

**CHAPTER 5**  
**MUSCULAR STRENGTH AND ENDURANCE**  
**REVISED JANUARY 2019**  
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## CHAPTER 5

### MUSCULAR STRENGTH AND ENDURANCE

#### 1. INTRODUCTION.

a. Muscular strength is defined as the force that a muscle or muscle group can generate against a resistance for one maximal effort. Muscular endurance is the ability of a muscle group to perform repeated contractions against a resistance for a period of time. Both are important, as they help improve posture and prevent or reduce muscular lower back pain. Regular strength training will help slow the decrease of lean mass that is associated with aging.

b. Unlike cardiovascular conditioning where intensity, duration, and frequency are essential, strength training principles are progressive resistance and working to fatigue.

(1) Progressive resistance principles state that as a muscle gains strength, the resistance must gradually be increased for continued improvement in size and strength.

(2) Working to fatigue means performing an exercise until the exercising muscles momentarily exhaust and not another repetition can be performed. If the stress upon a muscle is not great enough, then the mechanisms that cause the muscles to adapt, resulting in size and strength gains will not be activated.

#### 2. WEIGHT TRAINING.

a. Some terminology is necessary for understanding the basics of weight training.

(1) Repetitions refers to the number of times an exercise is performed.

(2) Sets are groups of repetitions.

(3) Load is the total poundage or resistance used for the exercise.

(4) Rest period is the time between each set.

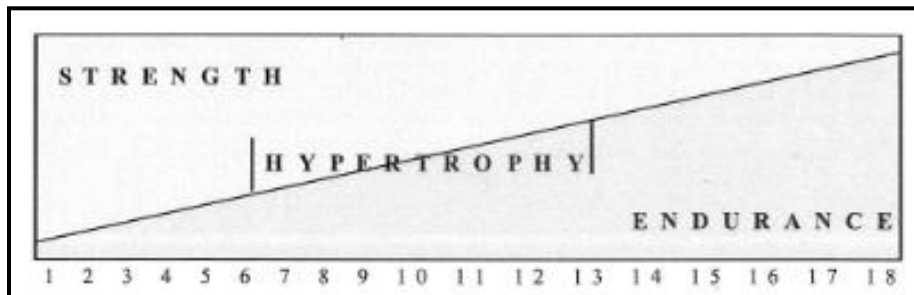
b. There are an array of weight training programs to develop muscular strength and endurance. Therefore, it is beyond the scope of this guide to discuss all of them. Furthermore, weight training is very individualized, and what works well for

one person may not for another. The following are guidelines and principles that can help individuals develop their own program.

(1) Frequency. With weight training, rest is just as important as the training. This is because muscle tissue is broken down during the training session and rebuilt during the days of rest after the workout. Training a particular muscle group with a minimum of 48 hours before training the same muscle group(s) elicits the best results in strength gains. Rest periods of 3 to 5 days may be needed for high volume weight training (8 to 15 sets per muscle group). A good rule to follow is, the greater the volume of training, the longer rest needed for the exercised muscles to recuperate.

(2) Sets. One to 3 sets for each muscle group is recommended for building strength and endurance. A larger number of sets (12 or more) performed by body builders has not been fully researched and does not confirm that more sets will produce better gains in muscular strength, endurance, or size. A beginner performing a large number of sets will certainly over-train in a very short period of time.

(3) Repetitions. Although the exact number of repetitions for producing strength, size, or endurance is unknown, there is evidence to suggest that a repetition range of 1 to 6 is associated with strength increases; a repetition range of 6 to 12 is associated with strength and muscle hypertrophy (increase in muscle size); and a repetition range of 13 or more is associated with muscular endurance. These ranges are merely guidelines, not absolutes. A person performing 14 repetitions will gain strength and hypertrophy, as well as muscular endurance; however, the gains in strength and hypertrophy are not likely to be as dramatic if they were using a lower repetition range. The diagram below illustrates the ratio of strength to endurance at various repetitions.



