression equation for RBLT performance) were loaded jump power, push-up performance, squat endurance, 1RM box lift performance, and 2-mi run time. Those factors most important in determining performance time on the load-bearing task were squat endurance, 2-mi run time, and body mass (kg), with the latter meaning that on average women with a greater body mass performed the load-bearing task in a shorter time. This last finding is particularly noteworthy, and is consistent with previous research on this topic (2). With all other things being equal, men and women with a higher body mass perform better in load carriage than their lighter peers. This is due, in part, because their muscle mass, strength, and absolute aerobic capacity are often higher, and because any given load represents a smaller proportional increase in overall weight for these heavier individuals than it does for lighter individuals (2).

Tactical facilitators that design strength and conditioning programs for women in the military, particularly programs preparing women for combat roles, will benefit from considering the key findings of this study. In particular, tactical facilitators may find it useful to consider the following:

- The strongest predictors of military-relevant repetitive lifting and load-carriage performance in women are listed. Strength and conditioning programs that specifically and progressively address these key factors, including maximal upper body strength, upper body and leg muscle endurance capacity, leg power, aerobic fitness, and muscle mass will enhance repetitive lifting and load-carriage performance in women. Of note, physical training to address these same types of factors has been reported previously to be important for developing load-carriage capacity in soldiers, generally (2). The current results simply reinforce findings that the same load-carriage training requirements apply to women and men (3).

- A review of relevant research findings noted that the physical training to address these factors and improve load-carriage performance will be most effective if it is specific to load carriage (2). Such training should incorporate strength training, aerobic training, and loaded marching—the latter with a frequency of at least 2 – 4 times per month and involving operationally relevant load-carriage conditions.
• In the context of the well-known and pervasive social pressures on women to restrict foods and reduce body mass it should be made clear that both men and women cope better with load carriage if their body mass is higher (2,3). Loss of muscle mass, which is likely to affect the strength required for load carriage adversely, is particularly troublesome. Focus must be placed on building strength and various aspects of operationally relevant fitness, and not on losing weight.

REFERENCES

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Rod Pope is currently an Associate Professor of Physiotherapy at Bond University in Australia. Pope provided clinical physiotherapy, rehabilitation, and injury prevention services at the Australian Army Recruit Training Centre before establishing and leading the Australian Defense Injury Prevention Program, at the request of the Defense Health Service Branch. In this role, he worked closely with senior military physical training instructors to optimize physical training practices. As part of this work and more recently in his university roles, Pope has conducted and supervised wide ranging research and consultancy projects on preventing injuries and enhancing performance during physical activity in tactical training and operational contexts. Very much a practitioner researcher, Pope’s research invariably stems from questions about practice in the field and aims to usefully inform this practice.
RUCK-BASED SELECTION TRAINING

Several organizations require tactical athletes to engage in endurance events while they carry heavy external loads. This includes entities such as military special operations, wildland firefighters, border patrol, as well as many other governmental agencies and organizations. Even the civilian world is creating a similar set of event challenges modeled after service training (e.g., Bataan Memorial Death March, GORUCK, and SERE Performance, to name a few). All of these events are based on a similar concept: requiring the participant to load up a pack (ruck) and cover a distance within a defined time period (whether or not the distance and/or time is known to the participant).

Training to move heavy weight over a distance presents the participant with a unique set of physical challenges not typically seen in other training programs. However, there is a greater risk for chronic and acute injuries if appropriate training is not engaged in prior to the event. Injuries ranging from soft tissue damage to stress fractures and compression injuries are common (8). The desired outcome is clearly defined as a “successful completion of the event by the participant with no injuries which would cause an inability to continue further or handle immediate operations” (injury is defined as continued discomfort after cessation of the event stimulus; participants are expected to experience some level of tolerable discomfort during the event) (8). It should be noted, the purpose of these events is to test an individual’s resolve, not to physically break them down.

Another important area of preparation is to approximate the final event as closely as possible during training. As such, exercise equipment requirements can be limited. At most, a place to perform pull-ups is needed. There are also two other items that can be thought of as the “low hanging fruit” of a ruck-based selection event: gear utilized and the biomechanics (mobility and techniques) of the individual. The topic of preventative foot care (with regards to taping, nail care, etc.), while extremely important, is outside the scope of this article.

GEAR

The two main components of gear that can typically be optimized are the individual footwear and the setup of the ruck; though control over the specific models and brands of either being utilized may not be available.

FOOTWEAR

Footwear is arguably one of the most critical components of ruck-based training since the participant will be moving weight over distance, mostly on foot. While some events have participants utilizing alternate modes of movement for sections (such as “bear crawls”), the majority of the movement in these events is by foot.

During a 10-km movement, assuming a “pace count” of 70 single steps per hundred meters (which approximately equates to 140 steps depending on the individual), the participant will strike the ground approximately 14,000 times with their bodyweight in addition to the added ruck weight. Footwear that reduces or minimizes the effect of this impact is important.

Another factor to consider is that humans thermoregulate and offload heat via the feet by sweating (the feet account for only one of several means for thermoregulation) (10). For example, feet that are wrapped in a couple layers of socks and encased in leather boots will have a tendency to collect excessive moisture. Excessive moisture can cause maceration of the tissues in the feet (2). This moisture will increase the risk of blistering (3). Participants should consider footwear that has appropriate venting (or those that are truly breathable), as well as socks (or other linings) that can effectively wick away moisture. They should also take opportunities to remove footwear and socks, when possible, to allow their feet to dry out, or use products designed for that purpose.

Avoiding footwear that is snug at the outset of the event or while the individual is unweighted is important as well. There is evidence to suggest that the size of the foot changes as weight is added to the individual (the referenced study showed size increase merely from the change from sitting to standing) (6). Footwear which fits “snugly” at the beginning of the training or event may induce a soft-tissue injury in the form of blisters as the potential increase in the size of the foot may begin to create pressure points. Additionally, temperature should be considered since it can indirectly decrease or increase available volume inside the footwear (cold temperatures may require the participant to wear thicker socks, etc.). It is important that the selected footwear, for both the training and the event, meets the criteria of being breathable, non-constricting, and sufficiently cushioned.

RUCK

The two most important factors of a ruck are how it contacts and connects with the individual and the way in which the weight is packed internally. It is not uncommon for the required weight in the ruck to be as much as 25 – 40% of the individual’s bodyweight. This means an average military operator who weighs 180 lb (81.6 kg) may carry a 60-lb (36.2 kg) ruck, which is around 33% of their bodyweight (5,11). In this example, the participant will move 240 lb over the distance of the event.

Firstly, it is important to make sure the ruck fits correctly to the individual’s body. If the ruck has a true hip belt (structurally designed to tie the frame to the individual’s pelvic girdle), it should be placed correctly to maximize the mechanical advantage. The shoulder straps should also be set for the torso length and
angle to efficiently pull the body of the ruck into the individual. Due to the wide variability in design, it may be beneficial to consult the manufacturers’ instructions before setting up and configuring the ruck.

Once the ruck has been fitted, it is important to ensure that the weight is loaded optimally to maximize the effectiveness of the structure of the pack. Generally, it is ideal to have the heaviest weight as high up and as close to the body as possible. This allows for a better way to engage the structural support of the spine and skeletal system, as well as reduce potential mechanical levers against the center of gravity (4). It is also important to take measures to prevent the load from shifting to a suboptimal position while inside the ruck. This can be accomplished by use of integrated compression straps that can be found in most rucks. Alternatively, something as simple as a bungee cord can be used and should be attached in such a way as to reduce or eliminate empty spaces in the pack via compression.

MOBILITY AND TECHNIQUE

Another consideration is how the individual moves the weight. The most efficient method for movement is evocative of the Pose Method®, and is commonly referred to as the ruck (or airborne) shuffle (9). The main relevant principles and concepts in the use of the Pose Method are the optimization of gravity and the transition of support. Since the individual is overloaded beyond bodyweight, it is essential to minimize the impact to the joints, while effectively utilizing as much advantage from forward momentum and gravity as possible (to better conserve energy and increase efficiency). This method also includes a focus on minimizing heel striking while limiting over-striding. This means that it translates to short steps with forehead landing with proper alignment of the acromion, greater trochanter, and lateral malleolus (1).

PRINCIPLES OF TRAINING

As with most training programs, the ultimate goal is to engage the tactical athletes in progressive overload within a periodized schedule. In some cases, the timing may need to be modified but the same basic concepts can still be followed. The weight and distance should be gradually increased while ensuring proper movement technique and ample recovery time to allow the tactical athlete to peak just prior to the event. The general concept is to increase weight, distance, and speed with the goal of peaking 7 – 10 days before the actual event. Using a six days per week training plan that is macro- and micro-periodized, the program can consist of alternating between increasing weight and increasing distance every other week.

SAMPLE 12-WEEK PROGRAM

This sample program should serve as a basis for development of a program for a specific event.

In this example, the participant is an otherwise healthy 25-year-old, 200-lb male attempting a 20-mi event with 25% of total bodyweight (dry; required weight does not include consumables such as food or water) and with a required maximum event time of 10 hr. This equates to a ruck with 50 lb and a pace of 20 min per mile. It is usually a good idea to build in some margin for error. One way to do this is to increase the event goals by about 20% in all categories. This means that the ultimate training goal will be 24 mi with a 60-lb ruck at a pace of 16 min per mile (approximately 3.7 miles per hour).

