



Battle-Ready Strength Training

High-intensity strength training is the best alternative to traditional boot camp exercises for military, police and firefighter conditioning.

By Wayne L. Westcott, Jim Annesi and Tracy D'Arpino

Traditionally, men and women who begin a career in the armed forces, police or fire department must complete several weeks of physical conditioning. Although these physical readiness programs take many forms, they typically require a lot of calisthenic exercises using bodyweight resistance. These include push-ups, sit-ups, bar-dips, pull-ups and a variety of squatting exercises.



Calisthenic classes are convenient, cost-effective and easy to administer. Generally, any open space serves as an adequate training facility, no exercise equipment is necessary (other than chin and dip bars), and one competent instructor can direct dozens of participants at the same time. Boot camp, as it is often called, has a long history of success for short-term conditioning purposes. However, a few problems exist with calisthenics programs that should be addressed for improved physical performance and reduced risk of overuse injuries.

A major weakness with bodyweight exercises is the fixed resistance (bodyweight), which makes it difficult to increase training intensity in a progressive manner. The standard procedure for making calisthenic workouts more demanding is to add more repetitions and more sets of each exercise. As the training volume increases, so does the likelihood of physical breakdown. The repetitive movements required with bodyweight exercises may place excessive stress on the musculoskeletal system (especially tendons), resulting in a variety of overuse injuries.

Higher training volumes may also be associated with mental burnout, as evidenced by the many military, police and fire recruits who stop exercising after completion of their boot camp training. This behavioral response is most likely due to the seemingly endless repetitions of the same calisthenic exercises.

Strength-training alternative

Standard strength training provides a progressive resistance alternative to bodyweight exercises. Unfortunately, standard strength training may be somewhat impractical for large groups of exercisers, due to the equipment and time constraints of multiple-set workouts. An effective and efficient means of strength exercise that appears to be particularly appropriate for recruit classes is known as high-intensity training. Properly performed, high-intensity training provides a high level of muscular fitness and presents a low risk for both physical injury and psychological burnout. High-intensity training is especially well-suited for larger groups, shorter exercise sessions and relatively brief (five- to 10-week) conditioning periods.

High-intensity strength training

The major difference between standard and high-intensity strength training is effort level. A set of standard strength exercise is typically terminated at the point of muscle fatigue; namely, when another repetition cannot be performed. This training procedure provides sufficient muscle challenge and produces satisfactory strength gains with both single- and multiple-set protocols.

On the other hand, **high-intensity strength training continues the exercise set beyond the point of muscle fatigue. That is, when another repetition cannot be performed, the resistance or the exercise is altered in a manner that permits continuation of the training set.** This requires greater effort, and results in further muscle fatigue, which involves more muscle fibers and increases the strength-building stimulus. **High-intensity strength training is more physically demanding than standard strength training, and requires longer recovery periods for enhanced tissue remodeling/muscle building. Two high-intensity training sessions a week are recommended for maximum strength development.** Three popular and productive high-intensity procedures are breakdown training, assisted training and pre-exhaustion training.⁵

Breakdown training

Breakdown training extends the exercise set at the point of muscle fatigue by reducing the resistance by 10 to 20 percent, and performing as many post-fatigue repetitions as possible. For example, lifters perform 10 biceps curls to muscle fatigue with 50 pounds. Instead of stopping the exercise set, they immediately change the weightload to 40 pounds, and complete five additional biceps curls to a deeper level of muscle fatigue. At a controlled movement speed of six seconds per repetition, the extended set of 15 repetitions requires about 90 seconds of continuous high-effort exercise, which is within the anaerobic energy system.

In a study with 45 beginning exercisers,³ half performed standard training (one set of eight to 12 repetitions to fatigue), and half performed breakdown training (one set of eight to 12 repetitions to fatigue, followed immediately by three post-fatigue repetitions with 10 pounds less resistance). As shown in Table 1, the breakdown training group experienced 40 percent greater strength gains over the two-month exercise period.

A later study with 11 advanced exercisers⁴ indicated that breakdown training was also effective for overcoming strength plateaus and for improving bodyweight exercises used in recruit assessments, even though these exercises were not included in the training protocol. After just six weeks of breakdown training, the subjects increased their chin-up performance by 1.5 repetitions, their bar-dip performance by 2.5 repetitions and their lateral raise weightload by 13.9 pounds (Table 2).

Assisted training

Like breakdown training, assisted training extends the exercise set at the point of muscle fatigue. This is accomplished with the aid of a trainer who provides manual assistance during the lifting phase of a few post-fatigue repetitions. Because muscles are approximately 40 percent stronger in eccentric contractions, assistance is not necessary during the lowering phase of the post-fatigue repetitions. For example, an exerciser may perform 10 biceps curls to muscle fatigue with 50 pounds. The trainer then provides just enough manual assistance to complete three to five more lifting movements. At six seconds per repetition, the extended set of 15 repetitions (10 independent and five with assistance) requires about 90 seconds of high-effort, anaerobic exercise.

