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**TABLE OF CONTENTS**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>TSAC RESEARCH REVIEW</td>
<td>Rod Pope, PHD</td>
</tr>
<tr>
<td>08</td>
<td>DEPLOYMENT FITNESS—CARRIER-SPECIFIC NAVY PHYSICAL TRAINING</td>
<td>Josh Hockett, MS, CSCS, NSCA-CPT, TSAC-F</td>
</tr>
<tr>
<td>12</td>
<td>WHAT IS IN YOUR SMOOTHIE?</td>
<td>Trisha Stavinoha, MS, RD, CSSD, CSCS</td>
</tr>
<tr>
<td>14</td>
<td>CONSIDERATIONS FOR SPECIALIST TACTICAL LAW ENFORCEMENT OFFICERS DURING LONG-TERM SPECIAL EVENTS</td>
<td>Shane Irving</td>
</tr>
<tr>
<td>18</td>
<td>PATTERNS OF FIRST RESPONDERS</td>
<td>Bryan Fass, ATC, LAT, EMT-P, CSCS</td>
</tr>
<tr>
<td>20</td>
<td>PREHABILITATION FOR THE TACTICAL ATHLETE</td>
<td>Brandon Stone, MS, CSCS</td>
</tr>
<tr>
<td>24</td>
<td>THE IMPORTANCE OF PROPER MOVEMENT FOR MARINES—PART 1: AN INTRODUCTION TO MOVEMENT AND POTENTIAL PROBLEMS</td>
<td>Matt Zummo, MS, USAW-1</td>
</tr>
</tbody>
</table>
**TSAC RESEARCH REVIEW**

This article is the first 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.

**DEPRESSIVE SYMPTOMS DURING ARMY BASIC COMBAT TRAINING**

Shannon Crowley and colleagues noted in their research that mental health-related problems are a significant reason for new soldiers dropping out of basic training (2). They also highlighted prior research in civilians that indicates physical fitness probably helps people cope with stress and maintain mental health (2). Whether this link between fitness and mental health holds true in a military population was the focus of their study, and the answer is clearly important for all personnel, not just those who are new to the military.

Their study involved 300 soldiers commencing Basic Combat Training (BCT). The researchers examined whether scores on the Army Physical Fitness Test (APFT), which incorporates a 2-min push-up test, 2-min sit-up test, and 2-mi run test, upon entry to BCT predicted whether or not soldiers reported symptoms of depression at the end of training. What they found was a strong link between entry fitness levels and whether or not soldiers reported symptoms of depression at the end of BCT (2). Those soldiers who entered BCT with a low level of physical fitness were much more likely to report symptoms of depression at the end of BCT than those who entered BCT with a high level of fitness. In fact, soldiers with low fitness levels were 2.5 times more likely to report symptoms of depression compared to soldiers with high fitness levels (2).

Having found these results, Crowley and colleagues suggest a number of physiological mechanisms by which physical conditioning might directly impact levels of depressive symptoms or recovery from psychological stressors. It is worth noting that previous research indicates that levels of physical fitness in military personnel and athletes can predict exercise economy and rates of muscle glycogen depletion, fatigue, injury (both to bones and soft tissues), and medical presentations (5,8,9,10,11). Furthermore, physical fitness and injury occurrence combine to predict the likelihood of dropout or success in military basic training. If soldiers are struggling with low levels of physical fitness and associated fatigue, injury, and illness while undergoing training, it is not surprising that they are more likely to experience symptoms of depression.

The study by Crowley and colleagues is another good reminder of the importance of physical fitness in improving the experience of military training for soldiers and their chances of success. The challenge is to develop structured strength and conditioning programs that are efficient and effective to conduct with large cohorts of personnel that also consider individual differences in starting fitness levels, individual injury risks, and individual training needs and goals at the same time. Progress has been made in addressing this challenge, but a lot of work still needs to be done in this area.

In the meantime, it is critical that tactical facilitators note the need for early development of physical conditioning that will enable personnel to cope both physically and mentally with the demands of military tasks. Hence, the use of physical conditioning as early as possible in a recruit training program is justified and should be considered. In helping to achieve this goal, they need to do their best to ensure that strength and conditioning programs are always characterized by adequate assessment of starting fitness levels and appropriate progression informed by this assessment. Any psychological evaluation or prescription will likely be beyond the scope of practice for a tactical facilitator, and should be addressed by qualified professionals.

**PERSONAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS**

Although an article from *Fashion and Textiles* that assessed personal protective equipment (PPE) of firefighters might seem to be off topic, in fact, the background and findings of this recent study are very relevant to tactical strength and conditioning (7). In this study, the researchers interviewed 54 firefighters in small groups from four different states in the United States to gather their thoughts on the PPE they regularly use (7). In particular, they considered design issues affecting PPE, ways in which these issues hamper physical performance and lead to injuries, and possible solutions to address these concerns. The researchers also usefully summarized a range of previous research regarding effects and concerns with PPE.

They noted up front, not surprisingly, that PPE is critical for protection of firefighters from thermal and toxic threats and from wounds caused by sharp objects, abrasions, and similar hazards in firefighting (7). PPE, they reported, often includes heavy boots, and a self-contained breathing apparatus, helmets, gloves, face masks, a hood, a protective coat, and pants. They also noted that PPE has become heavier and more bulky over the years in order to better deliver these protections, and that these features are leading to muscle strain, changes in center of mass, loss of balance, falls, slips, blisters, loss of finger and hand dexterity, impairments to mobility, rapid fatigue, restricted vision, restricted arm and neck range of motion, ankle sprains, and other injuries (7). Negotiating ladders and stairs; getting on and off fire trucks; walking and crawling through fire sites or confined spaces; using an axe, chainsaw, or fire hose; reaching overhead; turning and looking around; and operating other tools were all tasks the
firefighters in this study indicated were particularly affected by the weight and bulk of their PPE (7). Shorter firefighters and firefighters with less hand strength noted particular problems due to PPE fitting and interface issues (7). For example, shorter firefighters could not move the self-contained breathing apparatus sufficiently far down on their back to lower their center of mass (as an aid to control balance and reducing trunk and shoulder muscle fatigue) and to prevent the apparatus from interfering with head and helmet movement.

Thinking about the implications of these findings for tactical strength and conditioning for firefighters, in light of the findings of other research, several issues would seem to be important for tactical facilitators to consider:

• **Load carriage** – Increasing load carriage strength is likely to lead to a reduction in trunk, shoulder, and neck muscle soreness and assist with balance control, potentially reducing injury risk.

• **Agility and mobility when loaded with PPE and performing typical tasks** – Previous research in sports and military settings suggests it is highly likely that specific agility and mobility training involving performance of typical tasks in simulated operational settings while loaded with PPE may enhance precision and speed of movement, and this may enable firefighters to become increasingly more accustomed and skilled at maneuvering while loaded (1,3,4). One likely mechanism for these improvements is learning to more effectively use “feed forward” mechanisms to scan the environment and anticipate movements required and ways in which they will need to counteract and manage the forces exerted by their PPE loads in order to successfully achieve their movement goals without injury.

• **Balance and ankle control when loaded with PPE and performing typical tasks** – Previous research shows that agility training such as that discussed in the point above and practice of balancing on a “wobbleboard” or similar balance device are effective ways of improving balance control and preventing ankle sprains (1,4). These balance exercises can be progressed by the addition of secondary actions while balancing (e.g., reaching or performing an occupationally relevant task with the hands). These would be useful activities to conduct with firefighters, especially if progressing toward performing these activities when loaded similarly to when using PPE.

• **Hand strength** – Specific hand-strengthening exercises may enhance the capacity of firefighters to perform tasks requiring hand strength while wearing bulky protective gloves. It was notable that firefighters in this study indicated hand strength and dexterity were key issues when using gloves and that those with less hand strength struggled the most (7). However, care should also be taken to avoid excessive repetition and load progression that is too rapid, with either approach potentially causing a repetitive strain injury (7).

• **Specificity in strength and conditioning programs** – Strength and conditioning programs should be predominantly focused on activities that simulate (as closely as possible) or progressively prepare firefighters for tasks, movements, and body loading patterns typically experienced in operational contexts. Some of these tasks and movements are listed above.