As stated in the previous section, weight and distance are increased on alternate weeks. Each measure will be increased by a percentage based on the number of periods. Two exceptions in the training cycle can be made. Firstly, a baseline measure is needed for determining the volume of training, which can be done during the first week (if the schedule is very short and compressed, it may be helpful to determine baselines prior to beginning the program). Secondly, there is documented evidence that suggests that individuals are more prone to injury from overuse in the third week of a new training program as the body adjusts to the new training volume (7). Based on this overtraining evidence, distance and weight will remain static during the third week. In addition, the medium ruck and running will each alternate on day 2 each week to minimize the potential for overtraining.

Projecting speed requirements should be done after a baseline is established during the first week’s performance. This should be based on the pace of the tactical athlete during the 4-mi timed ruck. For the sake of this example, a tactical athlete averaged an 18.75 min/mi pace (or approximately 3.2 miles per hour). For a 12-week program, this means increasing the tactical athlete’s speed by 0.6 miles per hour (or roughly shave three minutes per mile from their time) each week. This equates to increasing their pace so the average per mile time is reduced by 15 s/mi.

The microcycle should follow a high-medium-low-high-rest intensity pattern. This pattern is sometimes difficult to achieve as it is easiest to perform the “long” day on days with more available time, such as weekends for people with weekly jobs, etc. Adjustments may be necessary for a specific tactical athlete’s schedule, but the order should still be kept intact. The rationale for this is that a gradual tapering up of intensity throughout the week with the third training day doubling as a pseudo “rest” day and a full true rest day after the week’s maximal exertion. The second medium day should comprised of a metabolic workout that minimizes the effects of gravity whenever
possible by utilizing activities that have a reduced load on the skeletal system (e.g., cycling, swimming). The metabolic protocols should meet those of a moderate, or medium, intensity workout.

It is also important to work on both the tactical athlete’s flexibility and trunk strength throughout the entire training cycle. It is especially important to ensure that good flexibility in the trunk, Tensor Fascia Latae (TFL), and shoulders is maintained. To facilitate and simplify the strengthening routines, two different sets of exercises are recommended. These should not be overly varied or complex exercises since the purpose is not to increase strength in these areas greatly, but rather to keep balance in the routine. Conditioning the shoulders and upper back may help to reduce fatigue from carrying the ruck as well. Additionally, developing the trunk area may assist with keeping the trunk stable. Finally, proper warm-ups and cool-downs that include stretching may be vital for helping to prevent overuse injuries.

**UPPER BODY COMPLEX**
- 1 x pull-ups, normal from dead hang (vertical pull)
- 2 x push-ups, normal (horizontal push)
- 1 x dips (vertical push)
- 1 x rows (horizontal pull)

**TRUNK COMPLEX**
- 3 x sit-ups, normal
- 3 x oblique sit-ups
- 5-s planks

These above complexes should be performed in a pyramid fashion with the numbers in parenthesis acting as modifiers for the repetitions in the complex for that day. So, in the program, when it says:

- 2 x trunk complex (2-4-2)

It means to do the following two times:

- 6 x sit-ups, normal (2 x 3 sit-ups)
- 6 x oblique sit-ups (2 x 3 oblique sit-ups)
- 10-s plank (2 x 5-s plank)
- 12 x sit-ups, normal (4 x 3 sit-ups)
- 12 x oblique sit-ups (4 x 3 oblique sit-ups)
- 20-s plank (4 x 5-s plank)
- 6 x sit-ups, normal (2 x 3 sit-ups)

- 6 x oblique sit-ups (2 x 3 oblique sit-ups)
- 10-s plank (2 x 5-s plank)

To give a rough idea of the maximum volume from this sample program, the final week’s “strength” workout consists of:

- 2 x upper complex (1-2-3-4-5-4-3-2-1)
- 2 x trunk complex (4-6-4-6-4)

**RUNNING**

The program should have a day devoted to running progressively longer distances every other week, but no more than half of the week’s maximum distance for the ruck. Intensity is going to follow the pattern of an easy run the first week at a distance and a moderate pace the following weeks. Starting on week seven, discontinue the distance runs (with the exception of deloading on week 9) and transition to interval training to keep the overall distance volume down. These workouts should start with a light intensity 1-mi run for a warm-up. Next, the tactical athlete should sprint a distance on a time interval. For example, “5 x sprint 100-m on 60 s” means they should run five 100-m sprints, with each sprint being completed within 60 s (if they beat the 60 s and return to the start, they get to rest for the remainder; the next sprint starts immediately after the 60 s expires). After the interval set, have the tactical athlete do a maximal “burnout” with a Tabata-style exercise. They should complete eight continuous rounds of a 20-s, full-intensity sprint, followed by 10 s of recovery (walking or jogging). This section will take four minutes total. The final item should be an easy half-mile jog used as a cool-down.

**WEEK 1**

**DAY 1 (HIGH)**
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

**DAY 2 (MEDIUM)**
Run: half of maximal distance at an easy pace, 2 mi

**DAY 3 (LOW)**
1 x upper complex (1-2-3-4-5-4-3-2-1)
1 x trunk complex (2-4-6-4-2)

**DAY 4 (MEDIUM)**
Metabolic workout

**DAY 5 (LOW)**
1 x upper complex (1-2-3-4-5-4-3-2-1)
1 x trunk complex (2-4-6-4-2)
DAY 6 (HIGH)
Timed ruck: 4 mi with 10 lb (dry) as fast as possible without running (record pace to use for determining speed progression); perform in full kit to mimic the clothing and equipment of the event

WEEK 2
DAY 1 (HIGH)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks
DAY 2 (MEDIUM)
45-min ruck with 10 lb (dry)
DAY 3 (LOW)
1 x trunk complex (4-6-4-6-4)
DAY 4 (MEDIUM)
Metabolic workout
DAY 5 (LOW)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)
DAY 6 (HIGH)
Timed ruck: 4 mi with 20 lb (dry) in full kit at a 18.5 min/mi pace (1h:14m)

WEEK 3
Week three is special in that it is important to attempt to reduce the risk of injury from training increases typically seen in the third week and it is generally related to movement over distance.
DAY 1 (HIGH)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks
DAY 2 (MEDIUM)
Run: half of maximal distance at an easy pace, 2 mi
DAY 3 (LOW)
1 x trunk complex (4-6-4-6-4)
DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)
DAY 6 (HIGH)
Timed ruck (slightly slower pace): 4 mi with 20 lb (dry) in full kit at a 18.25 min/mi pace (1h:13m)

WEEK 4
DAY 1 (HIGH)
1 x upper complex (5-8-9-8-5)
2 x trunk complex (2-3-5-3-2)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks
DAY 2 (MEDIUM)
60-min ruck with 20 lb (dry); goal is to push distance
DAY 3 (LOW)
2 x trunk complex (2-3-5-3-2)
DAY 4 (MEDIUM)
Metabolic workout
DAY 5 (LOW)
1 x upper complex (5-8-9-8-5)
2 x trunk complex (2-3-5-3-2)
DAY 6 (HIGH)
Timed ruck: 8 mi with 20 lb (dry) in full kit at a 18 min/mi pace (2h:24m)

WEEK 5
DAY 1 (HIGH)
1 x upper complex (5-8-9-8-5)
2 x trunk complex (2-3-5-3-2)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks
DAY 2 (MEDIUM)
Run: half of maximal distance at a moderate pace, 4 mi
DAY 3 (LOW)
2 x trunk complex (2-3-5-3-2)
DAY 4 (MEDIUM)
Metabolic workout
DAY 5 (LOW)
1 x upper complex (5-8-9-8-5)
2 x trunk complex (2-3-5-3-2)

DAY 6 (HIGH)
Timed ruck: 8 mi with 30 lb (dry) in full kit at a 17.75 min/mi pace (2h:22m)

WEEK 6

DAY 1 (HIGH)
2 x upper complex (3-4-6-4-3)
2 x trunk complex (2-4-6-4-2)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
60-min ruck with 30 lb (dry); goal is to exceed distance from previous week

DAY 3 (LOW)
2 x trunk complex (2-4-6-4-2)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
2 x upper complex (3-4-6-4-3)
2 x trunk complex (2-4-6-4-2)

DAY 6 (HIGH)
Timed ruck: 12 mi with 30 lb (dry) in full kit at a 17.5 min/mi pace (3h:30m)

WEEK 7

DAY 1 (HIGH)
2 x upper complex (3-4-6-4-3)
2 x trunk complex (2-4-6-4-2)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
Jog: 1 mi at an easy pace
5 x sprint, 100-m on 60 s
8 x sprint, Tabata around 400-m track
Jog: 0.5 mi at an easy pace

DAY 3 (LOW)
2 x trunk complex (2-4-6-4-2)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
3 x upper complex (2-3-5-3-2)
2 x trunk complex (2-5-7-5-2)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
60-min ruck with 40 lb (dry); goal is to exceed distance from previous week

DAY 3 (LOW)
2 x trunk complex (2-4-6-4-2)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
3 x upper complex (2-3-5-3-2)
2 x trunk complex (2-5-7-5-2)