REPETITIONS

(4) Rest Periods. The amount of rest between sets is dependent on the conditioning level of the individual and the repetition range that is being

performed. A person training to build strength using a repetition range of 4 to 6 should rest 2 to 3 minutes before performing another set. On the other hand, a person training to build endurance using 12 repetitions may rest 45 seconds to 1 1/2 minutes.

c. A good weight training program should involve the entire body. Isolation exercises, such as the biceps curl exercise, involve the movement of only one joint (the elbow). Compounding exercise movements involve 2 or more joints; for example, the squat incorporates movement at the hip, knee, and ankle joint. Thus, compounding movements enable a person to train several muscle groups with 1 exercise. It is also important to train opposing muscle groups to prevent strength imbalances around a joint, which can often lead to injuries. For example, when training the front of the thigh (quadriceps), also include an exercise that trains the back of the thigh (hamstring). Likewise, abdominal training should also include exercises to strengthen the lower back muscles.

### 3. GENERAL WEIGHTLIFTING GUIDELINES.

a. When lifting weights, exhale during the lift and inhale as the weight is being lowered. Breath should never be held during a lift as this can cause a marked increase in blood pressure and in the working heart rate. It also tends to restrict the return of blood to the heart and the circulation in the coronary arteries.

b. When lifting heavy weights in exercises such as the squat and bench press, always have a person available to assist, if needed.

c. As with any routine, doing the same thing over and over again gets boring and, in addition, the gains from the weight training program begin to slow or cease. This is known as a "sticking point." The way to overcome both boredom and sticking points is to vary the routine. This can be accomplished by changing rest periods, repetition range, number of sets, and the type of exercises performed.

d. Always exercise the muscle through a full range of motion. This helps improve flexibility and maximize strength gains.

e. Always use controlled movements when performing repetitions. Never use extremely fast or jerky movements, and avoid swinging or swaying while lifting the weight. For example, while performing a bench press, keep contact between hips and the bench; do not arch the back to lift heavier weight. Additionally, slower, controlled movements will help avoid injury, and may produce greater increases in strength. Try to take approximately 2 seconds to lift the weight and 4 seconds to lower the weight.

f. For safety, always use equipment that is in good condition. The following guidelines are to assist in evaluating equipment:

- (1) Dumbbells and barbells should have end collars tightened to keep weights from sliding.
- (2) Benches and racks should be stable and well-balanced.
- (3) Cables and chains for mechanical weightlifting equipment should not be frayed or broken.
- (4) Hand grips for weight equipment should be in good condition.
- (5) Weights with plastic parts should not be used if the plastic is cracked or worn.

#### 4. CALISTHENICS.

a. Calisthenics are an excellent way to build muscular strength and endurance. However, because body weight is used in these exercises, the workload is constant and only the number of repetitions can be increased.

b. Calisthenics are great for individuals beginning a strength program and/or desiring a change in their regular routine. The following calisthenics will assist in developing strength and endurance. One way to perform calisthenics is in a circuit training format, alternating exercises and muscle groups. For example, a person might do one set of sit-ups, a set of lunges, a set of push-ups, and a set of pull-ups; then repeat the cycle, starting with the sit-ups. This method allows the muscle groups to be worked alternately and provides the muscles an adequate rest period between sets.

c. If beginning a new program, it is helpful to start with a large number of sets and fewer repetitions. As endurance level increases, cut back to 2 to 3 sets with many repetitions in each set. The last few exercises will be the most difficult to complete.

d. Exercises performed on the floor should be done on a firm padded surface, either with an exercise mat or carpeting. Allow for adequate ventilation. Clothing should be comfortable and loose. Shoes should be comfortable sport-type shoes.

