THE IMPORTANCE OF GRIP STRENGTH FOR FIREFIGHTERS

Most firefighter activities require a high level of grip strength. For example, if a firefighter does not have adequate grip strength they will have a difficult time opening a fire hydrant, pulling hose, or carrying tools during multiple callouts across an entire shift (all typical job requirements). The International Association of Firefighters and International Association of Fire Chiefs Wellness Fitness Initiative (IAFF/IAFC WFI) incorporates grip strength as one of the physical fitness assessments (5). Yet, strength and conditioning professionals and tactical athletes will often overlook the utility of grip strength without realizing the benefits it plays in overall strength development and injury prevention.

Measuring grip strength can be accomplished by a few different methods: spring-loaded compression, air compression, and hydraulic dynameters. The IAFF/IAFC WFI recommends using the JAMAR Hydraulic Hand dynamometer (Lafayette Instrument Company, Lafayette, IN) which measures the force generated by the musculature of the hand and forearm. Since grip is a “force” and not pressure it should be measured in pounds or kilograms. The position of the elbow during testing is often a point of contention. According to a number of studies, grip strength has shown to be greater with less flexion of the elbow, but regardless of elbow position it is recommended that all procedures be normalized before testing to provide an accurate assessment (7,10).

The following research has suggested grip strength could be a possible predictor of current health and physical capabilities. Grip strength was related to differences in endocrine function and hormone release (e.g., cortisol, endorphins) following a night of sleep deprivation (4). This revelation could have important implications for firefighters as they have a high likelihood of incurring poor sleeping habits. The study showed that grip strength fluctuated throughout the day, suggesting that tasks that heavily rely on grip strength may also demonstrate similar fluctuations (4). According to Cappaert, grip strength had time of day differences with the peak being in the afternoon (2). Further studies have shown that grip strength also decreases following a day of intoxication, which suggests a possible correlation between immune function and grip strength (6).

Numerous studies have associated weak or weakened grip strength with poor nutritional status, rotator cuff weakness, fatigue, and overall physical function. According to Sayer et al. there is a graded association between increased glucose level, weaker grip strength, and impaired physical function in older men with diabetes (9). In another study performed at the Sutcu Imam University, values of handgrip strength tests were significantly lower in diabetic individuals compared with a control group (3).

Grip strength was even shown to be a consistent predictor of all causes of mortality in middle-aged and elderly people (8). This is simple and non-evasive measurement could provide the fitness professional additional information that could be combined with other assessments (BMI, bodyweight, etc.) to provide a better understanding of an individual’s underlying health risks and readiness to engage in physical training.

Another area grip strength can be applied is injury prevention and rehabilitation. Common problems such as lateral epicondylitis of the elbow (i.e., tennis elbow) are common overuse injuries in firefighters. For the most part, this problem occurs when there is a muscular imbalance between the elbow muscles and the forearm muscles and common rehabilitative practices include improving grip strength. Another common injury in firefighters is a sprain or strain of the rotator cuff muscles. Research has suggested that grip strength has a significant correlation with rotator cuff muscle strength on the injured side, and that there is an increased likelihood of rotator cuff weakness from a hand injury or disorder (1,10).

Finally, the most overlooked role of grip strength is in monitoring the rate of recovery and/or physical stress following a prolonged callout, or the accumulation of events over the course of a shift. Firefighters are often fatigued, especially within an academy setting. The central nervous system (CNS) usually recovers 5 to 6 times slower than the muscular system, and the central nervous system is most influenced by the quality of sleep, which also affects hormonal function (especially cortisol release) (4). This explains why more is not necessarily better when it comes to physical stress (e.g., excessive physical training on shift) because it could lead to CNS fatigue. Functions of the CNS include the ability to execute movement patterns and exert motor controlling, among others. Therefore, if a firefighter is constantly fatigued, they may have a higher risk of injury (4).

The strength and conditioning professional should always be aware of the athlete’s physical and mental state, and possibly modify the nature of a conditioning program on those days where the athlete looks tired and fatigued due to inadequate recovery. A population-specific periodized training program that allows for proper rest and recovery is important for helping recruits in a firefighter academy produce the highest quality of work and experience the best physical and academic gains. Grip strength is a simple indicator of physical readiness and provides feedback on the recruit’s ability to perform at a high level. Not every workout can be hard, therefore monitoring your grip strength throughout an academy will allow for higher quality of work with a reduction in injury risk. Given the important role of grip strength in many
occupational and everyday activities, exercise selection within a firefighter training program should also aim to increase grip strength capabilities.

