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TSAC REPORT

Contents

Concerns and Benefits of On-Duty Exercise Training for Firefighters

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Firefighting is a physically demanding profession that requires firefighters to achieve and maintain sufficient levels of physical fitness. Thus, it seems logical to recommend that firefighters exercise regularly to prepare for these unique demands. The National Fire Protection Association (NFPA) recommends that firefighters participate in a health-related fitness program (8). Furthermore, the NFPA recommends that fire departments allocate time for firefighters to participate in a health-related fitness program while on-duty (8). However, a recent study demonstrated that work efficiency on the fire ground decreases following an on-duty exercise session (3). Thus, it is important to consider both potential negative consequences and benefits of firefighters exercising on-duty.

Concerns of On-Duty Exercise Training: Fatigue and Training Status

A recent study was conducted by Dennison et al. to evaluate the effect of exercise fatigue and training status on fire ground performance (3). In this study, trained firefighters performed a simulated fire ground test to establish their baseline performance. On a separate day, the firefighters performed a circuit-based exercise session followed by the simulated fire ground test. Firefighters were given 5 min between the exercise session and the fire ground test to don personal protective equipment. The exercise session was composed of four multi-joint resistance training exercises with a load equal to 95% of the individual's 10-repetition maximum. In addition, a prone plank was performed for 30 s and a 3-min walking bout was performed on a treadmill at 3 mi·hr-1 (80.4 m·min-1) and 15% grade. Each firefighter completed two rotations of the circuit with a 30-s recovery period between exercises (≈1:1 work-to-rest ratio). The findings from this study indicate that the time to complete the simulated fire ground test following the exercise session increase, on average, by 9.6% (35 s increase) compared to the baseline trial. Thus, performing a circuit-based exercise session on-duty decreases work performance. However, it is important to note that this study evaluated the effect of exercise fatigue within 5 min of completing the exercise session. The short recovery period was purposefully used to maximize the effects of fatigue and evaluate the worst case scenario of responding to an emergency.

Another important dynamic to consider with regard to on-duty exercise training is the effect of the firefighter's fitness status on fire ground performance. The study conducted by Dennison et al. also compared the fire ground performance of a group of firefighters (n = 12) who-had been participating in a supervised, on-duty, training program to a second group of firefighters (n = 37) who had not been exercising regularly (i.e., "untrained") (3). The findings indicated that the average baseline (non-fatigued trial) fire ground performance of the trained firefighters was faster than 81% of the untrained firefighters, indicating that firefighters who exercise regularly have greater work efficiency than most untrained firefighters. More importantly, the average post-exercise fire ground performance (fatigued trial) of the trained firefighters was still faster than 70% of the untrained firefighters' baseline (non-fatigued trial) performance. These data suggest that firefighters who perform physical training while on-duty on a regular basis can perform firefighting tasks, even immediately after exercise, more efficiently than most untrained and rested firefighters.

Although the study does provide some insight regarding the effects of exercise-induced fatigue and training status on fire ground performance, it raises several additional questions (3). For instance, what fatigue-related effects do different types of on-duty exercise (e.g., aerobic exercise and traditional resistance training) have on fire ground performance? What acute effect does exercise intensity have on fire ground performance? What is the time course of recovery from various types and intensities of exercise? What is the interaction of fitness status on the magnitude of fatigue and the recovery rate? Answers to these questions may assist in the development of an appropriate on-duty exercise program. For now, we can only speculate that a more highly trained firefighter will be able to tolerate a greater exercise stimulus and recover in a shorter period of time compared to a lesser trained firefighter. Exercise training aside, consider what the effect of training status is if a firefighter has to respond to several emergencies within a given day. The highly trained firefighter will be able to perform more work, recover more quickly, and possibly have decreased risk of injury when responding to a subsequent emergency compared to a lesser trained firefighter.

Should Firefighters Exercise Exclusively Off-Duty?