##### (1) Abdominals.

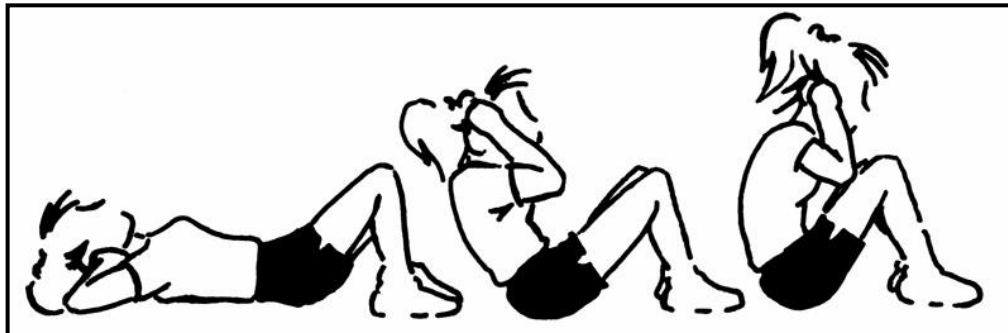
(a) One of the major causes of back pain is not weak back muscles, but weak abdominal muscles. If the abdominal muscles cannot carry their

workload properly, the back muscles may have to take up the slack, resulting in back pain. Never do straight-legged sit-ups, but instead always bend the knees. By bending the knees, this takes the pressure off the lower back and maximizes the use of the abdominal muscles. Arching the back or bouncing off the floor also puts tremendous strain on the back. Do not perform sit-ups with hands behind head as the tendency to jerk the neck up with the hands can strain neck muscles.

(b) Sit-ups.

1 Purpose. To develop the strength and endurance of the abdominal muscles.

2 Procedures. Lie on back with knees flexed and feet flat on the floor. Put hands at the side of the head near the ears with elbows out to the side. Roll up smoothly to a sitting position with head close to the knees. Breathe out while rolling up. Roll back smoothly, breathing in. Be sure to allow the back of shoulders to contact the floor before sitting back up. Try to keep abdominal muscles tensed between each sit-up.



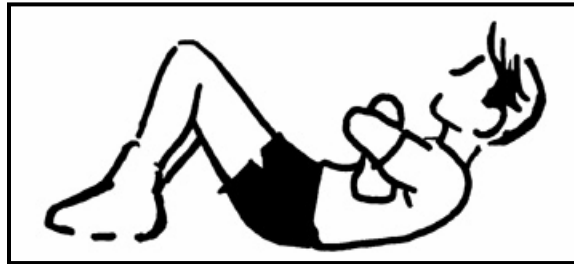
(c) Crunches.

1 Some beginners may not be able to do a full sit-up. Crunches may be used to help strengthen the abdominal muscles. They are also a good alternative for individuals with lower back pain.

2 Purpose. To strengthen the abdominal muscles.

3 Procedure. Lying on back with knees flexed, feet flat on the floor, and arms crossed over the chest, slowly curl head, shoulders, and trunk toward the knees, keeping the low and middle back on the floor.

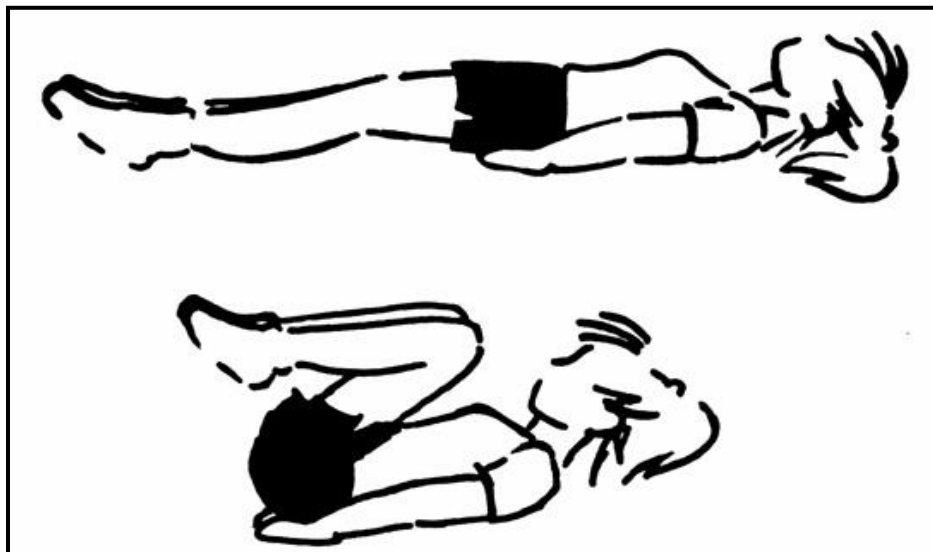
Breathe out while rolling up. Roll back while breathing in. The eyes should be looking up at the ceiling while performing the curl up.