DAY 6 (HIGH)
Timed ruck: 16 mi with 40 lb (dry) in full kit at a 17 min/mi pace (4h:32m)

WEEK 9 (DELOAD WEEK)

DAY 1 (HIGH)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)

DAY 2 (MEDIUM)
Run: half of maximal distance at an easy pace, 4 mi

DAY 3 (LOW)
1 x trunk complex (4-6-4-6-4)

DAY 4 (MEDIUM)
Metabolic workout
DAY 5 (LOW)
1 x upper complex (5-10-15)
1 x trunk complex (4-6-4-6-4)

DAY 6 (HIGH)
Timed ruck (slightly slower pace): 8 mi with 40 lb (dry) in full kit at a 18 min/mi pace (2h:24m)

WEEK 10

DAY 1 (HIGH)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
60-min ruck with 50 lb (dry); goal is to exceed distance from previous week

DAY 3 (LOW)
2 x trunk complex (4-6-4-6-4)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)

DAY 6 (HIGH)
Timed ruck: 20 mi with 60 lb (dry) in full kit at a 16.5 min/mi pace (5h:30m)

WEEK 11

DAY 1 (HIGH)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
Jog: 1 mi at an easy pace
9 x sprint, 100-m on 60 s
8 x sprint, Tabata around 400-m track
Jog: 0.5 mi at an easy pace

DAY 3 (LOW)
2 x trunk complex (4-6-4-6-4)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)

DAY 6 (HIGH)
Timed ruck: 24 mi with 60 lb (dry) in full kit at a 16 min/mi pace (6h:24m)

WEEK 12

DAY 1 (HIGH)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)
Maximal exertions of dead hang pull-ups, push-ups, sit-ups/crunches, and planks

DAY 2 (MEDIUM)
60-min ruck with 60 lb (dry); goal is to exceed distance from previous week

DAY 3 (LOW)
2 x trunk complex (4-6-4-6-4)

DAY 4 (MEDIUM)
Metabolic workout

DAY 5 (LOW)
2 x upper complex (1-2-3-4-5-4-3-2-1)
2 x trunk complex (4-6-4-6-4)

DAY 6 (HIGH)
Timed ruck: 24 mi with 60 lb (dry) in full kit at a 16 min/mi pace (6h:24m)
REFERENCES


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THE IMPORTANCE OF PROPER MOVEMENT FOR MARINES—PART 2: THE SOLUTION

This the second part of a four-part series on proper movement as it pertains to Marines. The first part discussed the current issues commonly found in the United States Marine Corps including musculoskeletal injuries caused by overtraining or repeated improper movement patterns.

Current musculoskeletal injury rates continue to hamper operational readiness and it is well established that quality movement gained through increased mobility and stability reduces injuries (15). The following holistic solution is proposed to increase functional, quality movement among Marines, thereby increasing physical performance, reducing injuries, and developing more effective warfighters. The holistic solution includes:

1. Enhancing mobility, stability, and movement quality by adjusting the standards of movement on the pull-up, crunch, and ammunition can lift.
2. Incorporating an evidence-based movement assessment into the Physical Fitness Test (PFT) and Combat Fitness Test (CFT) in order to ensure Marines are executing functional movement patterns and to hold Marines accountable for maintaining their mobility and stability.
3. Enhancing the current Combat Conditioning Instructor billet by providing formal education, similar to the Army’s Master Fitness Trainer Course, as well as increasing movement education at the recruit depots, Officer Candidate School, The Basic School (TBS), and the Staff Noncommissioned Officer (SNCO) Academy in order to ensure Marines understand how to move functionally and why it is important.

The approach to improving movement quality must be comprehensive. If only certain elements are implemented with certain populations, the change will be less likely to last (5). For example, if recruits at the Marine Corps Recruit Depot (MCRD) are given thorough instruction on proper movement, but upon reaching the operating forces those same movement assessment practices are not followed, these Marines may resort to doing what their small unit leaders are doing and lose the quality movement patterns gained during boot camp. Likewise, if SNCOs are given thorough movement instruction and assessment training at the SNCO Academy, but then return to their units where there is no movement accountability and the concept is not fully embraced by their unit’s leadership, they may be unable to share their newly gained knowledge. Similarly, if a new lieutenant checks into a unit and wants to assess the Marines’ movement quality and teach the proper movement techniques learned in TBS, but no one else in the unit is on board with these concepts, the lieutenant may be unsuccessful.

The Joint Services Physical Training Injury Prevention Working Group, which consisted of 29 military and civilian public health practitioners, clinicians, training officers, epidemiologists, analysts representing the four United States military services, injury experts from the Center for Disease Control (CDC), and professors at academic institutions, determined that education and leadership support were two absolutely necessary factors when implementing any type of injury prevention program (1). Leaders must fully buy into the concept and Marines must understand why it is important to have quality functional movement. Implementing these changes will require engaged leadership as resistance to any change is likely to be high. However, the current musculoskeletal injury rate affects operational readiness too much to continue to ignore the problem and hope that by continuing to do things the same way the problem will magically disappear.

PROPOSED MODIFICATIONS TO CURRENT MOVEMENT STANDARDS

In addition to evidence-based movement screening and education to increase their mobility and stability, the Marine Corps can require Marines to meet modified movement standards on the PFT and CFT, which will subsequently force Marines to increase their mobility and stability and improve their movement quality. Research shows that Marines will train to the tested standard (16). For example, in 1996 when Marines were allowed to kip on pull-ups, the average PFT score was 252 out of 300. When the standard changed the following year to dead hang pull-ups, the average PFT score was 252 out of 300. When the standard changed the following year to dead hang pull-ups, the average PFT score dropped to 225; however, by 2010 the average was back to 252 (12). Individual event scores were not kept prior to 2009. Knowing that pull-ups are worth five points on the PFT and that nothing else changed from 1996 to 1997, one can surmise that the average Marine performed five fewer pull-ups when the standard initially changed. The fact that the average PFT score incrementally rose back to where it was pre-dead hang pull-ups implies that Marines knew the maximum score for pull-ups was 20 and they trained to that standard. This also infers that if the standard were adjusted to 25 pull-ups as the maximum score, for example, the average number of pull-ups would potentially increase. Capitalizing on that concept, if the standards for movement with the current PFT and CFT exercises required more mobility, stability, and movement quality to execute, Marines would likely develop the appropriate movement patterns in their training to complete each event.
The Commandant of the Marine Corps explains that “the PFT was specifically designed to test the strength and stamina of the upper body, midsection, and lower body, as well as efficiency of the cardiovascular and respiratory systems,” (3). Implementing changes to movement standards that require increased mobility, stability, and movement quality can better execute the intent of the PFT. The first standard that should be adjusted is the pull-up. The current pull-up instructions in Marine Corps Order (MCO) 6100.13 allow for the palms to face inward or outward, the legs to bend at the knee, the head to be cocked back with the chin extended upward, and the thumbs to be either wrapped around the bar or placed adjacent to the fingers on top of the bar (3). The first modification proposed is to require the thumbs to be wrapped around the bar. Whether executing a pull-up (pronated grip) or chin-up (supinated grip), the thumb wrapped around the bar sets the shoulders into an internally rotated position, which is far more stable than an externally rotated shoulder position (17). The second modification proposed with respect to the pull-up involves maintaining a stable body position throughout the entire pull-up movement. Current standards allow Marines to overextend the lumbar spine and extend the neck to raise the chin to the bar.

Therefore, the recommended movement standard modification is to require Marines to create a stable torso by contracting the glutes and core muscles, and keeping a neutral head position when executing the pull-up.

While executing one set of pull-ups for a PFT with a dysfunctional movement pattern may not cause musculoskeletal injuries, executing hundreds of sets of pull-ups in training to prepare for the PFT may cause injury. Is executing a pull-up with the proposed grip and torso fully stabilized harder than the current standard? Absolutely; however, in keeping with the psychological aspects of training to the standard, Marines will likely make the necessary adjustments in their training and eventually achieve the same scores currently achieved (12).

In addition to modifying the pull-up movement standards, an exercise should be considered as an alternative to the crunch, which may more directly correlate with the ability to stabilize under load. Conducting a tactical task, such as dragging a wounded Marine to safety with dysfunctional movement can contribute to a lower back musculoskeletal injury (13). The fireman’s carry that is part of the Maneuver Under Fire course in the CFT requires trunk stabilization and directly reflects the stability required for various combat-related tactical tasks. While many Marines do not realize that this maneuver is evaluating the ability of the abdominals to stabilize under load, they do train specifically for that movement because they know it is part of the test. While the CFT does currently have an event that evaluates the abdominals through a stabilization requirement, the PFT does not. Knowing that Marines will train to the test, incorporating exercises into the test that require abdominal involvement that directly corresponds to improved stabilization under load may decrease musculoskeletal injuries and improve operational effectiveness.

The final proposed movement standard modification involves the CFT’s ammunition can lift. The current ammunition can lift instructions permit Marines to bend the knees, stagger the feet or have them shoulder-width apart, lean back, and press the ammunition can over their chest instead of their head (3). The fundamental flaw with this exercise is that Marines are allowed to move their back into hyperextension, and while executing one ammunition lift in this sequence may not cause a musculoskeletal injury, doing hundreds of sets in this manner may lead to musculoskeletal injuries in the lower back (11,13).