Since one study demonstrated that on-duty exercise does reduce fire ground performance, critics may suggest that firefighters not exercise on-duty in an attempt to avoid the acute effects of exercise induced-fatigue. However, there are several potential negative consequences to consider before making this recommendation, including the effects of muscle soreness, decreased exercise participation, and increased risk of chronic diseases.

First of all, not performing exercise on-duty will certainly eliminate the accumulation of exercise-induced fatigue, given that exercise is not performed. However, exercising off-duty may produce delayed onset of muscle soreness (DOMS) which subsequently, may be less likely to occur when exercising on-duty due to proper supervision and well-managed programs. Delayed onset of muscle soreness has been shown to significantly decrease force production for up to seven days post-exercise in untrained individuals (9). Therefore, strenuous exercise sessions performed off-duty may negatively affect on-duty fire ground performance. The magnitude of DOMS is typically greater following high-intensity eccentric muscle contractions, when performing a novel mode of exercise, and among firefighters with minimal physical training experience.

Another potential consequence of firefighters performing exercise exclusively off-duty is the high probability of low exercise adherence. Although there are limited empirical data on this topic in firefighters, it is likely that the majority of firefighters will probably not exercise on their own. Research in other populations indicates that exercise compliance is greater in supervised training programs compared to unsupervised programs (2). Firefighters likely face many perceived barriers to participating in physical activity, including lack of time for physical activity, accessibility, availability, and cost associated with the use of exercise facilities, as well as not getting compensated to exercise while off-duty, and lack of exercise knowledge and guidance.

An additional consequence of relying on firefighters to exercise while off-duty is the implication for cardiovascular disease. That is, sudden cardiac death is the leading cause of fatality among on-duty firefighters (4). Therefore, it is important for fire departments to address risk factors associated with cardiovascular disease. Given that a sedentary lifestyle is a positive risk factor for heart disease, it is critical that fire departments promote physical activity (1). Thus, simply relying on firefighters to exercise off-duty may not optimize physical activity levels. Whereas, recommending firefighters to exercise off-duty and strongly encourage, or require, them to exercise on-duty will ensure that they are exercising at least a couple of days per week. Current physical activity recommendations for health benefits state that adults should perform vigorous aerobic exercise for a minimum of 20 min on at least three days per week or perform moderate-intensity aerobic exercise for a minimum of 30 min on at least five days per week (6). Thus, assuming that a firefighter is on-duty about 2 – 3 days per week, performing moderate-to-vigorous intensity aerobic exercise while on-duty will help in meeting the minimum recommendations for health benefits. Additional physical activity beyond these recommendations will promote greater health benefits and physical fitness levels (6).

Benefits of Training On-Duty

There are several benefits to promoting supervised physical training while on-duty including increased performance outcomes, enhanced exercise compliance and safety, and a team-based atmosphere. Fire departments that provide qualified tactical strength and conditioning professionals to lead and supervise training programs for firefighters may enhance performance outcomes. To that end, a study by Mazzetti et al. demonstrated that providing direct supervision of exercise participants significantly increased maximal strength compared to unsupervised exercisers (7). In addition, supervised training programs have been shown to increase exercise participation which has significant performance and health implications (2). Finally, participating in an on-duty training program provides an opportunity for firefighters to develop teamwork skills like communication and being supportive of one another.

Suggestions for Training On-Duty

Acknowledging that on-duty exercise training does increase fatigue and decrease work efficiency, (according to the parameters used in the Dennison et al. study) there are several strategies that can be used to minimize the effects of fatigue. First, it is advisable to schedule physical training during low-volume emergency call times or train just prior to the end of the shift to decrease the likelihood of responding to a call immediately after an exercise session. Second, it is not advisable to introduce novel exercise programs or dramatically increase exercise intensities. Instead, systematically introduce aspects of a new training program and progressively increase intensity to minimize the accumulation of fatigue. It does not help anyone to exercise to the point of complete exhaustion while on-duty. Positive physiological adaptations also occur at submaximal levels. Third, it is important to include some aerobic training, as higher cardiorespiratory fitness levels are associated with a decreased risk of cardiovascular disease mortality (5). Although fatigue responses will vary between firefighters, in general, a firefighter that is lesser trained should begin by progressing up to 30 min of moderate intensity aerobic exercise (40 – 59% of heart rate reserve or 64 – 76% of maximum heart rate) (1). This is in contrast to aerobically trained firefighters that may be more able to exercise at vigorous intensities (60 – 84% of heart rate reserve or 77 – 93% of maximum heart rate) for 20 min without excessive fatigue (1). Above all, it is critical to communicate with the firefighter to determine how he/she tolerated a given workout, immediately after and later in the shift. Then, modify the exercise parameters accordingly for each firefighter.