In a study with 42 beginning exercisers,³ half performed standard training, and half performed assisted training. As presented in Table 1, the assisted-training group attained 45 percent greater strength gains over the two month exercise period.

A later study with 15 advanced exercisers⁶ showed assisted training to be an equally effective means for overcoming strength plateaus and for improving bodyweight exercises used in recruit assessments, even though these exercises were not included in the training protocol. After six

weeks of training, the subjects increased their chin-up performance by 1.4 repetitions, their bar-dip performance by 4.5 repetitions and their lateral raise weightload by 10.6 pounds (Table 2).

Pre-exhaustion training

Another high-intensity-training technique for extending the exercise set is known as pre-exhaustion training. Unlike breakdown and assisted training, which require more post-fatigue repetitions of the same exercise, pre-exhaustion training uses two separate exercises to accomplish the same objective. Pre-exhaustion training incorporates a rotary exercise followed immediately by a linear exercise for the same target muscle group. The first (rotary) exercise fatigues the target muscle group, and the second (linear) exercise brings into play fresh assisting muscles to push the target muscle group to a deeper level of fatigue.

For example, exercisers may perform 10 biceps curls (rotary exercise) to muscle fatigue. They immediately follow this exercise with five chin-ups (linear exercise) to further fatigue the biceps muscles with the help of fresh latissimus dorsi muscles. The 15 total repetitions require about 90 seconds of continuous biceps work, assuming six-second repetitions and a quick transition between the two successive exercises.

A research study involving advanced exercisers using the pre-exhaustion training protocol is presented in Table 3.⁴ Like breakdown and assisted training, the pre-exhaustion technique proved effective for overcoming strength plateaus and for improving bodyweight exercises used in recruit assessments, even though these exercises were not included in the training protocol. After just six weeks of training, the subjects increased their chin-up performance by 1.1 repetitions, their bar-dip performance by 2.8 repetitions and their lateral raise weightload by 9.5 pounds (Table 2).

Boot camp vs. high-intensity training

Having determined that high-intensity strength-training techniques are useful for both beginning and advanced exercisers, we conducted a comparative study of boot camp and high-intensity training.⁶ Twenty-nine well-conditioned subjects (20 males, nine females, mean age 35 years) trained twice per week for five weeks. Group one performed 10 one-hour boot camp workouts consisting of various calisthenics/bodyweight exercises conducted by the trainer for the Massachusetts Police Academy recruits. Group two completed 10 half-hour high-intensity strength-training sessions conducted by experienced personal trainers. The high-intensity trainees performed assisted training on a pre-exhaustion circuit almost identical to that presented in Table 3. Neither group practiced the evaluation exercises (chin-ups, bar-dips) during the training period.

As shown in Table 4, the boot camp exercisers increased their chin-up performance by 1.2 repetitions, and their bar-dip performance by 2.8 repetitions. The high-intensity exercisers made significantly greater improvements ($p < 0.05$), increasing their chin-up performance by 2.0 repetitions, and their bar-dip performance by 4.2 repetitions. They also increased their lateral raise weightload by 17.5 pounds, and their leg extension weightload by 31.4 pounds.

In addition, psychological assessments of 23 high-intensity trainees revealed no signs of overtraining or undesirable exercise-induced mood changes. The Profile of Mood States¹ showed no statistical change (pre-training to post-training) in subscales of fatigue, depression and vigor, which are prone to negative change with overtraining.²

Summary

Based on the findings from these six high-intensity strength-training studies, breakdown, assisted and pre-exhaustion exercise techniques represent effective and efficient means for improving muscle strength/endurance in both beginning and advanced participants. Furthermore, with respect to recruit conditioning, high-intensity strength training compares favorably to boot camp workouts. In addition to the better performance improvements, high-intensity strength training may offer the following advantages over traditional boot camp training:

- * Use of progressive resistance exercise
- * Relatively brief training sessions
- * High rate of strength development
- * Low risk of overuse injuries
- * Low risk of mental burnout

None of the subjects in these studies experienced an exercise-related injury during the training period, indicating that high-intensity strength-training techniques are safe for participants.

Several military bases (particularly Navy and Marine) and police groups have shown interest in high-intensity strength training, and some have arranged their weightstack machines in pre-exhaustion circuits similar to that presented in Table 3. It is most likely that recruit conditioning programs will place greater emphasis on strength exercise, especially high-intensity training techniques, in the future. By so doing, both the conditioning process and the training outcomes should be enhanced. FM

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