In addition, movement patterns become permanent; so, if Marines become accustomed to lifting items overhead with a hyperextended back, this pattern will likely be what they resort to during combat (4). The proposed movement standard should be adjusted to require a vertical torso at the end of the exercise. The ammunition can should finish over the head and not out in front of the body so that from a side view the ammunition can, participant’s arms, shoulders, torso, and legs are all in one straight line. Leaning back slightly while pressing the ammunition can overhead should still be permitted but a vertical torso angle should be reached upon full extension of the ammunition can overhead. Adjusting the ammunition lift to require trunk stabilization and overhead mobility will enforce positive movement patterns, which may help to create more effective warfighters. Without a doubt, all the proposed changes make the exercises harder to perform because the modifications require increased mobility, stability, and movement quality.

These proposed movement standard modifications are a critical component to a holistic approach at improving Marines movement quality. Modifying the movement standards for pull-ups, crunches, and ammunition can lifts in the PFT and CFT may be a key component to improving movement quality among Marines. When combined with an evidence-based movement assessment they can make direct contributions to musculoskeletal injury reduction and increased operational readiness across the Marine Corps.

Part three of this series will discuss evidence-based movement assessments, and how they can help with this issue facing the United States Marine Corps.
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Matt Zummo is currently the Executive Officer for 2d Tank Battalion, 2d Marine Division. He has over 15 years of experience as an active duty Marine Corps officer with multiple combat deployments. Having served as a platoon commander, company commander, battalion operations officer, and at the Marine Corps Recruit Depot San Diego and Officer Candidate School, he has trained thousands of Marines in various environments to include during austere combat deployments. He has a Bachelor of Science degree in Business Administration from the University of Colorado, a Master’s degree in Military Studies from the Marine Corps University, and is a Level 1 FMS, Level 1 USAW Sport Performance Coach, and CrossFit Level 1 coach.
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REINTEGRATION CONSIDERATIONS FOR TACTICAL ATHLETES

Most special operations units, whether military or law enforcement, conduct periodic selection barrier testing. It continues the recruitment, training, and placement cycle, as tactical athletes leave due to promotion, professional development, or retirement. Due to the high-tempo and high-pressure work environment tactical athletes experience for years, they often seek other employment options due to burnout, personal reasons, or further professional development. After time away, some tactical athletes may feel the urge to return to the operational arena. This then raises questions over their current physical, cognitive, and operational status. For example, where has the tactical athlete been performing their duties (if at all)? Have they lost skillsets or specific physical conditioning? These questions open the door to other issues, as it is widely recognized in the specialist operations community that senior operational members offer valuable operational experience that cannot be trained or bought, hence their tangible value as a specialist human resource. Then, how should they be reintegrated when they come back into a kinetically operational workplace from a strength and conditioning perspective?

NEEDS ANALYSIS

Recent studies have shown the need for the tactical athlete to be well conditioned for load carriage (3). Further studies demonstrated the positive influence of effective strength and conditioning programs to prevent injury during barrier testing (2). As such, selection procedures are arduous and present a high risk of injury or illness. Do we really want to expose experienced, some would say “veteran,” tactical athletes to the same barrier tests as first-time candidates and run the risk of injury? The answer is often “no” since once a member has passed the barrier testing successfully it is recognized that the human template is capable of being molded, trained, and further developed to pass the barrier. The reintegrating member has already proven this over years of being operational; however, a recognized benchmark still needs to be achieved that directly reflects the operational role. One method to determine this benchmark is to work backwards from the operator end-state by considering these questions:

1. What does the tactical athlete need to perform?
2. How fast do they need to perform it?
3. How much load and resistance do they need to carry?
4. What distance do they need to be able to cover and under what load?

5. How strong do they need to be relative to bodyweight?
6. How can all the above be tested properly?
7. Should age be benchmarked or scaled? Should the benchmark be a set standard that does not fluctuate depending on age?

SKILLS ANALYSIS VS. PHYSICAL REQUIREMENTS

The above are all valid questions and by no means exhaustive. When exploring the challenge of reintegration, it may be useful to categorize the basic tangible physical requirements of the tactical athlete related to the core skill sets.

They are all required to perform close quarter battle (CQB) clearances while dressed with a “high level” of personal protective equipment, including ballistic helmets, vests, respirators, and a rifle. These clearances can be for sustained periods under high stress and may even include movement through multi-level buildings. Therefore, general aerobic conditioning, strength endurance, high strength-to-bodyweight ratio, and agility are all identified as important physical qualities (1).

Reintegrating members are required to perform weapon fire and movement, and movement over urban terrain (MOUT) with a full combat load. The members are required to respond to major public disorders and riot events while carrying heavy loads. In addition to wearing heavy personal protective equipment (PPE), they have to be able to carry shields, less than lethal munitions, and a number of weapon delivery platforms. All of this requires strength endurance, anaerobic endurance, lactic tolerance, and aerobic conditioning.

The members have to be able to conduct “man down drills,” whether in an urban or rural environment. Therefore, they have to be able to move an injured tactical athlete while still wearing a full combat load. This requires strength, power, strength endurance, aerobic conditioning, and agility.

The members must be able to undertake protracted rural operations and self-sustainment with a full combat load while wearing a ruck or body armor. This requires strength endurance, aerobic conditioning, and specific ruck carrying endurance.

While there are other skill tests and tests that identify specific phobias (water, heights, confined space, etc.), these are secondary considerations to the primary criteria. Basic entry-level barrier tests for reintegrating tactical athletes are listed in Table 1, but pass marks may vary based on operational scope.
CONCLUSION
The selection of members for specialist operations teams follow similar patterns and requirements. The basic physical requirements of strength endurance, aerobic conditioning, coordination, agility, and power are all augmented with traits such as problem solving, fatigue tolerance, teamwork, and patience. Most specialist operations groups struggle to recruit the right fit, let alone retain them. The returning and reintegrating members need to be fostered and supported while acknowledging the physical conditioning parameters that need to be achieved, which are directly reflective of the role.

Another aspect that has to be considered is injury prevention and management, especially concerning age and previous injuries. This has to be balanced with the essential requirements of the role (e.g., can the member still perform to their optimum level as a tactical athlete and can they continue to be adequate contributors to an operational team).

The veteran tactical athlete can be assessed and reintegrated to the operational workplace and continue to contribute. The tactical facilitator should seek to strike a balance that not only mitigates the risks to the team and the individual tactical athlete, but also maintains high standards and helps the tactical athlete contribute to the unit’s capability and morale.

REFERENCES

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Shane Irving is currently serving as a tactical law enforcement officer in Australia. He has over 20 years of experience working domestically and internationally as a member of the Australian Police Tactical Groups and Special Operations community. Irving has an undergraduate degree in Exercise Science and supervises the physical conditioning of tactical officers in his current occupational role. He has also represented Australia as an elite athlete in track and field and triathlon. Irving is commencing his postgraduate studies at Bond University as part of the Health Sciences and Medicine Faculty.

TABLE 1. TASK REQUIREMENTS FOR PHYSICAL BARRIER TESTS

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<thead>
<tr>
<th>TASK/ROLE</th>
<th>PHYSICAL ATTRIBUTES</th>
<th>POTENTIAL BARRIER TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close Quarter Battle</td>
<td>Aerobic conditioning, strength, strength endurance, lactic tolerance, and bodyweight</td>
<td>Heaves test, basic strength tests, overhead press, front squat, deadlift, bench bodyweight for reps, beep test, Yo Yo test</td>
</tr>
<tr>
<td>Movement Over Urban Terrain</td>
<td>Aerobic/anaerobic conditioning, agility, bodyweight, and strength</td>
<td>Beep test, Yo Yo test, timed obstacle course in basic combat load</td>
</tr>
<tr>
<td>Riot</td>
<td>Strength endurance, and aerobic/anaerobic conditioning</td>
<td>Timed 500-m run in full PPE while carrying shield</td>
</tr>
<tr>
<td>Man Down Drills</td>
<td>Strength, power, anaerobic conditioning, and agility</td>
<td>Timed dummy drag, 85 kg replicating the average tactical athlete weight, and clean skin</td>
</tr>
<tr>
<td>Ruck Carry</td>
<td>Aerobic conditioning and specific conditioning under load carriage</td>
<td>Timed ruck carry of 35 kg over 20 km</td>
</tr>
</tbody>
</table>
TACTICAL PROGRAMMING CONSIDERATIONS—PREPARING FOR THE ARMY PHYSICAL FITNESS TEST

The value of a well-planned strength and conditioning program cannot be overstated when it comes to successfully preparing United States Soldiers for the Army Physical Fitness Test (APFT). The APFT is composed of three events: two-minute push-ups, two-minute sit-ups, and a 2-mi run (1,2). The training and coaching provided, in many situations, impacts whether a potential soldier passes or fails the test. There are many factors to consider in the planning, preparation, and implementation of any strength and conditioning program in an Army training environment. Although obstacles may exist, with proper planning, the tactical facilitator can be successful in preparing potential soldiers for the APFT properly.