Table 1: Suggestions for Training On-Duty

- Provide qualified exercise supervision
- Train during low-volume call times or just prior to end of shift
- Do not exercise to the point of complete exhaustion
- Train with lower relative intensities, but sufficient intensity to stimulate positive physiological adaptations
- Include aerobic exercise to promote cardiovascular health, weight management, and firefighter performance
- Focus on exercises that enhance mobility and stability throughout the kinetic chain to decrease risk of injury
- Train as a group to motivate and promote team unity
- Use a cool-down recovery period to work on mobility and flexibility
- Ensure adequate rehydration
- Replenish energy stores as soon as possible, either with a meal or meal replacement
- Consider a cold shower to promote cooling

Summary

Firefighting is a physically demanding profession. Maintaining sufficient physical fitness levels through regular exercise is critical to optimize performance, enhance health outcomes, and reduce the risk of injury. It seems reasonable to recommend that firefighters exercise while on- and off- duty. However, common sense should be used to not exercise to the point of complete exhaustion while on-duty. Instead, the tactical strength and conditioning facilitator must strike a balance within program design to maximize physiological adaptations while minimizing the accumulation of fatigue while on-duty. It is difficult to prescribe the "perfect" on-duty exercise program for all firefighters given differences in fitness levels, exercise experience, availability of equipment, varied work schedules of firefighters, and limited empirical data on this topic. However, it is safe to suggest that more highly trained firefighters can tolerate higher exercise intensities and volume while on-duty compared to firefighters that are lesser trained. Therefore, on-duty exercise programs should be modified based on the fitness level, training status, previous injuries, and the work schedule of the firefighter. It is important that the tactical strength and conditioning facilitator understand the benefits and concerns of training firefighters on- and off-duty to enhance their health and safety.

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Binocular Rivalry

Robert Vervloet

One of the most telling aspects of coaching athletes is the cliché statement that sports are "90% mental and 10% physical." And yet for the hours in the gym so many spend for physical perfection, an important component for improving performance training is one few tactical athletes or facilitators even consider undertaking in development.

While facilitators pride themselves in improving physical fitness, it is also very rare to find those who incorporate mental training into their programs. However, if that 90% figure is to be believed, a large and significant opportunity to improve the complete training envelope is being left on the table.

While mental toughness is an issue for tactical facilitators to impart in their programs, it is a separate category of attention. Mental toughness is not the same as mental quickness. In the athletic world, it is described as SAQ training (speed, agility, and quickness).

For elite athletes, if sports were truly that 90% number for mental skills, then why do training organizations describe quickness training as anything but mental training? If SAQ is described as the development of movement skills for athletes relating to decreasing reaction time, then it is an incomplete picture of the training needs for any athlete to improve their situational reaction abilities.

Teaching proper movement skills of either a sport function, or tactical maneuver, will improve an athlete's speed to achieve the end goal. However, is it not also fair to ask how quicker movement skill is even possible if the brain itself is not imparted with quicker thinking skills to manage them?

Increasing an athlete's thinking speed is just as crucial a component to increasing physical speed and body function at elite levels (10). Therefore, tactical facilitators should be very aware to the science of training their tactical athletes to be quicker and better thinkers, as well as stronger physically.