(d) Prone Tucks.

1 Purpose. To strengthen hip and abdominal muscles.

2 Procedure. Lie flat on back, placing hands palm down under the buttocks and elevate feet approximately 7 inches off the floor, keeping legs straight. Tuck by drawing the knees toward the chest while breathing out. Extend the legs while inhaling and repeat. Concentrate on keeping the small of the back on the floor and the head up.



(2) Back Muscles.

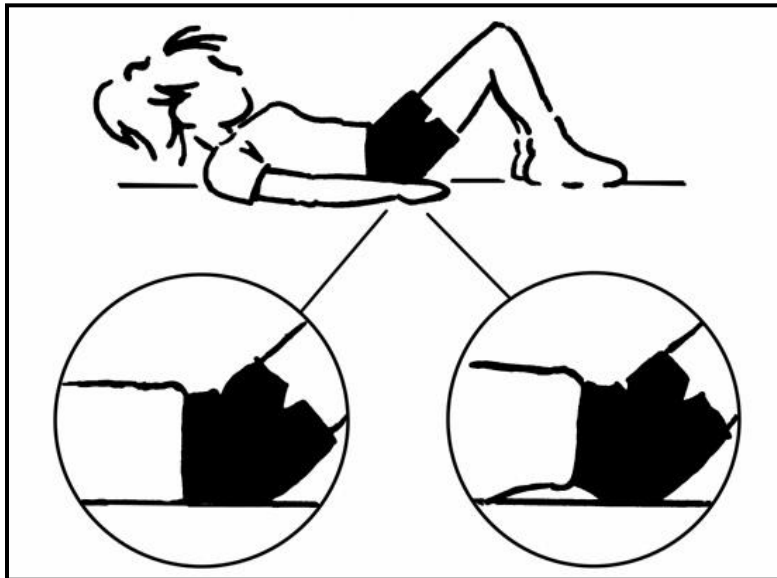
(a) Lower back pain is a common ailment in law enforcement. This is partially due to the long hours spent sitting in a patrol car and the twisting motion involved in getting in and out of the vehicle with heavy equipment

on. Other contributing factors are tension and muscular tightness, poor posture, obesity, inactivity, and lack of abdominal strength. Exercises such as the following, when performed regularly, can strengthen the back muscles, reduce pain, and lessen the chance of injury.

(b) Pelvic Tilt.

1 Purpose. To strengthen gluteal (buttocks) and abdominal muscles.

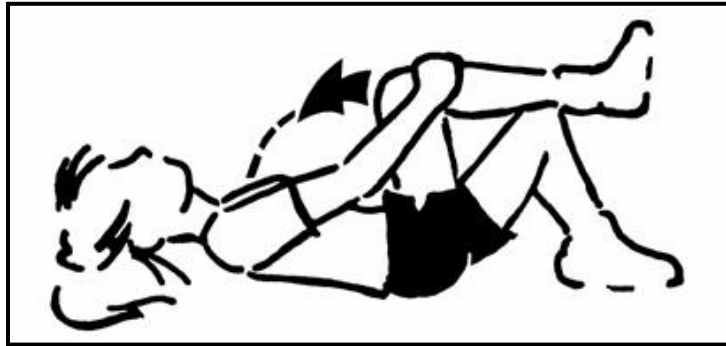
2 Procedure. Lie on back with knees flexed and feet flat on the floor. Squeeze the buttocks tightly together and press the lower back against the floor while simultaneously tightening the abdominal muscles. Hold for a count of 10, then relax and repeat 3 times, increasing gradually the number of repetitions. Do not hold breath.