TIME CONSTRAINTS AND TIME MANAGEMENT
Within a United States Army Initial Entry Training (IET) environment, Advanced Individual Training (AIT) soldiers operate primarily on a regimented schedule. The activities and drills of the day keep them busy and on the move. Outside of morning Physical Training (PT), the amount of time left in the daily schedule for structured exercise is minimal.

This means that the tactical facilitator may not be operating on a traditional schedule where workout times are always set in advance. Some workout sessions may be planned into the daily schedule, but many times the tactical facilitator is called upon at the last minute to provide training for soldiers.

Due to the sporadic nature of training sessions, the tactical facilitator must be flexible and ready at all times. It is in their best interest to always have programs prepared that address all areas of concern for the whole population of soldiers. Knowing the general make-up of the typical soldier helps tremendously when developing exercise programs. Having these generic, but specific to the task, program templates saves time and gives the tactical facilitator the ability to train anyone at any time. This preparation can help keep the tactical facilitator from being caught off guard and wasting time figuring out a plan of attack.

FACTORS IMPACTING PROGRAMMING AND PLANNING
Program design for a tactical facilitator operating in an Army training setting is different from that of a strength and conditioning professional designing programs in a civilian setting. Designing performance enhancement programs for AIT Soldiers requires an understanding of the amount and type of equipment available, the training environment, and the soldiers themselves. These three factors guide program design and help the tactical facilitator design programs effectively.

In most IET environments, the availability of strength and conditioning equipment is dependent upon battalion budget and how much is allocated to purchasing exercise equipment. This means that the tactical facilitator may have access to a little or a lot of equipment. The amount and type of available equipment influences the types of lifts and exercises that can be implemented.

The area of operation that the tactical facilitator trains in may impact programming as well. For instance, if a tactical facilitator has access to a large space that is conducive to training, it may allow for more creativity in the programing. It may also allow for more traditional strength and conditioning activities. On the other hand, the training space could be a converted or repurposed area that may not be ideal for training activities. If constricted to a smaller area or rough terrain outdoors, the tactical facilitator may have to make many adjustments while being mindful of the fact that the safety of the soldiers comes first.

The exercise backgrounds and fitness levels of the soldiers coming into each battalion and battery may vary greatly. Although the duties and physical demands of military occupation specialties (MOS) may be similar, the individuals that qualify for those MOSs may have experience levels ranging from novice to expert in relation to organized exercise and physical activity. This variation of exercise experience between soldiers may be one of the most influential factors in the tactical facilitator’s programming process. In some cases, what may be viewed as a beneficial method of achieving a passing score on the APFT for one soldier may not be suitable for other soldiers. To overcome this, the tactical facilitator should develop programs that are highly adaptable. In some cases, there may only be as few as one or two training sessions with the AIT soldiers before they take the APFT.

BASIC COMPONENTS OF A TRAINING PROGRAM TO HELP IMPROVE APFT PERFORMANCE
As stated previously, the training programs the tactical facilitator develops should be highly adaptable. Programs should include key components that guide the tactical facilitator no matter who is being trained. Primarily, a training program to help soldiers prepare for the APFT should:
1. **Enhance Performance on the Three Portions of the APFT**
   Success on the APFT should be a focus of any training program, aside from general soldier readiness. It should, in its barest form, be able to assist soldiers in accomplishing this task.

2. **Provide a Basic Introduction to Form and Technique for Both Lifting and Running**
   The program should teach the soldiers proper lifting technique as it pertains to the lifts used in the program. It should also provide a basic understanding of body alignment and foot strike techniques, as well as checkpoints to be aware of when they are running in order to assist with pacing.

3. **Create Physical Balance**
   In an Army environment, regular PT often includes push-ups, sit-ups, and running. While the program must address improving performance in these areas for the APFT, it should also include movements that strengthen and add stability to the entire body. Many soldiers have muscular imbalances that lead to injuries and the tactical facilitator should attempt to prevent and mitigate as many injuries as possible.

4. **Provide Trunk Strength, Endurance, and Stability**
   The tactical facilitator should use knowledge and expertise in this area to provide the best trunk training possible without sacrificing in other areas of training. The program should address trunk strength, endurance, and stability as it pertains to the events of the APFT as well as general soldier readiness.

5. **Provide Basic Sports Nutrition Information**
   Some AIT soldiers may have limited knowledge on how to maintain proper nutrition. While it is out of the scope of practice for a tactical facilitator to prescribe a diet, it may be useful to provide soldiers with basic nutritional information as it pertains to fueling their bodies for performance properly. An example of a source of information readily available to army personnel can be found on the Army Human Performance Resource Center at http://hprc-online.org/nutrition.

Programs should be specific to the individual soldier’s needs, providing the knowledge and physical capabilities to pass the APFT. Programs should include a guided warm-up, a self-paced workout, and a guided cool-down/stretching session. Self-paced workouts are more conducive because they give the tactical facilitator the ability to freely monitor the group and give individual coaching as needed. However, the tactical facilitator should guide all running, speed, agility, and quickness drills as well as all endurance exercises. These sessions require more instruction and allow the tactical facilitator to ensure proper pacing, technique, breathing methods, etc.

Table 1 is an example of a program that was used for the 1-78th Field Artillery 428th Field Artillery Brigade. For the purposes of this article, the format used in Table 1 is that of a five-day training schedule. In most situations, the tactical facilitator may have to adjust a “skeleton” program on a day-to-day or session-by-session basis based on the exercises performed and the intensity of the morning PT session. Program specifics such as load, repetition range, sets, rest periods, etc. are at the discretion of the tactical facilitator and should be individualized based on the skill set and abilities of each soldier. As there is the possibility of working with a different group of soldiers each session, some exercises are repeated on multiple days due to their effectiveness in improving scores on the APFT.

**CONCLUSION**

In conclusion, there are obstacles that the tactical facilitator will face when working in an IET environment for the United States Army; however, those obstacles are not insurmountable. When programming, the tactical facilitator should be mindful of the different training states and abilities of the soldiers and should plan for these variances during each training session. The equipment available will also dictate which exercises are selected. Knowing the equipment and space that will be available during the planning process makes it easier to establish stations, session flow, and foresee any issues that may arise. Although more complex movements have the potential to yield better results, simpler, easier to teach exercises are typically more suitable for the IET environment. With proper planning, the tactical facilitator should be able to help most, if not all, soldiers achieve success on the APFT.

**REFERENCES**


### ABOUT THE AUTHOR

Mark Walker is an independent strength and conditioning coach in Cincinnati, OH. He is a Certified Strength and Conditioning Specialist® (CSCS®) through the National Strength and Conditioning Association (NSCA) and Performance Enhancement Specialist (PES) through the National Academy of Sports Medicine. He served as a CSCS for Proxy Personnel, working with the United States Army. As part of the Musculoskeletal Action Team (MAT), he was responsible for Injury Prevention and Human Performance Optimization (IPHPO). For over two years, he was able to help over 400 soldiers pass the Army Physical Fitness Test (APFT) and remain injury-free throughout the training process. He also served as a Subject Matter Expert (SME) on the execution, teaching, and correct implementation of the Army Physical Readiness Training Program. Walker can be contacted by email at walkerperformance@live.com.

### TABLE 1. SAMPLE FIVE-DAY TRAINING PROGRAM

<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Warm-Up</td>
<td>Dynamic Warm-Up</td>
<td>Dynamic Warm-Up</td>
<td>Dynamic Warm-Up</td>
<td>Dynamic Warm-Up</td>
</tr>
<tr>
<td>Jumping jacks</td>
<td>Jumping jacks</td>
<td>Jumping jacks</td>
<td>Jumping jacks</td>
<td>Jumping jacks</td>
</tr>
<tr>
<td>Seal jacks</td>
<td>Up-downs/burpees</td>
<td>Seal jacks</td>
<td>Up-downs/burpees</td>
<td>Seal jacks</td>
</tr>
<tr>
<td>Bodyweight squats</td>
<td>High knees</td>
<td>Walking high-knee pulls</td>
<td>High knees</td>
<td>Bodyweight squats</td>
</tr>
<tr>
<td>Sit-ups</td>
<td>Toy soldiers</td>
<td>Walking quad pulls</td>
<td>Toy soldiers</td>
<td>Sit-ups</td>
</tr>
<tr>
<td>Push-ups</td>
<td></td>
<td>Push-ups</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Push-Up Improvement
- 3-position isometric holds +15 push-ups
- 3-position push-ups (wide, shoulder, and diamond)
- Standing band rows
- 3-position sit-ups (incline, floor, and decline)
- Kettlebell military presses
- Supine kettlebell floor presses
- Dips
- Biceps curls
- Overhead triceps extensions

#### Sit-Up Improvement
- Mountain climbers crossovers
- Planks
- Side bridge (both sides)
- Bows and toes (modified pike)
- Overhead sit-ups
- Russian twists
- Good mornings
- Leg lifts
- Weighted sit-ups

#### Push-Up and 2-Mile Run Improvement
- 3-position isometric holds +15 push-ups
- Sprint*
- 3-position push-ups (wide, shoulder, and diamond)
- Race pace run**
- 3-position sit-ups (incline, flat, and decline)
- Sprint*
- Band rows
- Lateral raises
- Front raises
- Race pace run**