Perceptual skill training is not simply a missing chapter in any training manual. In reality, it is something that has not been examined with any critical thought for study until very recent. That is why tactical facilitators should be on the cutting-edge of the science. For centuries, the socially accepted conclusion was that individuals are born with the brains they get, and their functional abilities are a fixed element. Recently, the science of studying how the brain learns and grows in ability has generated a concrete path to define its foundation of study (1).

Evidence underscoring the claim that the human brain very much has the ability to improve how it guides an individual through their environment is known as plasticity (4,5). Through measuring neural pathways, plasticity documents how it can grow, develop, and improve in functional skill (11). The capability to improve the performance of a tactical athlete to move about their environment with greater skill, control, and comprehension, training their brains as well as their bodies to be quicker and faster is the newest component to athletic training in the realm of exercise science.

For the tactical athlete, the 90% figure is not simply a cliché, but foundation to the perception skills necessary to survive any battlefield or other high-stress environment where visual and perceptual decision-making skills are made with life and death consequences. No different than muscles, the human brain is slowly being recognized as one more component in the kinetic chain of training that can be improved through continuous and evidence driven training routines.

So what benefit does brain training offer? The list includes improving depth perception, speed perception, peripheral vision, night vision skills, visual search skills, decision making confidence, decreased reaction times, improving how many separate objects one is able to visually track, situational awareness, enhanced driving skills, improved probability inference, as well as strategy development in problem solving.

Training the brain is often referred to as "Binocular Rivalry." This refers to the concept that humans have two eyes, with each contributing its own distinct visual image to the brain for processing (2,7). From those two distinct images, without much recognition to its complexity, the brain synthesizes them together to create an accurate picture of their surroundings (8).

While humans have two eyes identical in biology, few are aware to how radically different each eye functions and how the brain functions with that difference. Since the brain is divided into two hemispheres, it is imperative that each half be responsible for different visual task priorities to our decision-making processes (9). So while each individual eye takes in visual information, out of efficiency, they each focus on completely separate components (3). While differences of information processing by each hemisphere of the brain contribute to the end decision it makes, which side is dominant is rarely mentioned as a component of an individual being right or left-handed. That biological difference impacts how they reach different conclusions/responses to the same stimuli than others.

That subtle shift in view is what defines the "rivalry" between the two eyes to provide the dominant source of information for the brain to process visual information. Therefore, opposite-handed persons, even if they observe the same event may have completely different views, and potential solutions to problem solving.

While side strength dominance is well understood in the strength and conditioning realm, it is vital for tactical facilitators to recognize the importance of developing visual training for tactical athletes to ensure they are more visually aware of their surroundings in any environment they may face.

Introductory exercises can include taking the time to train with everyday tasks utilizing the weakest eye, in visual skill, alone. Performing everyday tasks with a focus on one eye or the other is one way to improve spatial body control regardless of the task.

There are various ways to implement visual training and tactical facilitators should analyze the needs of each individual to determine their need for visual training. It is important that the tactical facilitator access potential weaknesses and determine which areas may need improvement. By shifting the way a tactical athlete views a particular scenario or exercise, improvements in visual perception can be achieved and contribute to better tactical situational awareness.

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Six Areas of Focus for Tactical Facilitators to Address When Training Police

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Tactical facilitators are faced with a difficult task when training police officers. They strive to improve performance but also prevent training injuries to the police officers, or tactical athletes, that they train. The following are six areas of focus for tactical facilitators to address when training this tactical population.

The Time of Day

Time of day can be a big factor in relative fatigue of the tactical athlete. The tactical facilitator should be aware of the changes in relative intensity due to outside humidity and temperature in the training environment. For example, when performing an outside pre-academy and post-academy physical assessment test on police officers, the time of year can play a factor in the margin of improvement. If the squad tests in the winter first and then the summer, the temperature outside will affect the average margin of improvement relative to other squads testing at different times of the year. This is not as important when comparing the best-fit tactical athletes to others in the same squad but it is especially important when comparing overall performance.