(c) Single Knee Raise.

1 Purpose. Stretch low back and hamstring (back of the thigh) muscles.

2 Procedure. Lie on back with knees flexed. Squeeze the buttocks and tighten the abdomen so that the lower back is flat on the floor. Raise one knee over the chest. With hands over the raised knee, pull the knee slowly toward the armpit. Hold for a count of 5. Return to a starting position, relax and repeat with the same knee for a total of 3 times, increasing gradually to 10 times. Repeat with the other knee.



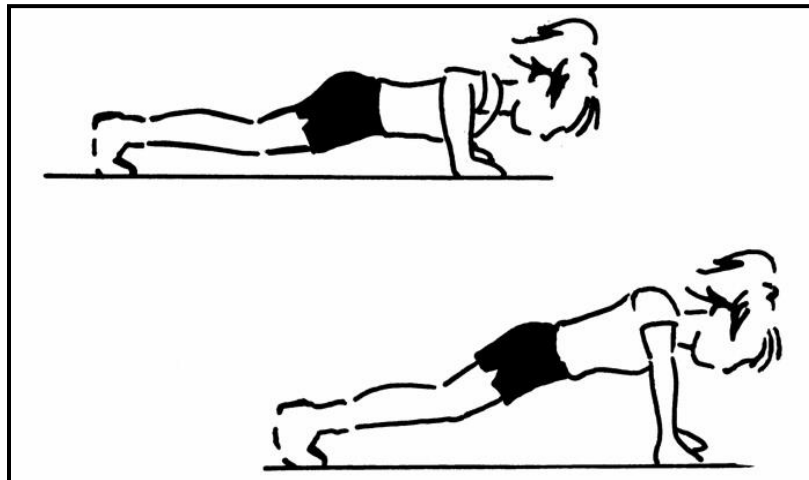
(3) Upper Body.

(a) Developing and maintaining upper body strength is a necessary component of any fitness program. Many of the tasks required of an officer, such as carrying an injured victim or wrestling a combative subject, require upper body strength.

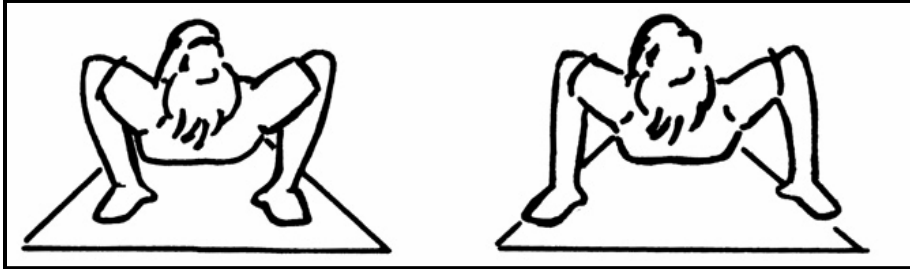
(b) Push-ups.

1 Purpose. To develop strength and endurance in the back of the arm (triceps), chest (pectoral), and shoulder (deltoid) muscles.

2 Procedure. Place hands on the floor slightly outside shoulder width. Support body weight on the hands and toes. Keeping the body straight, bend the elbows, lowering the chest until it almost touches the floor, then push back up. Breathe in while lowering the upper body and breathe out while pushing up.



3 Several variations can be added to the push-up. The closer the hands are placed under the body, the more the push-up will work the triceps muscle. The farther apart the hands are, the more the pectoral muscles will be used. Both variations also strengthen the deltoids.