#### Sit-Up and 2-Mile Run Improvement
- Overhead sit-ups
- Sprints*
- Bows and toes
- Race pace run**
- Toe touches
- Sprints*
- Weighted sit-ups
- Race pace run*
### TABLE 1. SAMPLE FIVE-DAY TRAINING PROGRAM (continued)

<table>
<thead>
<tr>
<th>Static Cool-Down (30 s each)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanging hams</td>
</tr>
<tr>
<td>Toe grabs</td>
</tr>
<tr>
<td>Pretzels</td>
</tr>
<tr>
<td>Supine knee pulls</td>
</tr>
<tr>
<td>Kneeling hip flexor stretch</td>
</tr>
<tr>
<td>Overhead arm pulls</td>
</tr>
<tr>
<td>Saigon squats</td>
</tr>
<tr>
<td>Partner stretch</td>
</tr>
<tr>
<td>Foam roll</td>
</tr>
</tbody>
</table>

*Sprint sessions are no longer than 1 min per set/bout

**Race pace runs are no longer than 2 min per set/bout

***Bike sessions are no longer than 5 min per set/bout
Eating healthy when training and competing is intuitive. Many tactical athletes are precise and often ritualistic with pre- and post-workout nutrition, hydration, and rest. However, the question arises as to whether the same approach is applied when the unexpected and tragic happens and someone is injured. Recovering from an injury may be more critical than recovering from a workout and how tactical athletes nourish themselves during this time can facilitate or delay their recovery.

After an injury, people usually do not feel like cooking and may select foods based on convenience rather than nutrition. Also, people often tend to get depressed post-injury. They may binge on unhealthy comfort foods (in some cases this may include foods that are high in simple sugars or saturated fats), drink more alcohol, or even start smoking when injured. Use of any of these items in combination or excess can contribute to the inflammatory process and delay healing (1). What prompted me to write this article was a bike crash I endured and my pursuit to apply my knowledge and experience in nutrition to promote a quick recovery.

One day after work, I went out for what was going to be about a 40-min bike ride. About 10 min into my ride, I was struck by a car. I flipped over the hood and landed on my head and side. Immediately after the incident, a United States Army medic stopped and rendered aid, along with an emergency medical technician (EMT), police officer, and I think a fire truck—all of the main branches of the tactical community were represented. I was taken to the emergency room and after x-rays, a computerized tomography (CT) scan, and being put on three different narcotics, I was released and allowed to go home. Amazingly, nothing was broken but I did get banged up pretty good.

The last snack and fluid in preparation for my ride was at 2:30 pm and I suffered significant muscle trauma about two and half hours later. I returned home around midnight, over seven hours after the initial trauma occurred. During that time, I was not given any food at all post-injury. While most of us would prefer to crawl into bed after an evening like that, narcotics should usually be taken with food and the injured muscles require adequate nutrition to start the healing process. Fortunately, I had a milkshake in my freezer containing 20 g of protein. Other options may have included meal replacement drinks, protein powders, cereal and milk, or Greek yogurt. I also went to bed with a bottle of water to take with my second dose of narcotics.

The days immediately following an injury are critical. As activity levels decrease, and swelling and inflammation set in, maintaining a diet that promotes healing is essential to keeping weight under control and speeding up recovery (1). Often during workouts, people are reminded to drink adequate amounts of water. When not training as much, they may unintentionally drink less. A minimum of 3.7 L of water per day for men and 2.7 L per day for women is recommended for proper hydration, which will assist in the overall recovery process (4). Sport drinks are not necessary and the extra sodium may not help the swelling and edema. However, sports drinks can be used to help replace electrolytes and therefore hydrate an individual if they have difficulty consuming plain water. However, these drinks should not be used as a replacement for water.

Protein is needed during the recovery phase as well. It is recommended to consume about 20 – 30 g of protein 3 – 5 times per day (as opposed to all at one time) as protein is better utilized in smaller doses, especially when recovering and an individual is less active (5). A fantastic source of protein for healing is salmon. This is due to the high content of omega-3 fatty acids, protein, and vitamin D (1). In fact, salmon is one of the richest food sources of omega-3 fatty acids and one of the few food sources of vitamin D, both of which have anti-inflammatory properties. These nutrients are also important when a potential head injury is involved. Though I was wearing a helmet and the CT scan indicated no damage, it did not hurt to get some docosahexaenoic acid (DHA), a form of omega-3 fatty acid, from salmon to aid in my healing and brain health (2). For the low maintenance cook, frozen, canned, or pre-cooked salmon is readily available. Farmed salmon may have more omega-3 fatty acids, whereas wild salmon may have more vitamin D (1).

Fruits and vegetables are also tremendously important to consume when injured (1). They are a great source of fluid and fiber, which may help prevent the aforementioned possibility of constipation caused by consuming prescribed medication to manage pain. The natural anti-inflammatory nutrients found in these foods may help curtail the inevitable inflammation post-injury (1). Pineapple is rich in bromelain, an enzyme with anti-inflammatory properties (3). Dark green vegetables such as kale, spinach, Brussels sprouts, asparagus, broccoli, and collard greens are also plentiful in anti-inflammatory nutrients (3). Adding beets to a diet may help with blood flow, especially to the brain (6). Another option to obtain additional antioxidants and unsaturated fats is to cook vegetables in a small amount of olive oil and top salads or oatmeal with walnuts.
Generally speaking, tactical athletes are at a high risk for traumatic injuries. Since being a tactical athlete is their job, a fast recovery is paramount. To do so, one must treat the injury like the most intense strength training session ever in terms of nutrition. During rehabilitation, tactical athletes should respect the rehabilitation process like they would respect a training camp. They should be sure to get adequate rest, stay hydrated, and consume fruit, vegetables, protein, and whole grains 2 – 3 times per day.

REFERENCES

ABOUT THE AUTHOR
Trisha Stavinoha’s United States Army and dietetic career began in 1998 after earning her Bachelor of Science degree in Nutrition from Texas State University and being accepted into the United States Army’s dietetic internship program. Stavinoha earned her Master of Science degree in Sport Nutrition from Long Island University while concurrently competing on their track and field and cross-country teams. She has been a credentialed sport dietitian and strength and conditioning coach since 2008. Her credibility in sport nutrition comes from being a soldier, scholar, and athlete. Stavinoha’s experience with athletes includes a wide range of Olympic hopefuls in the Army’s esteemed World Class Athlete Program, high school and collegiate cross country runners, triathlon and endurance athletes, tactical soldiers, Wounded Warriors, and overweight service members trying to pass body fat and physical fitness standards.
UTILIZING THE PRIORITY TRAINING SYSTEM FOR FIRST RESPONDERS

There have been many instances where the first responder has commenced a workout only to have the call alarm sound. Many first responders work in a department where once a call comes in, it may be three or four hours until they can return to the station. There is no question that staying fit for duty is paramount, yet a common theme has emerged: as call volumes have increased, the available time to exercise during work time has decreased. Some departments have mandated specific time to be used for exercise; however, two common complaints with this have emerged, these being: getting the personnel to work out and getting the workout completed without being interrupted by a call.

In a perfect world, all first responders would take pride in their fitness and make personal wellness a priority; sadly, it is not a perfect world. Research shows that workplace injuries continue to increase and disease continues to take the lives of first responders (1,3,4). Generally, tactical facilitators do not always place importance in the teaching of first responders on how to be healthy and well before they hit the street. After they complete their firefighting education, the cultures and traditions of public safety often influence what many of these first responders do.

Alternatively, if first responders exercise too much it can also be problematic. For example, if they decide to perform tire flips, heavy squats, or perform deadlifts to the point of extreme fatigue, when a call comes in these first responders may then be put in a potentially dangerous situation. The physical exertion required for many firefighting and emergency medical technician (EMT) tasks can far exceed what is encountered in many other professions.

A potential answer to addressing both ends of the spectrum, in terms of fitness program adherence and fitness program participation, may be priority training systems. The programming method called “priority training system” consists of training and programming specific to public safety and the needs of this population. It is based on a style of training and conditioning used for mixed martial arts (MMA) fighters to promote extreme anaerobic conditioning and boost mental toughness while reducing injury risks (2). The name “priority training system” is in reference to the levels of response to emergency calls. This method only has four training days in the week and there are specific rest days built into the training cycle.

Just like a real first responder call, this method categorizes different levels of response based on the levels of intensity. Priority 1 is the highest response category, and therefore is the most intense workout. On the other hand, the least demanding category is Priority 4.

Using the priority training system, Day 1 is always focused on upper body while Day 4 is lower body. Days 2 and 3 are priority workouts. The priority days are designed to “stir the pot.” In other words, they are used to challenge the body anaerobically and metabolically in order to develop adaptations to stress. A total day of rest is between Days 3 and 4. If a workout must be missed entirely it should always be a priority day.

Creative programming helps to avoid overtraining at work. During short weeks, first responders can get away with training a little harder but on long weeks they should keep the intensity lower.

**Priority Rules**

With any good program there must be guidelines to work from. Since the goal of the priority training system is to build cardiorespiratory endurance and muscular endurance while limiting fatigue, the following rules will help achieve these goals.