**LOAD CARRIAGE FOR LAW ENFORCEMENT OFFICERS**

In this study, 20 male law enforcement students were observed as they performed a vertical jump and sprint, first without and then with a diving belt that weighed 9 kg (about 20 lb) to simulate the weight of an officer’s protective vest and duty belt. The average vertical jump height the students could achieve was 9 cm (about 3.5 in.) less when wearing the weight belt than when not wearing it, representing a 17% reduction in height achieved when wearing the belt (6). The average sprinting speed across the first six strides when starting to sprint was reduced by 5% when students were wearing the belt (6). The average rate of acceleration in sprinting speed reduced by 13% when wearing the belt (6).

These findings indicate that loads carried by law enforcement officers, including items like a protective vest and duty belt, affect their ability to overcome inertia and move quickly when needed during operational tasks. In some cases, this reduction in ability to move fast may be life threatening for the officer, their colleagues, or those they seek to protect. Given that the load itself is protective and necessary, the key issue is then the capacity of the officer to generate sufficient force very rapidly, or “explosively,” through their lower limbs, to overcome initial inertia and achieve the required speed of movement, despite the load they must carry. This capacity is clearly an issue that the tactical facilitator can address in strength and conditioning programs by focusing on developing speed of force production through the lower limbs.

Once again, specificity of training is important and it would be worthwhile to ask law enforcement officers about the particular positions from which they frequently have to move. This input should be used as context for designing training programs because, for instance, mechanics could be different for officers when they wear an actual duty-belt as compared to the diving belt used in the study. Positions experienced by officers may vary with context and operational tactics, and strength and conditioning programs should specifically build the capacities of officers to move rapidly from these tactical positions. Strength and conditioning programs can employ progressive loads that eventually exceed carried loads while on duty by a substantial margin to account for fatigue and other stressors that affect physical capacity. Specificity in the ways in which the loads are carried, to simulate operational scenarios closely, will also be important during these tactical strength and conditioning sessions.
References

ABOUT THE AUTHOR
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.
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REAL ATHLETES. REAL SCIENCE.
DEPLOYMENT FITNESS—CARRIER-SPECIFIC NAVY PHYSICAL TRAINING

The United States Navy, like other branches of the United States Armed Forces, has its own unique set of internal and external environmental influencing factors that affect the confines, limits, directives, and restrictions of any one command’s workplace, combat zones, and physical training (PT) domains. Unlike all other branches of the military, Navy Sailors primarily perform their duties away from the rural and urban combat zones of a land-based terrain. Rather, they perform their duties in either “sea-trial” conditions (short periods of 2 – 8 weeks of training exercises performed at sea but not in an active combat zone) or in an actual deployment (6 – 9 months, most of which is spent on an aircraft carrier at sea with minimal time in port domestically or overseas). This provides a unique challenge unlike that of the other military branches.

This article will focus primarily on the training and physical fitness/nutrition considerations of U.S. Navy Sailors while out at sea as compared to shore installations. More specifically, this article will focus its scope to that of large deck carriers that have a “fit boss” assigned to them.

A “fit boss” is someone brought onto the carrier who is responsible for providing fitness, training, and recreational activities to the sailors aboard. They must be able to work around and within the daily schedule of an operational carrier. This can be a challenge that requires considerable open and direct communication, daily planning with key personnel of the ship’s active duty unit to procure spaces, as well as awareness of the ship’s multiple evolutions and drills that occur 24 hours a day (some at a moment’s notice). Working on a moving, unstable carrier with an open flight deck and hanger bay brings in challenges of strong wind, sound interference, and balance (of people and gear) that would otherwise not be such a consideration in shore-based settings. Working around spaces that often have multiple aircraft/support materials need to be factored into how large a PT session can be, where it can be held, and what kind of activity can be planned for that workout. The ship’s hanger bay and flight deck surfaces have a unique “non-skid,” ripple-like texture (Figures 1 – 3) that can be very abrasive to skin, even when the body is covered by clothing. Matting is a requirement for each sailor to perform ground-based exercises on most ships safely.

Aircraft carriers (CVN class) typically contain three or four formal spaces/rooms (Figures 4 and 5) dedicated to open use for traditional gym equipment (machines and free weights) and for PT training on a voluntary basis or in small groups. Ceiling height must be considered more closely when picking specific items to place in the ship’s PT areas. Of course, square footage must also be considered so that those items placed in a PT space have full functionality/movement, allow for safe traffic flow, and do not cause overcrowding of the space. More is not always better in this context; in fact, less is often preferable to more due to the confined space. Each piece of equipment the fit boss selects should have a purpose that benefits the largest population of the command in a meaningful manner. Instead of choosing between a squat cage and a preacher curl station or an Olympic bench and a seated calf press, dual/multi-function units are advised rather than independent machines. Power requirements and availability also are crucial factors to consider in the placement and selection of cardiovascular equipment in this space. Power-based equipment (e.g., motorized treadmills) should only be placed in locations that include dedicated circuits for them, while other self-powered units like elliptical machines, bikes, versa climbers, and rowers can be placed elsewhere. The fit boss may need to speak with the ship’s electrical staff to assure that power is or can be made available to select spaces before installing power-based equipment.

Furthermore, the storage space is very limited on most large carriers. With available space being a premium commodity for all command needs, the fit boss must be careful and mindful as to what is needed or not needed for essential fitness gear. Larger machine-based items can and should be kept to the ship’s designated PT spaces. Smaller items like kettlebells, Olympic bars, medicine balls, jump ropes, sand bags, stretch bands, etc. can be kept in a large conex box (Figure 6) for storage. Ideally, these conex boxes should be stored near the areas that PT will occur for ease of access for setting up and taking down.

Fit kits, provided by Commander, Navy Installations Command (CNIC), can be useful tools to integrate into daily PT sessions due to their small bag storage, simplicity of use, and convenient transport (Figure 7). Large-group PT and one-on-one training sessions can be led using the fit kits for beginner and advanced sailors alike. Using the Navy Operational Fitness and Fueling System (NOFFS) training series guide as a primary guide to exercise programming over a deployment period is also an option for fit bosses on large-deck carriers (3). Progressions in length, difficulty, and sailor experience are all factored into the NOFFS program using the fit kits and bodyweight exercises.

The specific demands of the Navy for PT are set forth by instructional policy (1,4). The policy requires all sailors to perform the 1.5-mile run and as many repetitions as possible in two minutes for curl-ups and push-ups. They also must pass the height/weight requirements for gender and age and/or the Navy’s Body Composition Assessment using the taping method if height/weight requirements are not met. Fit bosses should become familiar with, and keep close, references to these assessments.
and scores to ensure that when working with individual sailors, he or she can accurately instruct the sailor to the proper level of fitness needed to pass the biannual Navy Physical Fitness Assessment. This is done while making sure each sailor is able to sustain or improve outcomes on these tests, while also keeping their personal fitness goals in mind so that conflicting objectives do not impede a sailor’s ability to stay within the standard. Sailors are given 150 min per week, during the work day, to partake in PT-related activities under supervision of their command or fit boss. This can be done in three 50-min sessions or two 75-min sessions per week depending on which schedule best fits the command’s operational demands and needs.

Nutritional support year-round, in port or at sea, is always important to the health, fitness, and well-being of any sailor. However, at sea, where the only source of whole food nutrition comes from the galleys and mess decks, it becomes even more important to ensure that sailors are educated and aware of how to make informed choices about their food selections, portions, and dietary habits. The Navy 21-day menu offers a wide variety of wholesome and nutritious foods daily at all meal times (e.g., breakfast, lunch, dinner, and midnight rations) (3). Vending machines and a ship’s in-house store are also available most hours of the day on large-deck carriers for snack and beverage purchases. However, there are also options available that are not conducive to the health and wellness of a sailor if eaten too often or with improper portions. The fit boss can work with the food service division and the ship’s food service officer (FSO) to create nutritional programs or implement campaigns already in place by the Navy in order to make nutritional education, awareness, identification, and selection as easy as possible. For example, Go for Green® is a simple 3-color coded system that describes what a particular food’s color represents for health and fitness properties (2). Go for Green is a joint-service food labeling program sponsored by the Department of Defense (DoD) for the military community (2). Through this program, the foods served on the mess decks are labeled with nutritional fact cards that also have a colored star sticker of green, yellow, or red that tells the sailor if that food is an optimal, okay, or poor food choice. This ties in well with the component of the NOFFS program that uses comprehensive food lists (specific to the 21-day Navy menu rotation), proper portions, meal timing, and exercise nutrition education elements to take sailors deeper into the understanding of sound nutrition and weight management.