Frequency of Training

It is important when scheduling physical conditioning, to take a look at the entire schedule of training. When the fitness schedule is mapped out for a squad, training progression, and frequency of training should be taken into consideration. Most course lessons (such as Defensive Tactics or Firearms) in an academy setting are scheduled based on a set number of lessons. The lessons are typically referred to in a numerical order and built on skills in a set order. The same pattern is used for every squad and outlined by the number of lessons and specific objectives that are skill-based. The physical conditioning sessions should be developed with other blocks of training that could affect fatigue levels in mind.

Teach to the Top 10%

Regardless of a physical fitness entry requirement, always teach to the top 10% of fitness levels in the squad. The worst of all possibilities is to coach to the least fit and risk lowering the fitness levels of the best tactical athletes. Oftentimes, a tactical facilitator will change an exercise when they see tactical athletes getting fatigued and losing form. This is a problem because the most unfit tactical athletes can then dictate the frequency of exercise variety based on their poor fitness levels. The fit tactical athletes will consequently not get the type of fatigue they expect. The fatigue often is not only physical but it can be psychological. To demonstrate their psychological willingness to complete the task, tactical athletes must be able to improve their poor form and respond to any direction given to them by the cadre of tactical facilitator. If they are physically unable to perform the exercise correctly, they should be given the opportunity to momentarily reduce intensity and immediately resume the exercise. This allows the tactical athlete to momentarily change the pattern of fatigue, prevent possible injury, and keep moving to demonstrate willingness to perform.

Develop a Consistent Set of Rules for the Physical Training Arena

Every tactical facilitator in an academy has their own set of experiences and perceptions of what should and should not be permissible in training. In order to guide a program properly, the tactical facilitator should implement the same sets of rules that apply to everyone. These rules can often be understood between instructors that have been working together for a long time, but when a new instructor comes in there are often inconsistencies in discipline that can confuse the tactical athletes. These rules range from simple communication to weight room protocols. When an instructor creates a new guideline or rule to be followed, every instructor must be made aware of this. It seems like a simple concept but is hard to implement in every instance.

Lead by Example

The tactical facilitator should be able to demonstrate every exercise they ask of their tactical athletes. Tactical facilitators that look like they are in shape but never physically perform any exercises undermine their own credibility. Leadership is not just demonstration but appearance as well. Every tactical facilitator should be dressed the same. If the squad is not allowed to carry a towel or wear gloves then the tactical facilitators should not be allowed to carry such items. Leadership from the top down creates a psychological advantage and provides much needed stability.

Tactical Facilitators Must Conduct Safety Checks and Remain Vigilant During Training

It is important that all tactical facilitators continually move around the tactical athletes while they train to observe them to make sure they are performing every exercise with proper form. Injuries often occur when tactical facilitators passively watch the squad. It is important to reinforce proper lift mechanics if a tactical athlete struggles with execution of an exercise.

Being a tactical facilitator in a police training academy can be rewarding as well as potentially punishing. Physical fitness trainers often coach without formal training and it is assumed that they know how to instruct training sessions just because they graduated the academy. It is important that tactical facilitators, or anyone in a similar position, gain the necessary knowledge to properly instruct and prescribe training to avoid injury and promote development. Tactical facilitators are encouraged to seek ongoing professional development through such organizations as the National Strength and Conditioning Association to ensure that the tactical athletes they train receive the most relevant and accurate strength and conditioning information to help avoid training injuries.

Concurrent Training: Is There an "Interference Effect" on Tactical Performance?

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The views expressed in this article are those of the author, and do not necessarily reflect the official position or policy of the Air Force, the Department of Defense, or the U.S. Government.