1. Sprinting is a great way to stimulate the entire body. Treadmill sprints and short sprints are recommended; even a speed ladder will work if space is tight.

2. Each priority workout has three series and each series is completely separate. Within each series are a sprint and two “shock” exercises, which are intended to keep the metabolic demand high with little recovery during each series. This means that there are six total resistance exercises possible during the workout. A “set” consists of a sprint followed by two exercises done for three rounds. Then there is a rest period prior to the next cycle. These rounds are fast, and it may be easiest to leave the treadmills running throughout.

3. Priority 4 consists of bodyweight resistance exercise only.

4. Priority 3 is medicine balls, ropes, hoses, etc. Priority 2 should use light weights. Priority 1 is job-specific movements and/or heavy resistance.

5. For less fit first responders, heart rate should guide the workout. In general, if the heart rate is more than 120 -130 beats per minute (bpm), do not start the next sprint. More fit first responders can push past this mark to reach higher heart rates, as long as it is done in a safe manner. If a first responder is deconditioned or has orthopedic issues, an elliptical, stationary bike, or rowing machine can be acceptable substitutions.
6. After each cycle there should be a rest period prior to moving on. It is important to get 100% effort and maximal contraction during all three sets. This requires the heart rate to recover between each series.

7. Speed and momentum are acceptable, but sloppy and dangerous is not. Movement matters but not movement that can be dangerous. As an example, in Table 2 the curl to press can be done rapidly without a pronounced pause between movements.

8. No leg training in addition to the sprints during priority workouts.

Table 1 is an example of a Priority 4 workout on Day 2. These workouts are quick and easy to program with multiple variations. Since the workout on Day 1 was heavy upper body, Day 2 will focus mostly on the trunk musculature.

Table 2 is an example of a Priority 1 workout. This is normally done after the built-in rest day. This example demonstrates a Priority 1 workout for Day 3 with a heavy leg workout the following day.

The key to this workout system is a very thorough warm-up, mobility work, and active stretching. The workout is specific to the demands of the job and can be individualized based on the first responders’ fitness levels. Plus, there is definitely a team mentality to this programming method. As a final note, this system can help simulate the metabolic demands on firefighters and law enforcement during high stress environments without compromising time, space, or injury considerations, if implemented properly.

### TABLE 1. PRIORITY 4 SAMPLE WORKOUT FOR DAY 2

<table>
<thead>
<tr>
<th>SET</th>
<th>TREADMILL SPEED/INCLINE</th>
<th>EXERCISES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.5 mph at 6% grade</td>
<td>20 s sprint, 15 push-ups, and 10 pull-ups (3 sets)</td>
</tr>
<tr>
<td>2</td>
<td>10 mph at 6% grade</td>
<td>20 s sprint, 15 curl-ups, and 15 Russian twists (3 sets)</td>
</tr>
<tr>
<td>3</td>
<td>10.5 mph at 6% grade</td>
<td>20 s sprint, 15 dips, and 15 ab wheels or stability ball roll-outs (3 sets)</td>
</tr>
</tbody>
</table>

### TABLE 2. PRIORITY 1 SAMPLE WORKOUT FOR DAY 3

<table>
<thead>
<tr>
<th>SET</th>
<th>TREADMILL SPEED/INCLINE</th>
<th>EXERCISES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11 mph at 8% grade</td>
<td>30 s sprint, 10 bench presses, and 10 bent-over rows (3 sets)</td>
</tr>
<tr>
<td>2</td>
<td>11.5 mph at 8% grade</td>
<td>30 s sprint and 15 dumbbell curl to presses (3 sets)</td>
</tr>
<tr>
<td>3</td>
<td>12 mph at 8% grade</td>
<td>30 s sprint, 30 s farmer’s walk, and 30 s rope slams (3 sets)</td>
</tr>
</tbody>
</table>

### REFERENCES


### ABOUT THE AUTHOR

Bryan Fass is an expert on public safety, injury prevention, fitness and wellness, speaking, consultations, as well as being an author of the “Fit Responder” and column writer for officer.com, firerescuel.com, and ems1.com. Fass works nationally with departments, corporations, and state and local governments to design and run targeted injury prevention and wellness programs for public entities and private organizations. He is frequently contacted for expert opinion and content contribution for all aspects of public safety. President and Founder of Fit Responder, Fass also functioned as a paramedic for over eight years.
RESISTANCE TRAINING TO IMPROVE PISTOL SHOOTING PERFORMANCE

Accurate marksmanship in pistol shooting is dependent on many variables. Those variables include the skill of the shooter, experience, upper extremity and core strength, and posture control (3,12). Tactical athletes in both law enforcement and the military must be very proficient in these areas if they are to become successful in marksmanship. According to research, a tremor in the lateral and vertical plane during pistol shooting is based on stability from the shoulder and the wrist (3,12). Most of the lateral oscillations produced by the body occur during aiming at a target (12). These oscillations are more apparent at the distal portions of the shooter’s arm (elbow, wrist, and hand) (12). These oscillations can be the result of inadequate isometric strength and stability from the muscles and tendons of the shooter’s arm. The anatomy of the shooter’s arm consists of the shoulder joint, biceps, triceps, elbow joint, forearm muscles, wrist joint, and muscles and joints of the hand (thumb and fingers) (3,12). Regardless of the skill of the shooter, a postural tremor is present during aiming and firing. The amount of the tremor is dependent on the skill and upper extremity/core strength of the tactical athlete. Research shows a strong correlation between hand grip strength and being successful in pistol shooting training among police cadets (3). It is important that upper extremity strength and/or muscular endurance is adequate enough to increase shooting performance among tactical athletes in situations where it counts.

In a previous issue of the TSAC Report (Report 35), the article “Kinesiology Tape Application to Improve Pistol Shooting in Tactical Athletes” was written to illustrate the usefulness of using kinesiology tape to enhance muscular contraction and muscular endurance within the shooter’s arm. Research supports the claims that a combination of kinesiology tape application in conjunction with a resistance training program will improve muscular activation via motor and cutaneous unit recruitment (6,9). Kinesiology tape applications are useful during periods of muscular fatigue and injury (6,9). Injuries to the shooter’s upper limbs that can impede shooting. A combination of a kinesiology tape application and a progressive resistance training program for the upper extremity can potentially increase overall performance of the shooter’s arm during pistol target shooting.

THE SHOOTER’S ARM

The shooter’s arm starts at the shoulder girdle. The shoulder girdle consists of the glenohumeral joint, sternoclavicular joint, and the scapulothoracic joint. The major muscles around these joints include the deltoid, pectoralis major, pectoralis minor, trapezius, rotator cuff muscles, biceps, triceps, and to a slightly lesser degree, serratus anterior, and rhomboids. In order to stabilize the shoulder joint (glenohumeral joint), the muscles of the rotator cuff are important. The job of the rotator cuff is to stabilize the shoulder joint during aiming but will need to be significantly active during firing of the pistol so that the recoil does not disturb the arm’s position (4). When shooting, the arms will be at approximately 90 degrees of shoulder flexion. The anterior and medial deltoids are important during the aiming and firing of the pistol. As the shoulder is in approximately 90 degrees of flexion, the biceps and triceps assist with stabilization of the shoulder and elbow during pistol shooting. In addition, serratus anterior and rhomboids help with scapular control and stability. The elbow and wrist joints also play roles in pistol shooting and must have strength for optimal performance (1).

The muscles of the forearm (extensors and flexors) provide muscular tension to the long tendons in the fingers, specifically in the tendons of the second and third fingers. The second finger extensor tendon is primarily the trigger finger when the trigger of the pistol is depressed. According to research, grip strength in the form of steadiness is key to achieving excellent marksmanship (1,3,12). The muscles of the hand include the thenar eminence, hypothenar eminence, and the lumbricals, which provide muscular power for proper grip. These muscles need to be strong enough to help maintain a stable position when the trigger is depressed as well as limit postural sway (1,3). The lumbricals of the fingers must aid in the proper position of the gun handle and activate smoothly as the second finger depresses the trigger (3).

PROGRAMMING CONSIDERATIONS

The muscular strength, posture control, experience, and skill of a shooter may determine the accuracy of their shooting. The resistance training program of the upper extremities should be comprised of exercises that focus on stability, muscular endurance, and motor unit activation throughout the entire arm. The combination of kinesiology taping while shooting and a resistance training program may benefit the tactical athlete by enhancing motor unit recruitment within key muscles of the upper extremities used during training and pistol shooting (1,5,10). The exercises should be equally comprised of all actions of the muscles (i.e., concentric, isometric, and eccentric). By employing all the actions, the muscles of the shooter’s arm will be able to specifically adapt to the demands of pistol aiming and firing without causing fatigue or injury to the arm during strength training and shooting. Research has demonstrated that there is an inverse relationship between upper extremity tremor and the strength and conditioning of the shooter’s arm (12). In all
exercises listed below, proper form is crucial; the tactical athlete should never sacrifice form for increased weight or resistance. When all repetitions and all sets suggested in this article can be performed with perfect form, it may then be appropriate to increase the weight or volume progressively. Weight progression is typically increased by five pounds or until significant challenge of the exercise is accomplished without sacrificing form of exercise technique. The tactical athlete should engage in strength training as much as three or four sessions per week to improve optimal performance in pistol shooting.