The fit boss can also be a powerful reference for sailors who have questions about dietary supplements, weight loss, eating for muscle gains, athletic performance improvement, etc. They can refer sailors to such materials as well as other primary sources such as the Operation Supplement Safety campaign, which is a comprehensive research-backed DoD website for updates, resources, handouts, and educational materials for sailors on dietary supplements and nutrition (5).

In conclusion, it can be seen that like all aspects of fitness training, the demographic at hand must be carefully considered. The military sector requires tactical facilitators to become very familiar with their branch and its unique demands and operational settings. Knowing the resources, limits, constraints, and unique nature of the United States Navy physical fitness culture would serve the tactical facilitator well in developing long-term and daily programming with the command at-large. Understanding the arena of large-deck aircraft carriers in the Navy would prove essential to any tactical facilitator looking to become involved with fitness positions at sea, as well as those ashore. Navy aircraft carriers are the heart and soul of how and where the frontlines of sailor manpower are placed and thus tactical operations are enacted at sea. The health, fitness, and longevity of these sailors reside in their ability to sustain, promote, and foster this culture during lengthy periods at sea. This is in stark contrast to other branches of the military, where rural and urban warfare settings are common. The fit boss is in a prime position to act as a leader and subject matter expert in assuring his or her command is always fighting fit and ready to sustain the Navy mission.

REFERENCES
ABOUT THE AUTHOR
Josh Hockett received his Bachelor of Science degree in Kinesiology from the University of Wisconsin-Milwaukee and a Master of Science degree in Exercise Science from the University of Wisconsin-La Crosse. He has worked with the University of Wisconsin-Madison Athletics Department via the women’s volleyball and hockey teams as well as the men’s hockey team. Hockett was the Personal Training Director for Anytime Fitness in Madison, WI for two years prior to his two years as the Strength and Conditioning Coordinator for MizzouRec at the University of Missouri in Columbia, MO. Hockett has worked as the Afloat Fit Boss for the USS Ronald Reagan in San Diego, CA since 2012. He is also an American Natural Bodybuilding Federation (ANBF) pro men’s physique competitor and coach. Hockett also holds certifications from the National Strength and Conditioning Association (NSCA) as a Certified Strength and Conditioning Specialist® (CSCS®), NSCA-Certified Personal Trainer® (NSCA-CPT®), and Tactical Strength and Conditioning Facilitator® (TSAC-F®).
FIGURE 5. DEDICATED PT AREA

FIGURE 6. CONEX BOX

FIGURE 7. FIT KIT
WHAT IS IN YOUR SMOOTHIE?

For this column, I decided to evaluate the smoothies made at a local fitness center. This facility in particular makes four smoothies, which includes meal replacement, whey protein, muscle-enhancing, and fat-burning options. The goal of this evaluation was to investigate the differences between the smoothies, and determine what ingredients were being added to make it “enhance muscle” or “burn fat.” Many tactical athletes utilize smoothies for various reasons/purposes. Some drink smoothies as replacements for a typical meal, while others consume smoothies for the potential post-workout benefits. However, not all smoothies are made the same, and due to the nature of process (i.e., mixing many ingredients), oftentimes the nutritional information provided may not reflect exactly what is contained within the drink (if it is provided at all).

Before reading what I thought the smoothie would or would not contain, I would like to note that not all facilities follow the same procedures for creating and/or labeling their smoothie products. What follows is an examination of the four smoothies offered in one sample facility, as well as a breakdown of how to apply this information and why it is important to tactical athletes.

MEAL REPLACEMENT SMOOTHIE

A small meal replacement smoothie should have the caloric equivalent of a small meal. For the purposes of an example, this would be about 250 – 350 calories and 15 g of protein, similar to a Slim Fast® or Ensure® drink. At this sample facility, the small meal replacement smoothie contained approximately 500 calories with 37 g of protein. Based on limited observations, most individuals ordered the medium or large, which contains about 660 – 970 calories and 50 – 75 g of protein.

WHEY PROTEIN

With whey as the protein source, this smoothie should be the highest in protein of all smoothie options and equal to the other smoothies in carbohydrate amounts. Typically, a small whey protein smoothie of this type would be about 190 calories, with 25 g of protein and 13 g of carbohydrate. However, at this sample facility the small actually contained 400 calories, 35 g of protein, 50 g of carbohydrate, and 40 g of sugar. Overall, it had more sugar than it had protein. This illustrates the importance of looking into the nutritional facts of any given smoothie instead of selecting one based on the name or the assumption of what is contains.

MUSCLE-ENHANCING SMOOTHIE

A typical “muscle-enhancing” smoothie should have the same protein content as the whey protein but with additional amino acids. The small sized option muscle-enhancing smoothie provided at this sample facility listed the contents at 230 calories and 12 g of protein. However, this smoothie option can actually contain around 540 calories and 32 g of protein. The additional calories come from carbohydrate and sugar in the powder used. Since the customer has the option of adding creatine or additional protein in any amount, the contents of this smoothie type can vary wildly.

FAT-BURNING SMOOTHIE

Common sense would indicate that this smoothie type should be the lowest in calories of the four options. It is likely this smoothie type also contains a stimulant. However, the fat-burning smoothie provided at this sample facility was actually the same as the meal replacement smoothie except for an added 200 micrograms (mcg) of chromium supplement. The large sized option had about 970 calories and 75 g of protein with 70 g of sugar. For reference, an average 20 oz soda has around 65 g of sugar. In terms of calories, it seems contradictory to have a fat-burning smoothie that contains 900 calories. This illustrates the importance of checking the additives included in any smoothie. If the goal is to “burn fat” and a tactical athlete consumes excess sugar, it could affect their training and progression, not to mention their overall health.

CHROMIUM

Chromium was mentioned as an ingredient that was added to the fat-burning smoothie. However, chromium supplements present potential problems, which include contamination of toxic forms and unregulated doses. Chromium is a trace mineral, making it essential to the body in small amounts (2). Chromium is required for insulin function and blood sugar control (2). It is often consumed in order to help individuals reduce fat, increase lean muscle mass, increase energy, and enhance athletic performance (6). Studies on the beneficial effects of chromium on bodyweight and composition have been inconclusive (3). Some studies have shown some benefits along these lines, but those studies have been criticized for not controlling the dietary intake of the participants properly, and some would deem these studies unreliable (3). There are various forms of chromium (chromium picolinate is the most common form used in supplements) and while no tolerable upper intake level (UL) of chromium has been established, supplementation of 50 – 200 mcg per day is safe for most people (5).

Doses of 200 – 400 mcg per day can induce cognitive, perceptual, and motor dysfunction, which are all contraindicated for tactical populations (7). Some individuals experience headaches, insomnia, sleep disturbances, irritability, and mood changes. Doses above 600 mcg can lead to anemia, thrombocytopenia, hemolysis, hepatic dysfunction, and renal failure (7).

Daily adequate intake for males are shown to be 25 mcg for 9 – 13 year olds, 35 mcg for 14 – 50 year olds, and 30 mcg for 50 year olds and up (3). For females, it is generally less than males, unless during pregnancy or lactation. Daily intake of chromium for females are shown to be 21 mcg for 9 – 13 year olds, 24 mcg for 14 – 18 year olds, 22 mcg for 19 – 50 year olds, 18 mcg for 51 – 70 year olds, and 15 mcg for 71 – 100 year olds (3).
for 14 – 18 year olds, 25 mcg for 19 – 50 year olds, and 20 mcg for 50 year olds and up (3). The typical American diet provides an average of 39 – 54 mcg of chromium per day for adult men and 23 – 29 mcg of chromium per day for adult women (3).

At this sample facility, a small fat-burning smoothie contains one 200-mcg capsule of chromium picolinate, a medium smoothie has two capsules, and a large smoothie has three capsules. Therefore, some medium or large smoothies could contain double or triple the daily amount of chromium that is regarded as safe. For obvious reasons, commercial food products should not contain an ingredient that can be toxic at high doses without warning the consumer of that ingredient and possible side effects of consuming too much. Without knowing exactly how much is added to a smoothie, it can be hard to determine if its contents fall within a safe range or not.