Tactical athletes must possess a diverse array of physical abilities in order to successfully accomplish their missions (15). Tactical athletes must possess strength/muscular endurance for carrying heavy loads, speed for pursuing enemy targets, and agility for traversing rough terrain or dodging enemy fire. Such varied occupational tasks require multiple modes of training. Endurance training (ET), resistance training (RT), agility training and high-intensity interval training (HIIT) are all critical components for improving "fit to fight" capabilities. A significant constraint on these training components is lack of time. At home, long/unpredictable work schedules, plus family priorities may compromise the amount of time available for physical training. While deployed, maintaining physical fitness may be challenged by long missions, with little down time, combined with duty stations where training facilities may be nonexistent.

One possible solution is to combine multiple modes of training into a concentrated single session. An example of such concurrent training (CT) would be combining a lower body RT session with lower body ET, such as running. Concurrent training would therefore save the tactical athlete valuable time, which could be partitioned out for other responsibilities. There is a potential downside to CT. Training the same body part for both endurance and strength may result in an "interference effect," which could compromise the optimal development of aerobic fitness and/or muscular strength/size (21).

Evidence from molecular biology does suggest the potential for an interference effect from CT (14,21). Both RT and ET stimulate skeletal muscle protein synthesis. Resistance training results in increases in myofibrillar protein synthesis, whereas ET results in an increase in mitochondrial protein synthesis. Interestingly, HIIT also results in an increase in mitochondrial biogenesis, despite the brief exercise time involved (2). Genes involved in cell signaling responses to RT and ET also differ, and these divergent responses may occur over very short time periods. One recent study compared these divergent responses, and also investigated whether exercise order affected the responses (5). Subjects in this study were randomly assigned exercise trials of either RT followed by ET, or ET followed by RT. The RT was 80% 1RM sets of leg extension; the ET was 30 min of cycling at 70% VO_2peak. The results suggest that ET immediately prior to RT may blunt the anabolic effects of RT, whereas ET performed after RT may increase post-exercise muscle damage. The authors of the study concluded that, "our results provide support for the contention that (acute) CT does not promote optimal activation of pathways to simultaneously promote both anabolic and aerobic responses," (5).

By contrast, recent research does suggest that CT may not produce an interference effect, at least in certain subject groups (6). This study utilized sedentary middle-aged men. The training protocol consisted of RT, ET, and CT. The RT was multiple sets of leg extensions over a single session. The ET was a single bout of 40 min of moderate-intensity cycling, and the CT was a 50% combination of the RT/ET protocols. The results suggested that CT produced increases in myofibrillar and mitochondrial protein synthesis similar to those seen during RT/ET. In addition, cell signaling that is indicative of anabolic/aerobic adaptations occurred to a comparable extent in CT as in RT/ET. The authors of this study concluded that "these results occurred without an interference effect on muscle protein sub-fractional synthesis rates, protein signaling, or mRNA expression." Another recent study reported similar results (28).

Whether CT interferes with aerobic/strength adaptations has been a subject of debate for over 30 years (16). An early study compared RT/ET only subjects to CT subjects over 10 weeks (16). The RT group trained for five days/week. The ET group combined running and cycling over six days/week. The CT group utilized both RT and ET protocols. For the first seven weeks, the RT and CT groups steadily increased leg strength as measured by a 1RM squat test. The RT group continued to increase leg strength for the entire 10 weeks. The CT group leg strength leveled off between the seventh and eighth weeks, and declined over the final two weeks. After 10 weeks, the RT group had improved 1RM strength by 44% compared to 25% for the CT group. The 1RM strength of the ET group did not change through the course of the study. Maximal oxygen consumption (VO_2max) increased to a similar extent in the CT/ET groups, but was unchanged from baseline in the RT group.

Some subsequent studies have documented an interference effect that others have not (3,6,11,12,17,19,20,26). This inconsistency extends to studies employing military populations (13,15,19, 24,25). Most studies which have not found an interference effect have used sedentary/untrained subjects, and concerns have been expressed regarding the use of such subjects, as physiological adaptations seen in untrained subjects appear to differ from trained subjects (8). A recent study provided support for those concerns (29). This study examined acute changes in protein synthesis and molecular signaling from RT and ET in untrained subjects, and then again after ten weeks of mode-specific training. In the untrained state, RT increased both myofibrillar and mitochondrial protein synthesis, whereas at ten weeks, only myofibrillar protein synthesis was stimulated. In ET subjects, mitochondrial protein synthesis increased in the untrained and trained state, with no changes in myofibrillar protein synthesis. Signaling protein responses did not show training-specific changes, suggesting that such changes in gene transcription are controlled elsewhere.