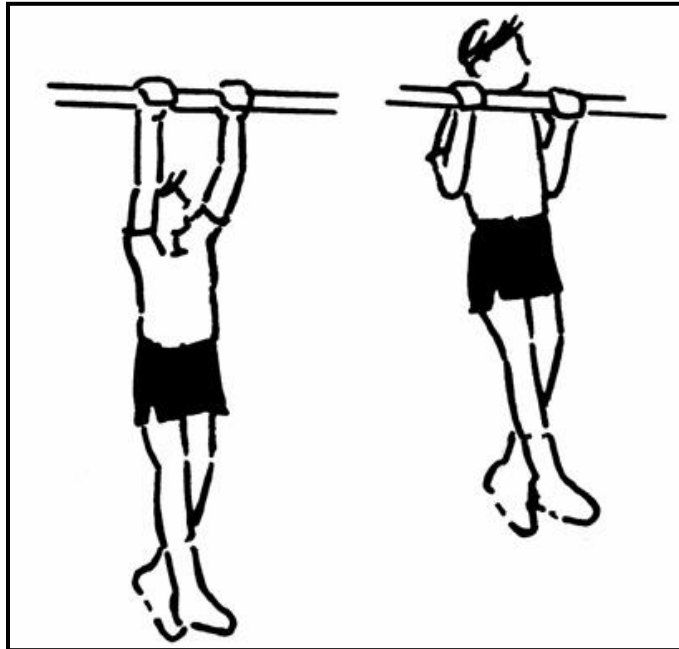


4 The modified push-up (pushing off bent knees instead of the feet) is of little value as less than 30 percent of the body weight is being lifted. Beginners may use it; however, they should move on to straight leg push-ups as soon as possible.

(c) Pull-ups.

1 Purpose. To strengthen arms, upper back, and shoulders.

2 Procedure. Standing under an overhead bar, jump and grasp the bar with palms facing away (overhand grip). Hang with the arms fully extended and the feet crossed at the ankle. Pull up until the chin clears the top of the bar, then lower back down until the arms are again fully extended. Do not swing the legs while doing the pull-up.



3 If unable to do a complete pull-up, begin to strengthen the involved muscles by doing negative resistance pull-ups. Use a chair or stool to rise so as to begin the exercise with the chin above the bar and arms and hands ready to provide support. Step off the chair and as slowly as possible, gradually lower the body until the arms are fully extended and the body is hanging freely. Continue doing negative resistance pull-ups until the arms will no longer support weight. Check improvement periodically by attempting a regular pull-up.

(d) Chin-ups.

1 Purpose. To strengthen the front of the shoulder, upper back, and biceps (front of the upper arm).

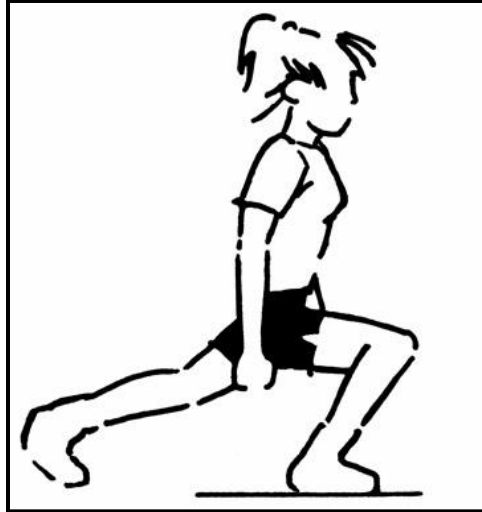
2 Procedure. The same as in the pull-up except reverse the hand position on the overhead bar so that the palms are facing inward.

(4) Lower Body–Lunges.

(a) Purpose. To strengthen the front and back of the thigh (quadriceps and hamstrings) and buttocks.

(b) Procedure. Stand straight with arms at sides and feet about 6 inches apart. Beginning with the right leg, step forward as far as possible, planting the foot firmly. Let the left heel come off the floor and touch the

floor with the left knee if possible. Push back up to a standing position and repeat with the left leg. Start with 5 thrusts for each leg and gradually increase the number of repetitions. Do not bend the knee of the forward leg past a 90-degree angle.



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