**DIETARY SUPPLEMENTS**

The problem with dietary supplements added to smoothies is there is no one to see if the customer is taking too much of the ingredients, other medications that interact negatively with the supplements, or has health problems contraindicated with the ingredients. Dietary supplements are not required to be tested by the Food and Drug Administration (FDA) or any agency prior to sale. Some supplement manufacturers voluntarily have their products tested by a third party agency such as United States Pharmacopeia (USP), ConsumerLab, Informed-Choice, or National Sanitation Foundation (NSF) International to ensure safety and purity. Many dietary supplements are recalled due to contamination with unapproved ingredients; although not all supplements considered “tainted” get recalled (4). The majority of recalled supplements fall into the categories of weight loss, bodybuilding, or sexual enhancement products (4). Since supplements do not need to be tested for content purity/accuracy, a tactical athlete could consume far more than the recommended dosage by adding a supplement to a smoothie.

**CONCLUSION**

The bottom line is that it is always best to avoid consuming mystery smoothies, or any sort of food or drink in which the ingredients are unknown. If a tactical athlete chooses to partake in drinking a smoothie, or the like, they should never be shy about inquiring exactly what the ingredients are and how much is contained. Some meal replacements can be an option to control calories if an individual is trying to lose weight. Third party certified, ready-to-drink protein drinks are a convenient way to add a controlled amount of protein after a workout. However, neither of these products can take the place of a balanced diet and solid workout plan. Tactical athletes need to be cognizant of all the options out there and make sure to maintain healthy nutritional habits.

**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.
The security situation in the world today has a direct impact on specialist human resources (i.e., tactical law enforcement teams, military special forces, and other security agencies), especially during major planned events. These major events include large public gatherings, such as rock concerts, sporting festivals, economic forums, or dignitary and political visits. Risk management policies include the maintenance of public protection and multilayered security measures, which require specialist tactical response members to support these events with essential critical incident response capabilities.

These events are often staged over long periods; for instance, the Olympic Games last three weeks. The length of the event, combined with extensive lead-up training, briefings, planning, and preparation means that a tactical team may be engaged in a given task for a significant amount of time. During this pre-event period, these specialists may not be able to conduct adequate physical conditioning due to competing priorities, which may result in a drop in human performance, known as deconditioning (5).

Several papers have examined the needs of the tactical athlete to stimulate key physical fitness attributes regularly. These studies have demonstrated that a consistent and well-balanced strength and conditioning program augmented with specific and necessary load carriage activities every 7 – 14 days may enhance performance in relative strength, power, and aerobic/anaerobic capacity; all fundamental to a tactical athlete's occupational role (3,5).

The lack of specific conditioning time for these tactical athletes during long deployments poses a significant risk to their overall operational performance at large scale events. This potential reduction in performance can be attributed to the large time gaps between consistent physical training sessions. These gaps are often due to logistical constraints (i.e., shift work, long working hours, and residing in temporary accommodation, motels, or military barracks with limited access to adequate conditioning facilities).

The specialist tactical law enforcement team’s charter in any jurisdiction is “response.” In this case, response can be defined as rapid activation of highly trained and highly skilled use of force exponents utilizing specialist tactics, equipment, and methodologies to cordon, contain, and resolve high-risk situations outside the capability of first responders. Police tactical groups exercise these skills and tactics by regularly testing methodologies via “stimulus response training,” such as rigorous scenario training in selected training venues that elicit the appropriate use of force responses required to deal with the presented threat (i.e., active shooters, hostage situations, etc.).

This stimulus response training mimics the actions that would be expected in a real-life, real-time critical event. The training should be conducted wearing full operational load, including ballistic personal protective equipment (PPE), respirator (gas mask), ammunition, water, specialist equipment, and weapons. Sustaining this essential operational load (up to 25 kg) means that this training can be extremely physically demanding, and it requires regular resilience conditioning otherwise performance may be directly affected by the load (5). Considering this, while functional training may require the tactical athlete to be able to carry the load and maintain good postural core strength, while also having high levels of relative strength, anaerobic conditioning, and aerobic conditioning, the stimulus response training may not only be time consuming but also mentally fatiguing thereby decreasing the desire of the tactical athlete to perform any maintenance training (1,3).

Take the Group of 20 (G20) economic forum, which recently concluded in Australia, as an example. The G20 security operation ran for approximately six weeks with the focus on two key days of meetings. This operation involved 6,000 law enforcement and military officers, including Special Forces and Australian Police Tactical Groups. These special tactical law enforcement groups exercised via scenario-based training in the venue areas of the event providing essential operating environment familiarization and specific on-the-job skills enhancement.

It is the responsibility of the special law enforcement officers to maintain the skills and tactics, command and control, and operational factors necessary to ensure safety at these major events. The aforementioned primary risks are the deleterious effects that long-term deployment has on the individual’s physical conditioning; therefore, it is essential to maximize finite training time and minimize the impacts of the environment.

A description of factors, variables, and challenges that negatively affect the tactical athlete’s ability to maintain peak condition during major events is presented in Table 1. It is worth noting that the list is not exhaustive.
Tactical athletes will often come up with their own unique and interesting ways to maintain their conditioning. To assist the tactical athletes in maintaining a baseline of conditioning during major events and to combat the negative outcomes in Table 1, Table 2 provides some strategies that can be adopted to mitigate these effects.

Specialist tactical law enforcement officers and Special Forces teams are often required to perform duties at a high level of alertness while at major long-term special events. By the very nature of the operational task, tactical athletes that ordinarily maintain a very high level of strength and conditioning may sustain the effects of deconditioning during a prolonged period without the ability to train. It is vitally important for tactical athletes in these situations to be mindful of the possibility of detraining and try to prevent it when possible; mitigation strategies can help to assist tactical athletes to perform at their best and to reduce the risk of occupational injury (4).

REFERENCES


ABOUT THE AUTHOR
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 post graduate studies at Bond University as part of the Health Sciences and Medicine Faculty.

### TABLE 1. FACTORS, VARIABLES, AND CHALLENGES THAT AFFECT CONDITIONING

<table>
<thead>
<tr>
<th>FACTORS/VARIABLES/CHALLENGES</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long working hours</td>
<td>Fatigue; simply no time to train.</td>
</tr>
<tr>
<td>Travel</td>
<td>Often tactical athletes have to drive operational response vehicles with essential equipment long distances to attend the events. In addition, travel includes the daily commute between accommodation and venue locations, if not based at critical infrastructure sites.</td>
</tr>
<tr>
<td>Nutrition</td>
<td>Often operators have to perform long shifts in static locations where options may not exist for healthy food choices. In addition, meals may have to be replaced with Meals Ready-to-Eat (MREs) or fast food.</td>
</tr>
<tr>
<td>Accommodation</td>
<td>Housing large numbers of tactical athletes and supporting staff can be difficult. This means teams may not be accommodated in an area that has access to appropriate strength and conditioning facilities.</td>
</tr>
<tr>
<td>Fatigue management</td>
<td>Shift work, long shifts, and poor sleeping conditions (i.e., barracks, ground sheet, or tent line accommodations) directly impact energy levels and performance.</td>
</tr>
<tr>
<td>Situational awareness and security environment</td>
<td>Due to the high threat environment and nature of operations, opportunities may not exist for members to exercise in venue precincts. During the course of major events, tactical athletes may be dressed in PPE and maintained at a “high level” of alertness for days on end. They may also be confined to specific holding areas with limited options for physical activity.</td>
</tr>
</tbody>
</table>
### TABLE 2. STRATEGIES TO MAINTAIN CONDITIONING DURING MAJOR EVENTS