Most studies which have examined the effect of CT on endurance performance have reported improvements (9). A small number have found no change, or a small decline (7,31). The latter results are seen when RT is added to existing ET, with no change in ET volume. This suggests overreaching may be a factor in those studies which have shown no improvement in endurance performance from RT. The interference effect appears to be almost exclusively in the direction of ET compromising RT adaptations. Some of this may also be due to an overreaching effect. Concurrent training studies which have found an interference effect are typically greater than three days per week, with the ET component greater than 30 min in duration (30). One recent study found that compared to RT, CT subjects exhibited compromised improvements in hypertrophy, 1RM strength, squat jump performance, and peak rate of force development when nearly 10 hr per week of ET was added to an existing RT protocol (23). There is some evidence the mode of ET may affect the magnitude of an interference effect (10). One study compared two CT protocols where the mode of ET differed. The CT which utilized incline treadmill walking resulted in a significantly greater interference effect than the CT which utilized cycle training. Another CT study which incorporated rowing as the ET component did not see a significant interference effect (11). By contrast, endurance running consistently results in an interference effect, particularly with high-volume training (29). One study using sprint intervals found an interference effect with this exercise mode (4). However, two other studies using sprint intervals did not (1,22). The reasons for these differences are not clear; they may be related to differences in muscle contraction type, muscle damage, and/or mode-specific nervous system entrainment. In untrained subjects, mode of ET may not matter, if exercise volume is low (27).

A recent meta-analysis of CT potential to produce an interference effect came to the following conclusions (30). There is a significant interference effect in regards to the development of strength, power, and muscle hypertrophy. This interference effect is exclusively related to effects ET on RT. However, RT does not appear to impose a significant interference effect on ET. Both volume and frequency of ET affect the magnitude of interference effect. Running, but not cycling, imposed an interference effect on hypertrophy and strength. High-intensity interval training did not result in an interference effect. Body fat loss was related to ET training intensity, with higher intensity ET resulting in greater fat loss than moderate-intensity ET.

Recommendations

Based on the above, tentative recommendations for tactical athletes engaged in CT can be made. Endurance training should be limited to no greater than three days per week, with a duration not exceeding 20 – 30 min per session. If tactical athletes train with lower body CT, cycling and rowing, are preferred ET modes over running. Interference effects are body part specific; for example, upper body RT performed with lower body ET produces no interference effect. High-intensity ET is preferred over low-intensity ET for body fat loss. High-intensity interval training is less likely to interfere with strength, power, and hypertrophy than moderate-intensity ET. High-volume ET, if performed, should be separated from lower body RT, and not performed concurrently. It does appear that CT frequently results in an interference effect on strength, power, and hypertrophy. This is important, as these attributes are associated with improved occupational/tactical performance (15). By contrast, there does not appear to be an interference effect on endurance performance from RT. This article should provide guidance to tactical athletes on how to train to minimize an interference effect, while simultaneously increasing strength, power, size, and aerobic capacity, which in combination optimizes their ability to perform their missions, both at home and while deployed.

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Kelly Kennedy is one of the nation's leading experts in fitness training for police. While working for the largest police department in the southeast United States, she has physically trained and tested over 1,700 police recruits and officers since 1999. In addition, she owns a law enforcement fitness consulting company called Fit-to-Enforce.com. After graduating with a Master's degree in Health Education with a specialization in Exercise Physiology, she worked as an adjunct instructor at Florida International University. Kennedy is a Certified Strength and Conditioning Specialist®, a certified CrossFit Instructor, Defensive Tactics Instructor, and earned a PhD in Educational Leadership from Lynn University.

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