Physical training for recruits at a fire academy can be a difficult task. Their days are often long (6 am – 6 pm) and the physical stress placed upon them can be exhausting both physically and mentally. The goal of the strength and conditioning professional is to find the right balance of effective training that will enhance their performance while offering adequate recovery from the stresses related to training. Trying to gauge this can be quite daunting especially when a strength and conditioning professional may have over 40 or more athletes. The California Regional Fire Academy recently implemented grip strength as a simple measurement of recovery. This allowed the academy to implement a more specific training program that allowed the athletes to train hard but also provide enough recovery. Table 1 shows an example of trends in grip strength from a sample of athletes (11 of the 40 are presented) during the first 10 weeks of an 18-week training protocol at the California Regional Fire Academy.

Most of the tactical athletes were able to perform at a higher level early in the week, but as the week progressed, they became fatigued. The same can be seen as the weeks started to add up, so the fitness program was developed to compliment the fluctuating stress levels. Speed was placed in the early part of the week due to high neural fatigue and the distance of 40 yards was selected to help reduce hamstring injuries. As the weeks progressed so did the focus on execution, as many of their central nervous systems were exhausted. If speed training was applied later in the week (e.g., Friday), the athletes would not have been able to perform at or near maximal effort (which is needed when developing speed), and could have increased the chance for injury. A sample program of the structure of the first four weeks of this program can be found in Table 2. Most of the athlete’s grip strength responded in a similar manner regardless of athletic ability, sex, or age. The one common denominator was that they all fluctuated slightly throughout the week and across the 10 weeks.

REFERENCES

ABOUT THE AUTHOR
Katie Sell is an Associate Professor in the Department of Health Professions and Kinesiology at Hofstra University. She currently teaches undergraduate and graduate courses in exercise physiology, physical fitness assessment, and exercise programming. Her primary research interests lie in the area of physical fitness assessment and exercise programming for wildland firefighters and law enforcement personnel. She is currently on the National Strength and Conditioning Association (NSCA) Tactical Strength and Conditioning Special Interest Group (SIG) Executive Council.

John Hofman is one of the leading experts in the field of first responder health and wellness. As the Strength and Conditioning Coach of the Sacramento Fire Department, Hofman oversees the Wellness Centre, coordinates the department’s medical and fitness assessments, develops recruit fitness training, works with pre-employment medical and fitness evaluations, and assists the department’s 20 certified Peer Fitness Trainers. In addition, Hofman also works as the Strength and Conditioning Coach for the California Regional Fire Academy, Sierra Fire Technology Program, as well as numerous other fire departments in Northern California. In 2012, he was appointed the Health and Wellness Coordinator of the Firefighter Cancer Foundation.
### TABLE 1. EXAMPLE OF GRIP STRENGTH TRENDS IN TACTICAL ATHLETES OVER THE FIRST 10 WEEKS OF FIRE ACADEMY TRAINING

![Graph showing grip strength trends over 10 weeks for different exercises.](image)

### TABLE 2. SAMPLE FIVE-DAY TRAINING

<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Speed</td>
<td>Power</td>
<td>OFF</td>
<td>Strength</td>
</tr>
<tr>
<td>10 x 40 m sprints</td>
<td>3 sets of 4-6 reps</td>
<td>3 sets of 6-8 reps</td>
<td>3 x 1200 m every 8 min</td>
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<table>
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<tr>
<th>Intensity</th>
<th>100% effort</th>
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<th>75-85% 1RM</th>
<th>70-80% MHR</th>
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<table>
<thead>
<tr>
<th>Recovery</th>
<th>Full recovery</th>
<th>90 s rest between sets</th>
<th>90 s rest between sets</th>
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</thead>
<tbody>
<tr>
<td>1:3 ratio</td>
<td></td>
<td></td>
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**MONDAY**
1. MB overhead toss
2. Olympic clean
3. Bulgarian squat
4. Pull-up
5. Half kneeling, single-arm press
6. Farmer’s walk

**TUESDAY**
1. Hex bar deadlift
2. Horizontal row
3. Half kneeling, single-arm chest press
4. Half kneeling, single-arm Row
5. TRX body saw pike tuck
6. Single-arm bottoms up carry