<table>
<thead>
<tr>
<th>Factors/Variables/Challenges</th>
<th>Mitigation Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long work hours</strong></td>
<td>Managers and supervisors need to ensure that tactical athletes do not forgo sleep in order to train, as fatigue will be cumulative over the course of the event. An individual balance needs to be obtained between training stimulus and conditioning maintenance, and the tactical athlete’s overall fatigue.</td>
</tr>
<tr>
<td><strong>Accommodation</strong></td>
<td>These days, most elite tactical units have full-time tactical facilitators at their service; therefore, tactical athletes know how to train with less. “Flyaway kits” are travel boxes/trunks that contain training aids, which can be transported with the team equipment. These kits contain aids such as sand bags and water bags, which can be transported while compressed and then filled on location. Kettlebells (if travelling via road) can add enough weight and variation to allow for strength, endurance, or high-intensity training options. Jump ropes, medicine balls, abdominal belts, foam rollers, and TRX® systems can all be packed into trunks for transportation. The Beep Test App on an iPhone can also be a useful tool. Imagination and motivation will result in operators often completing enough activity to reduce the effects of detraining.</td>
</tr>
<tr>
<td><strong>Travel</strong></td>
<td>There is a substantial difference in terms of equipment that can be packed depending on whether the travel is by road or air. Road travel allows for transportation of flyaway kits and more training aids.</td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
<td>In preparation for the event, nutritional considerations must be addressed. Sports nutritional supplements can be easily packed and transported, such as sports bars, protein replacements, shakes mixed with water, high protein and energy foods that are prepared in advance, and dehydrated foods such as beef jerky, nuts, dried fruits, muesli, etc. Foods that can be stored with limited space at room temperature can be useful between meals or when healthy options are not available.</td>
</tr>
<tr>
<td><strong>Fatigue management</strong></td>
<td>Ensuring proper sleeping patterns is critically important, and should be managed on a daily basis. Sometimes resting and achieving adequate sleep may be the best physical maintenance tool.</td>
</tr>
<tr>
<td><strong>Situational awareness and security environment</strong></td>
<td>The operational environment sometimes mandates that the only physical conditioning or training that can be squeezed into a schedule are basic push-ups, sit-ups, burpees, static holds, or some basic mobility, while dressed in full PPE in a holding area. Due to the nature of operations, it may not be appropriate for members to have breaks or time to devote to physical conditioning. Basic movement, mobility, and some activity is better than nothing, and can reduce the risk of injury (4).</td>
</tr>
</tbody>
</table>
CONSIDERATIONS FOR SPECIALIST TACTICAL LAW ENFORCEMENT OFFICERS DURING LONG-TERM SPECIAL EVENTS

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OVEREXERTION INJURY: When the body is subjected to external forces that exceed its structural potential, the tissue can fail or become weakened. This failure can lead to injury. The body’s tissue tolerance to external forces is limited, and when these forces exceed the tissue’s capacity, injuries can occur. Overexertion trauma occurs when the body is subjected to forces that exceed its tolerance, leading to tissue failure. Prolonged static positioning is a common cause of soft tissue trauma in first responders, as they are often required to perform tasks that involve static postures. These positions can lead to tissue compression and potentially result in injury.

REPETITIVE MOTION DISORDER: Repetitive movements can cause microtraumas that weakens the tissue, leading to injury. This is a common issue in first responders, who often perform tasks that involve repetitive motions, such as lifting or reaching. Overuse of muscles over time can lead to muscle fatigue, and if the muscles are not used correctly, injury can occur.

PROLONGED STATIC POSITIONING: Children go to school and may often sit at little tables with a hunched forward posture. Many adults essentially do the same thing, except adults are typically more sedentary. Hours spent behind a computer desk or in a car can lead to muscle fatigue, and if the muscles are not used correctly, injury can occur. First responders, such as firefighters, are exposed to prolonged static positions as they carry out their duties. This can lead to muscle fatigue and injury.

PATTERNS OF FIRST RESPONDERS

Life is full of patterns, from how one sits to what leg is primarily used to climb or descend stairs. Everyone possesses his or her own unique patterns that have been developed, reinforced, and adapted throughout their lifetime. Consider standing for a long period and the tendency to shift weight. Will the weight be predominantly shifted towards the stronger side, the tighter side, or the weaker side?

Tactical facilitators need to understand the patterns that first responders encounter on the job and the patterns that they bring with them to work. These patterns can have a profound effect on underlying biomechanics and can often contribute to tissue loads that far exceed what the body can safely handle. A firefighter or an emergency medical technician (EMT) that has to perform the postures that firefighters do will be at risk of injury.

The problem presented in this instance lies in the fact that training lifts, often used to establish job strength, are done with Olympic bars or kettlebells where the handle places the initial hip hinge lift position roughly at mid-shin height. This conundrum is twofold. First, if constantly training with heavy lifts from the floor, first responders may be quickly exposed to spinal torques that are dangerous and could lead to injury. Secondly, many responders have underlying biomechanical patterns that inhibit deep safe lifting. Of course, the easy answer is to not lift from the floor. There are techniques that can alter this lift height and make it safer, but in many cases, patients have to be lifted from the floor and no tool can help in all situations.

Before looking at some specific examples of poor mechanics and their potential for injury in tactical populations, it is prudent to review the three major causes of soft tissue traumas in the public sector. These causes are overexertion trauma, repetitive motion disorder, and prolonged static positioning.

1. Overexertion Trauma: Overexertion injury occurs when the external force that is encountered produces torques and compressive loads that the tissue is unable to handle. When the failure tolerance is met, the tissue can fail outright or sustain microtraumas that will weaken the tissue causing it to fail. An example of this can be seen when a responder has to pick up a patient from a bathtub to move them into a hall where medical treatment can begin. The restricted working environment and the weight of the patient may cause the tissue to sustain forces beyond its structural potential, in which case the tissue will fail.

2. Repetitive Motion Disorder: Repetitive movements can ultimately lead to tissue failure from countless repetitions of faulty and dangerous movements. A common pattern seen is how first responders enter and exit their vehicles. Years of rapid entry and exit from vehicles, often weighed down with gear, can fatigue the tissue to the point of failure. The same effect can be seen from faulty lifting; it is common for EMTs to suffer rotator cuff strain after lifting the 40-lb electrocardiography (ECG) monitor from the floor to the top of the cot in a swinging motion. These repetitive traumas of the job eventually lead to the tissues being weakened and yielding to the external force.

3. Prolonged Static Positioning: Children go to school and may often sit at little tables with a hunched forward posture. Many adults essentially do the same thing, except adults are typically more sedentary. Hours spent behind a computer or a steering wheel can produce spinal torques and compression loads exceeding 1,700 – 2,500 lb.

Law Enforcement Officers (LEO): LEOs can display an upper crossed syndrome due to prolonged wearing of ballistic vests and essential gear coupled with prolonged sitting and typing on a data terminal in their patrol car. These patterns, day after day, may cause the sternocleidomastoid, upper trapezius, and shoulder internal rotators to become short and tight, often displaying a lower activation threshold. The pain and/or “symptom” that they experience is commonly posterior due to the protraction of the scapula and can commonly include headaches, neck pain, rotator cuff, and glenohumeral disorders due to the protraction of the scapula and can commonly include headaches, neck pain, rotator cuff, and glenohumeral disorders.

Firefighters: Standing on concrete floors, hours spent in duty boots, training and working in boots/gear, and hours on ladders and pitched roofs may lead to tightness in the calf, foot, and ankle of firefighters. This tightness in the foot and ankle can affect firefighter movements, like how they enter and exit their vehicle and, through changing the mechanics of the movement, increase their potential for injury. The same can be seen in other tasks when the ankle joint is tight and/or restricted, the ability to squat and climb steps is altered; this can be especially problematic if firefighters neglect to maintain ankle and foot range of movement through rolling and stretching the gastrocsoleus complex and posterior tibialis.

When tight, these muscles can affect the...
distal and proximal joints while also contributing to anterior tibial stress syndromes (shin splints) and patellofemoral joint dysfunction.

Pre-shift and pre-training stretching is therefore a recommended requirement for all firefighters. Active foot and ankle glide stretches, followed by static stretching and foam rolling may help to ensure sufficient foot and ankle range of motion and reduce the potential for injuries sustained when climbing and lifting.

**EMT:** A very common pattern prevalent in EMTs is that the hip flexors can become very short and tight (2). As they become tight, they cause an anterior pelvic rotation or translation that inhibits and weakens the abdominal muscles, which may lead to the spinal system taking additional loads. Additionally, the hamstrings may become increasingly tight; as Vladimir Janda identified, when the glutes become dis inhibited and weak, the hamstrings tighten in an attempt to pull the pelvis back into neutral (agonist-antagonist relationship with the hips flexors) (5). As this pattern becomes more and more severe (lower crossed syndrome) the EMT loses the ability to lift properly. The most common manifestation of this is seen when an EMT lifts a cot into the ambulance. Most EMTs will pick up the cot (empty weight is 95 lb for a manual and 145 – 165 lb for a powered cot) using poor technique that loads the lumbar system as they stand up. This loading of the lumbar system is created by the need for spinal extension from a position of deep spinal flexion, which in turn is caused by poor hip joint range of motion (restricted by the tight hamstrings and gastrosoleus complex) and may lead to a back injury.