The sample resistance training program and exercises can be used as a basis from which tactical athletes may design and implement their training program to help improve pistol shooting performance.

**SAMPLE RESISTANCE TRAINING EXERCISES**

**SHOULDER INTERNAL/EXTERNAL ROTATIONS**

An exercise that can be recommended is internal and external shoulder rotations. This exercise can be beneficial to strengthening the rotator cuff musculature (supraspinatus, infraspinatus, teres minor, and subscapularis) (11). However, it can also be potentially detrimental if prescribed to tactical athletes that are asymptomatic (not displaying a need for strengthening in that area). A main concern with the implementation of this exercise in asymptomatic populations is a greater risk of impingements or injuries due to increased thickness of the musculature, which may limit subacromial space (5,7).

However, this exercise can be utilized by tactical athletes to address specific deficiencies or imbalances in shoulder strength, specifically in the rotator cuff (8). In terms of general injury patterns, injuries in the shoulder complex comprise a large portion of all reported injuries from several studies, with prevalence rates ranging from 22% to 36% (7). However, oftentimes these injuries are the result of improper exercise technique (7,11). If internal and external shoulder rotations are utilized, it is recommended that tactical athletes lie on their side on a table with a small towel under their top arm with their elbow at 90 degrees of flexion and the shoulder abducted at 30 degrees (9). Keeping the elbow fixed to the side of the body, the forearm should be raised towards the ceiling using a small degree of motion, about a 30-degree arc, before returning to the starting position (9). Using a towel will help maintain the proper position for the movement (about 30 degrees of abduction in the starting position) as well as allow for adequate blood supply to the shoulder complex (9).

**PUSH-UPS**

This common exercise incorporates the majority of the muscles of the upper extremities and the trunk. The tactical athlete should start in a prone position lying on the ground with the elbows to the sides of body and hands alongside the shoulders/head. Then, the tactical athlete should use a powerful push against the ground, keeping the trunk stable, to raise the entire body off the ground until the arms are fully extended with the elbows maintaining a very slight flexion. The body should be aligned in a straight line without allowing the anterior torso or hips to sag toward the ground. Hold this position for two seconds then slowly lower the whole body toward the ground until the chest is approximately three inches from the ground. Repeat this movement to complete three sets of 12 – 15 repetitions.

**SHOULDER PRESSES (FIGURES 1 AND 2)**

The tactical athlete should sit erect on an exercise ball. The exercise ball will challenge the posture control of the tactical athlete’s trunk. Since the exercise ball will challenge stability, performing shoulder presses on an exercise ball may aid in body and extremity stability during aiming and firing. Holding dumbbells with a pronated grip, the tactical athlete should start with the elbows bent to 90 degrees with the forearms vertical and perpendicular to the ground. The tactical athlete should push both dumbbells over the head until the elbows are fully extended. Then, slowly lower the dumbbells to the starting position and repeat the motion. The tactical athlete should maintain an erect posture and keep the traps relaxed during the exercise. Complete three sets of 10 repetitions each.
SHOULDER FRONT RAISES (FIGURE 3)
The tactical athlete should sit on an exercise ball and keep the back straight without slouching. This exercise can be performed either with a single arm being raised while switching back and forth, or with both arms raised at the same time. The exercise that is demonstrated in Figure 3 is a single-arm raise. The tactical athlete should start with the dumbbell at their side and then raise the dumbbell with the arm straight at the elbow until approximately 90 degrees of flexion is reached at the shoulder. The hand should be slightly below the shoulder/trap line. The tactical athlete should hold this position for 1 – 2 s and slowly return the dumbbell to the starting position. It is important to remain in an erect position while sitting on the exercise ball without slouching or moving the back into extension. Complete three sets of 10 repetitions each.

PRONE LATERAL RAISES (FIGURES 4 AND 5)
The tactical athlete should lie prone on an exercise ball with the chest off the ball. With a dumbbell in each hand, start the exercise with the arms in front of the body. Raise the arms until they are parallel to the ground with the palms facing down; the tactical athlete should make sure not to bend the elbows. The tactical athlete should squeeze the shoulder blades together when the arms are parallel to the ground. Complete three sets of 10 repetitions.

BICEPS CURLS (FIGURES 6 AND 7)
The tactical athlete should sit on an exercise ball with a dumbbell in each hand. The hands should be in a neutral position (thumb pointed toward the ceiling). Begin by raising each dumbbell toward the head by bending the elbows until full elbow flexion is reached. Slowly lower the dumbbells down toward the ground by extending at the elbows. The shoulders should remain relaxed and in a neutral position. The tactical athlete should keep the dumbbells in front of the body by keeping the elbows in front of the trunk. It is also important to keep the back straight and not to allow any motion to be generated by the back muscles. Complete three sets of 10 repetitions.
PRONATION AND SUPINATION–FOREARM ROLL (FIGURES 8 – 10)
The tactical athlete should sit on an exercise ball with the forearm resting on a table. The tactical athlete should grab a light dumbbell (2 – 8 lb) at the end of the dumbbell as shown in Figures 8 – 10. The start of the exercise can be either the palm facing down to the ground or up toward the ceiling. The tactical athlete will slowly rotate the dumbbell using the supinator or pronator muscles so that the dumbbell finishes in the position opposite of where it started. The motion strictly originates from the forearm. Pause for 1 – 3 s between each set. Complete three sets of 10 repetitions then repeat with the other arm.
WRIST EXTENSIONS (FIGURES 11 AND 12)
The tactical athlete should sit on an exercise ball with the forearm resting on a table holding a dumbbell. The wrist should rest on the table while the hand hangs off the table in passive wrist flexion (due to gravity). The tactical athlete should bring the wrist up towards the ceiling and hold this position for 1 – 2 s, then slowly move the wrist towards the ground. The importance in this exercise is the lowering of the dumbbell back toward the ground. This is known as an eccentric contraction of the wrist extensors. The rate of lowering the wrist back towards the ground can be measured by counting backwards from four to zero. At the count of zero the wrist should be back in the hanging position. The tactical athlete should be careful not to allow the wrist to rotate in any direction during this exercise, or to fall uncontrollably. Complete three sets of 10 repetitions with each arm.

WRIST FLEXION (FIGURES 13 AND 14)
The tactical athlete should sit on an exercise ball with the forearm resting on a table holding a dumbbell. The back of the wrist should rest firmly on the table while the hand hangs off the table with the palm facing the ceiling in passive wrist extension (due to gravity). The tactical athlete should activate the wrist flexors and flex the wrist so that the hand is moved towards the head of the tactical athlete. They should hold this position for 1 – 2 s and then slowly return the wrist back to the starting position. Eccentric contraction of the wrist flexors is important for the tactical athlete when returning the wrist back to the starting position. Do not allow the wrist to rotate or fall uncontrollably. Complete three sets of 10 repetitions with each arm.
RADIAL DEVIATION (FIGURE 15)
The tactical athlete should sit on an exercise ball with the forearm resting on a table and the hand off the table holding a dumbbell. The wrist should be placed in a neutral position so that the thumb is pointed towards the ceiling and the fingers are pointed to the side. Flex at the wrist so the thumb is moved towards the head of the tactical athlete. They should hold this position for 1 – 2 s, and then slowly return the hand to the resting position. The tactical athlete should maintain control during the eccentric contraction of the wrist when lowering the dumbbell. Complete three sets of 10 repetitions with each arm.

FIGURE 15. RADIAL DEVIATION

LUMBRICAL SQUEEZE (FIGURES 16 AND 17)
The tactical athlete will start by placing their hand on the edge of a table with the fingers off the edge pointing down towards the ground. Keeping the palm flat against the table, the tactical athlete should squeeze the side of the table with the fingers and pull the knuckles up towards the ceiling without bending the fingers. The palm of the hand should move superiorly towards the ceiling without the fingers bending. This exercise may be used to help improve grip strength. Complete three sets of 10 repetitions with each hand.

FIGURE 16. LUMBRICAL SQUEEZE – START

FIGURE 17. LUMBRICAL SQUEEZE – FINISH
REFERENCES

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Keith Chittenden is a Certified Strength and Conditioning Specialist® with Distinction (CSCS, "D") and Tactical Strength and Conditioning Facilitator® with Distinction (TSAC-F, "D") through the National Strength and Conditioning Association (NSCA). He holds a Master’s degree in Exercise Science from California University of Pennsylvania and is a doctoral candidate at the University of Hartford. He was a columnist for the NSCA’s TSAC Report and continues to be a regular contributor to NSCA Associate Publications. Chittenden has over 13 years working with athletes, police officers, and military personal in areas such as fitness, performance enhancement, and post-rehabilitation.

TABLE 1. SAMPLE PISTOL SHOOTING RESISTANCE TRAINING PROGRAM

<table>
<thead>
<tr>
<th>EXERCISE</th>
<th>REPETITIONS</th>
<th>SETS</th>
<th>RESISTANCE</th>
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<tbody>
<tr>
<td>Push-up</td>
<td>12 – 15</td>
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<td>Bodyweight</td>
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<td>Shoulder press</td>
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<td>3</td>
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<td>3</td>
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<tr>
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<td>3</td>
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