Active stretching of the hip flexors and hamstrings followed by a long duration of low-load stretching of the hip flexor group and hamstrings may reduce the tightness that many EMTs experience daily. Tying this into some simple gluteal integration exercises like single-leg bridges, lateral step-ups, and bowler squats can have a positive effect.

Thus, the take-home message is that without job-specific mobility that is practiced and trained constantly, first responders will continue to sustain injuries. Teaching simple yet highly effective exercises that are related to job-specific tasks are important, so that when first responders are in dangerous ergonomic situations, they will possess the physical ability to complete the task without sustaining an injury. However, prior to performing these job-specific exercises, the tactical facilitator must ensure that the tactical athlete is performing the movement with the correct patterns of posture and muscle activation. This is a better alternative than a “get it done” mentality, which could lead to injuries that will continue to plague them.

**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, firerescue1.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.
PREHABILITATION FOR THE TACTICAL ATHLETE

In the last few years, the term “prehabilitation” has become a buzzword across the strength and conditioning landscape. Prehabilitation has been implemented to stave off injuries and remedy deficits among individuals in order to prevent potential future injuries from occurring. With the rise of prehabilitation as a form of exercise prescription also comes misconceptions of what it truly is, where it originates from, and most importantly, what it can do for the tactical athlete.

WHAT IS PREHABILITATION?

Initially, prehabilitation was used as a preoperative measure (6,12). In theory, a person who has conditioned the key structures that will become weaker post-surgery prior to operative measures may be able to reduce recovery time and atrophy, while restoring function quicker. Research published on this topic focused on several injuries to the knee, lumbar spine, and shoulder that required surgery (6,12). The results suggest that individuals on a preoperative plan might show a reduced recovery time once the surgery is completed. These studies also noted that a prehabilitation program worked on other conditions, including osteoarthritis, cancer, and patients in intensive care units (6,13,14).

Outside of a hospital setting, the version of prehabilitation that is most commonly seen is one in which exercises are given as a preventative measure before an injury occurs. The thought process is that injuries that are more serious can be prevented if there is an intervention after a low-level injury is sustained or if a neuromuscular deficiency is found. Research confirms the use of prehabilitation routines for assistance in preventing injuries from occurring and decreasing asymmetries within individuals (12,13).

The rise of prehabilitation has been due to a variety of factors. Today’s tactical athlete is required to perform a myriad of physically demanding tasks. With proper progression of human performance programs, tactical athletes may optimize their ability to perform any given task from a physical perspective. However, not only can the given demands of the tactical athlete lead to injuries occurring, but so too can ongoing low-level injuries and developed neuromuscular deficiencies. On this basis, implementation of a prehabilitation program may be of benefit to tactical athletes.

HOW?

While there is a plethora of injuries in the tactical realm, studies from two Special Forces groups show that the most common injuries occur to the lower back, lower extremities, and shoulders (1,5,8). While the lower back, lower extremities, and shoulders may seem to be normal across the athletic landscape, it is the difference in the cause of these injuries, typically based on the demands of the tactical athlete, which requires attention. For example, certain tactical athletes may have to carry upwards of 40 lb loaded in occupational equipment and personal protective equipment, like ballistic armor. Research has shown that wearing this ballistic armor can increase the metabolic cost of locomotion and alter gait mechanics (2). In addition, this added weight can create a compression of the back and shoulders, increasing muscular demands, which in turn may cause quicker fatigue, impair the performance of the tactical athlete, and expose them to potential injury (4).

With the background knowledge of why prehabilitation is important for tactical athletes, it is necessary to remember that prior to any prehabilitative exercise prescription it is essential that the tactical athlete undergo an initial evaluation to determine the proper course of action. There are several good movement screens available, including the Functional Movement Screen™ and Fusionetics. Research has shown the value in these functional movement screening tools, which together with aerobic fitness can identify individuals with a higher risk of future injury (7,10). If available, these screening tools should be completed in conjunction with an assessment by a physical therapist. Physical therapist assessments will typically focus on specific movement-based issues, joint dysfunctions, and compensation patterns that are present following an injury.

WHAT TO LOOK FOR

Based on the above information, the tactical facilitator can take the initial screening evaluation tools and then combine them with performance measures. One method is to begin with the tactical athlete’s locomotive patterns (i.e., how do they walk, jog, run, etc.). In particular, the facilitator should consider whether their gait looks awkward and if so, are they compensating for something (e.g., stiffness or previous injury)? With the performance measures (e.g., pro-agility test, 300-yard shuttle, etc.), consider whether there are differences between right and left turns as well.

In applying a ground up approach, it may also be useful to have the tactical athlete do some sort of jumping and landing testing (like a drop squat, jump for height, or jump for distance). Here, the facilitator should consider how the tactical athlete jumps. How effective is their countermovement? Do they hinge properly at the hips, with proper hip/knee/ankle relationships (alignment and sequencing)? How do they land? Do they have a solid base of support with their feet relatively even or is it staggered and lacking control?

From a unilateral perspective, the results of screening using lunging patterns or single-leg hopping can help to determine differences between legs by comparing one leg to the other. Using a single-leg squat or single-leg bodyweight Romanian deadlift can provide a baseline of where the tactical athlete is at with each leg.
Moving up the body, movement screen analyses can provide an indication of spine mobility and function, shoulder and hip mobility, and overall basic core strength. Once these tests are performed and evaluations are made in collaboration with the physical therapy staff, the prehabilitation routine can be added. The next question then is where to place it?

**WHERE TO PUT PREHABILITATION IN THE PROGRAM?**

Once screening has been completed and any deficits and/or injuries have been determined, it is time to decide where to put the prehabilitation exercises into the tactical athlete's program. One of the most common obstacles encountered is time constraint. Tactical athletes are not typically able to devote a whole hour to two hours per day specifically to prehabilitative efforts so phases like the warm-up must be examined.

The purpose of a warm-up is to increase the functional potential of the body as a whole. Specifically speaking, the purpose of a warm-up is to establish the best relationship between the movement, exercises, and activities of the central nervous system (11).

The first place that prehabilitation exercises can be used is in the warm-up (Table 1). Here are a few questions to consider when applying prehabilitation exercises into the warm-up program:

1. Is it static or dynamic? Does it involve bodyweight or external resistance?
2. Is it a neuromuscular activation exercise or a range of motion exercise?
3. What is the purpose and pattern of the exercise?

In adding prehabilitation movements, it is important to take into account the type of workout, type of prehabilitation, and specificity of patterns in the warm-up. There are a myriad of warm-up templates to choose from, but a sample warm-up is provided as an example in Table 1.

The next place to fit prehabilitation exercises is after the warm-up and before the workout. These exercises typically involve external resistance and are specifically related to the need of the tactical athlete in correlation with the workout for that given day. Most often, these are progressions from the warm-up. The key differences are that they are performed at the end of the warm-up and they require more external resistance and movement patterning than the exercises in the warm-up.

Thirdly, tactical facilitators can implement given exercises as fillers or ancillary exercises. Typically, these are performed after the main exercise as a superset or block of exercises (Table 2). No matter the program, there will be a period of rest between sets, repetitions, and exercises. This is a perfect time to add prehabilitative movements and exercises, especially if they are focused on the outcomes for that specific day.

Lastly, prehabilitation efforts can be added as a post-workout modality. These can also include exercises that use foam rollers, lacrosse or tennis balls, and bands. The primary aim of prehabilitative exercises here would be to return balance to the body and limit the development of compensation patterns by returning used muscles to their optimal lengths.

**CONCLUSION**

Prehabilitation is a modality in which the tactical athlete can greatly benefit from and may enhance performance while reducing the potential for injury. There are a variety of ways to add prehabilitative exercises into the tactical athlete's program. These exercises can take shape in a plethora of ways, and can be implemented in several phases. Since it is known that prehabilitation exercises can assist in minimizing movement deficiencies in the tactical athlete and can aid in recovery and prevention, it is essential that these exercises be added in some way to the tactical athlete's program. Placement of these exercises, specificity of the exercise (based on individual needs), and duration of the program are things for the facilitator to keep in mind. After all, it is the responsibility of the tactical facilitator to strive to optimize the tactical athlete's ability to perform effectively and safely.
REFERENCES


ABOUT THE AUTHOR
Brandon Stone has worked as a Human Performance Specialist at both the 7th and 10th Special Forces Groups (Airborne). His duties include being the Director of the Bridge and Education programs as well as programming for the Green Berets pre, during, and post deployment. Prior to his work in the tactical community, Stone has worked at the National Collegiate Athletic Association (NCAA) and professional levels, including garnering two NCAA National Championships. He possesses a Bachelor of Science degree and a Master of Science degree, while also holding the Certified Strength and Conditioning Specialist® (CSCS®) certification through the National Strength and Conditioning Association (NSCA).
### TABLE 1. SAMPLE PREHABILITATIVE WARM-UP

<table>
<thead>
<tr>
<th>General Dynamic Warm-Up Exercises (approximately 8-12 minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warm-Up</strong></td>
</tr>
<tr>
<td>Skip</td>
</tr>
<tr>
<td>Knee hugs</td>
</tr>
<tr>
<td>Backward skip</td>
</tr>
<tr>
<td>Quad stretch</td>
</tr>
<tr>
<td>Lateral skip</td>
</tr>
<tr>
<td>Inside leg cradle</td>
</tr>
<tr>
<td>Across knee hug</td>
</tr>
<tr>
<td>Crossover skip</td>
</tr>
<tr>
<td>Reach and touch</td>
</tr>
<tr>
<td>Straight-leg march</td>
</tr>
<tr>
<td>Shoulder &quot;X&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foam Roll (1 Set)</th>
<th>Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glute</td>
<td>x 5</td>
</tr>
<tr>
<td>Hamstring</td>
<td>x 5</td>
</tr>
<tr>
<td>Iliotibial band</td>
<td>x 5</td>
</tr>
<tr>
<td>Thoracic spine</td>
<td>x 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prehabilitation-Specific Exercises (2 Sets)</th>
<th>Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarecrows</td>
<td>x 10</td>
</tr>
<tr>
<td>Internal/external shoulder rotations</td>
<td>x 10 each</td>
</tr>
<tr>
<td>Hip abductions/adductions with band</td>
<td>x 10 each</td>
</tr>
<tr>
<td>Fire hydrants/glute bridges</td>
<td>x 10 each</td>
</tr>
</tbody>
</table>

### TABLE 2. SAMPLE PREHABILITATIVE EXERCISES IN A WORKOUT

<table>
<thead>
<tr>
<th>Block</th>
<th>Exercise</th>
<th>Set 1 (reps)</th>
<th>Set 2 (reps)</th>
<th>Set 3 (reps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main exercise</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Secondary exercise</td>
<td>6 each</td>
<td>6 each</td>
<td>6 each</td>
</tr>
<tr>
<td></td>
<td>Prehabilitation movement</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Barbell step-ups</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Pull-ups</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Lying hamstring flosses</td>
<td>5 each</td>
<td>5 each</td>
<td>5 each</td>
</tr>
<tr>
<td>3</td>
<td>Landmine presses</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Drop push-ups – explosive</td>
<td>10</td>
<td>10</td>
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<td>Single-leg hops</td>
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The first block shows an example set up. Perform the main exercise, secondary exercises, and then prehabilitation movements in succession for the first set, which is then repeated for an increased number of sets (an additional two sets in this instance).

The second and third blocks are examples of exercises that can be implemented into a program.
THE IMPORTANCE OF PROPER MOVEMENT FOR MARINES—PART 1: AN INTRODUCTION TO MOVEMENT AND POTENTIAL PROBLEMS

The United States Marine Corps is well-known for its intense training and demanding physical standards. However, an incredibly important first step, teaching Marines how to properly move themselves through space, is often skipped or overlooked. Musculoskeletal injuries of the lower extremity and low back continue to affect Marines, causing time on light or limited duty and decreased performance on Physical Fitness Tests (PFT), Combat Fitness Tests (CFT), and more importantly, in combat (20). The types of musculoskeletal injuries commonly seen include plantar fasciitis, hip bursitis, patellar tendinitis, stress fractures, and herniated discs, to name a few (20). Many studies within the past decade have shown a correlation between poor movement quality and musculoskeletal injuries (6,17,24). Therefore, it can be hypothesized that many musculoskeletal injuries in the Marine Corps are a result of Marines having poor movement quality, most notably poor mobility and stability (9,13).

The ability to move the human body through space effectively is essential to the performance of Marines in combat. This includes standing quickly from a prone position while wearing 50 lb of gear and sprinting to a new position, which would provide cover from enemy fire, and then preparing to repeat that task repetitively under high stress conditions. Movement in combat may also include climbing into and out of a vehicle, carrying supplies (including ammunition, food, and water) to a new location, or simply patrolling with a heavy pack over varying terrains for several hours over several days. These examples are only a fraction of the tasks that Marines perform in combat. However, they all involve moving with the additional weight of protective gear, ammunition, and/or water, which, if executed with poor movement patterns, can potentially cause injury and significantly decreased performance (9,17,24). Evidence has shown that improved movement quality has the potential to reduce injuries and improve performance (9,13,24).

This four-part series will address implementing a comprehensive evidence-based approach to proper movement patterns in order to reduce movement dysfunction through assessment, education, and movement standard modification, which can increase the movement quality and physical task performance of Marines while simultaneously decreasing their potential for injuries. This approach may facilitate making Marines more effective warfighters, while also saving on healthcare costs. However, prior to discussing potential solutions to movement dysfunctions, the problem must be fully defined to understand why particular solutions were chosen.

THE PROBLEM

Musculoskeletal injuries continue to plague all Department of Defense (DoD) branches, to include the Marine Corps. Musculoskeletal injuries cost over 27 million dollars and 470,000 days in light duty annually (20,28). Most of these injuries can be prevented, yet little is currently being done to address the issue. Musculoskeletal injuries refer to injuries related to bones (hard tissue) and, muscles, ligaments, and tendons (soft tissue) and include, but are not limited to fractures, dislocations, sprains, and strains. Sprains and strains include damage to ligaments, muscles, and tendons. In addition to these more acute injuries, some are chronic in nature, like patellar and Achilles tendinopathies, plantar fasciitis, and chronic pain along the spinal column, to name a few. Overuse or overtraining injuries result from excessive musculoskeletal loading that exceeds the ability of the tissue to recover and can be caused by exercise or physical training (4). If a Marine is unable to train due to overuse and overtraining injuries, it can greatly reduce their operational readiness.

Available evidence regarding recovery times shows that the average lower extremity sprain and strain costs 14 days of light duty, an upper extremity sprain or strain is seven days of light duty, and spine or back injury is 30 days of light duty (26). There is also a significant dollar cost to each injury. In 2005, the average musculoskeletal injury cost the DoD $674 in medical costs per injury (this excludes the approximate $1,972 per injury cost in days of light duty) and with 508,766 musculoskeletal injuries, that resulted in $343,061,134 in medical costs alone (28). To illustrate how these light duty days add up, in 2004 there were 583,374 musculoskeletal injuries reported across the DoD which resulted in 8,874,571 days of light duty (26). Lower extremity and back sprains and strains accounted for 174,210 of these, which resulted in 3,080,108 estimated days of light duty (26).

Narrowing the scope to the Marine Corps exclusively, in 2011 there were 70,083 injuries reported among Active Duty Marines (does not include recruits at Marine Corps Recruit Depot in San Diego or Parris Island) (20). Of these, 33,850 (48.3%) were musculoskeletal injuries (20). Using a 1.2% inflation rate increase per year from 2005 to 2013 and assuming that approximately the same number of musculoskeletal injuries occurred in 2013 as in 2010 and 2011, each musculoskeletal injury cost the Marine Corps $800 in medical costs for an approximate annual total of $27,080,000 (20).

In terms of light duty days, musculoskeletal injuries cost the Marine Corps over 470,000 days on light duty per year (20,26). This equates to almost two infantry battalions being unable to
train for an entire year. Furthermore, musculoskeletal injuries significantly impact units in combat as well. From January 2004 to December 2007, musculoskeletal injuries caused 8,104 (24%) medical evacuations in DoD personnel from Iraq and Afghanistan (7). Combat-related injuries were the second leading cause at 4,713 (14%) of medical evacuation among DoD personnel (6).

The injury numbers mentioned above do not include unreported injuries, and as such, it is impossible to determine exactly how many more musculoskeletal injuries occur in the Marine Corps each year. However, due to the culture of the Marine Corps, and in order to continue training, many injuries are ignored and not reported. Examples include cases of plantar fasciitis, joint inflammation, and sprained ankles. While the ability to continue physical activity through pain is paramount to success in combat, it must be balanced in garrison situations so that minor injuries do not become more severe.

The study of the patterns, causes, and effects of health and disease conditions in defined populations has shown that not all injuries are accidents, and therefore, can often be predictable and preventable (4). While injuries occurring from traumatic events (e.g., car accident, falling off the rappel tower, etc.) cannot be directly associated with poor movement techniques, traumatic events cause the minority of musculoskeletal injuries. The vast majority of the approximately 34,000 musculoskeletal injuries occurring annually in active duty service members are the result of small, previously ignored injuries (minor sprains/strains/inflammation), that turn into larger, more severe injuries, or are the result of overuse and overtraining (15).

At first glance, it appears the Marine Corps has a large musculoskeletal injury problem. However, understanding that many of these injuries are “predictable and preventable,” it is apparent that the injuries are a symptom of a root problem. Analyzing studies that demonstrate how having full range of motion and the ability to stabilize the torso may significantly reduce injuries, it seems evident that the root of the problem may be that many Marines lack the required mobility and stability to conduct exercise and combat training safely (17,19,24). A study conducted on nearly 1,500 British Army recruits further illustrates this point, as it was determined that a simple stretching and strengthening program reduced anterior knee pain by 75% (11). This means that by stretching the muscles that surround the knee (i.e., quadriceps, hamstrings, adductors, and calves), knee pain reduced significantly. There was no change in training or reduction in running and hiking mileage, just simply stretching the muscles surrounding the knee combined with leadership fully supporting the implemented strength and mobility program. However, these results should be considered with caution as a study by Pope et al on 1,538 Australian army recruits found that a stretching program conducted as part of a warm-up routine had no impact on injuries (25). Likewise a recent study of 732 male and 47 female army recruits from the Australian Army Recruit Training Centre found no significant differences in injury presentation following the implementation of a balance and agility training program (12). As such, the timing and type of stretching and mobility interventions must be considered and further research is still required in this regard.

Considering this, a recent literature review of movement quality, as determined by the functional movement screen, has found that poor movement patterns are predictive of injury potential in a tactical population (1). While there are no published statistics regarding the mobility and stability on the approximately 34,000 Marines that experience musculoskeletal injuries each year, it can be hypothesized that the vast majority of Marines who experience musculoskeletal injuries may have dysfunctional movement patterns to some degree.

WHAT IS QUALITY MOVEMENT?
In order to establish a baseline context, quality movement must first be defined. There are two constant themes in the definition of movement. First, it can be defined as the ability to have full range of motion (ROM), or mobility, in all muscle groups (27). Mobility, in turn, can be defined as “the ability of the neuromuscular system to allow for efficient movement of a joint or series of joints through a full, non-restricted, pain-free range of motion,” (5). Various muscle groups overlap the entire skeletal system with some serving as stabilizers and others providing the body the ability to move. When muscles are unable to stretch to attain full range of motion, the joints (e.g., ankle, knee, hip, shoulder, elbow, etc.) may absorb excess stress as the body continues to move (10).

A simple example of the effect of range of motion can be seen in young children as they can sit endlessly in the bottom of a deep squat and move in ways that could cause severe injury to most adults. Children are able to do this because their muscles and joint structures are not tight and they have full range of motion among nearly all of their joints and muscle groups. On the contrary, a Marine who cannot touch their toes due to having tight hamstrings and lower back musculature is an example of what it is like to lack range of motion. When a muscle or joint lacks full range of motion, altered movement mechanics become necessary and the joints and surrounding systems become more susceptible to injury (16,27).

The second component to the movement definition is stability. Stability can be defined as “active muscular control exerted on a joint to redirect force and control movement in the presence of normal muscular flexibility and joint mobility,” (5). The central nervous system (CNS) consists of the brain and spinal cord. The
CNS is the main “processing center,” which controls all body movement (14). Stability combines motor control, which involves the CNS telling the musculoskeletal system what to do, with biomechanical efficiency in order to allow a person to maintain balance (18).

Stability in static scenarios is typically established more easily than in dynamic scenarios and a person cannot stabilize in a dynamic scenario of a given movement unless they first understand how to stabilize statically within that movement (27). When standing vertically, an optimal stable standing position is created by having the feet shoulder-width apart, postural stabilizing musculature activated, and joints in optimal alignment. Figures 1 and 2 provide a comparison of an optimal stable standing position compared to an inefficient stable standing position.

In order to bear any type of load effectively, “the spine must be stabilized by muscles and ligaments,” (21). Without the stabilizing muscles firing, “severe stress is placed on the joints and discs,” (21). Not surprisingly, people that move with dysfunction and do not properly stabilize their torso when lifting or moving under load often suffer from low back pain (23). A Marine performing a squat with weight on their back is a simple example of stability. As the Marine removes the weight from the rack, if they are not actively creating a stable position by engaging their stabilizing muscles, the weight will cause the Marine to resort to a compromised position from which they will not be able to generate as much power and could potentially overload structures and cause injury.

A Marine conducting push-ups also illustrates the stability concept (Figures 3 and 4). In Figure 3, the Marine is engaging all stabilizing muscles and the optimal alignment of key joints is very clear. In Figure 4, the Marine is also at the top of the push-up position, however, the stabilizing muscles are not engaged correctly, and the sag in the hips is very evident. This lower back sag places significant stress on the lower back and could eventually lead to injury (26).

Properly stabilizing the lumbo-pelvic region also applies to hiking with a pack. A Marine who does not properly stabilize their torso and hips while hiking with a pack may expose their lower back to unnecessary stress that may lead to injury. Likewise, a Marine who understands how to stabilize the spine properly during physical training will be better able to stabilize while hiking under load or conducting fire and movement while being shot at (27). In order to create effective stability in dynamic situations, a Marine must first understand how to create stability in a static situation on the physical training field.

The combination of range of motion and the ability to create an optimized stability ultimately defines quality movement. As an individual loses range of motion and the ability to stabilize, their movement becomes dysfunctional and their performance potential remains limited. They may also become highly susceptible to various musculoskeletal injuries that include torn tendons and ligaments in the knees and shoulders, as well as in the back (10,17,22,24).

EXACERBATING THE PROBLEM

Marine Corps fitness assessments include the PFT and CFT. These tests assess “the strength and stamina of the upper body, midsection, and lower body, as well as efficiency of the cardiovascular and respiratory systems” and “evaluate strength, stamina, agility, and coordination, as well as overall anaerobic capacity,” respectively (8). The Marine Corps assesses health and wellness through the Periodic Health Assessment (PHA). A PHA assesses a Marine’s health status and performs “reviews of other pertinent medical readiness information by a qualified Deployment Health Provider at a Deployment Health Center,” (2). Neither of these assessments deal with the two movement components described previously. Unless a physical training routine specifically addresses movement dysfunction, mobility and stability issues will likely not be addressed (3).

Furthermore, “training poor movement patterns reinforces poor quality and creates greater injury risk,” (10). The current Marine Corps Physical Fitness Order contributes to training poor movement patterns by describing the performance standards (i.e., achieve 20 pull-ups to attain the maximum score, the starting point is a dead hang with arms fully extended and the finishing point is chin above the bar), but neither specific movement techniques nor proper movement are addressed. When a dysfunctional movement pattern (e.g., holding the top of a push-up position with sagging hips and internally rotated shoulders) is repeated over and over, as is often the case in individuals throughout the Marine Corps, the pattern becomes ingrained in the individual. This individual may be more likely to move with poor movement patterns throughout their career unless proactive measures are taken to teach and assess proper functional movement pattern.

Part two of this series will address the solution for this foundational movement problem and examine possible revisions for movement standards.
REFERENCES


**ABOUT THE AUTHOR**

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.
Physical Performance in Combat

Movement Under Load

Movement with Intensity

Quality Movement

FIGURE 5. COMBAT PERFORMANCE PYRAMID
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