**High-Volume or High-Intensity?**

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     Coach, how many sets should I do?

     Players and visiting coaches alike ask us this more than any other question.

     It is a hotly debated issue in the strength coaching ranks, with some discussions resulting in near donnybrooks.

     High-volume advocates continue to espouse the need for multi-set schemes (usually in excess of 3) for optimal strength, power, and hypertrophy enhancements.

     High-intensity proponents insist that if the standards of quality and effort are predominant, sets should be limited (e.g., 1-3).

     Who’s right?  Before we crown a winner in this debate, maybe we should do the following: (1) take a quick look at the available scientific literature, (2) examine some of the considerations for the practical setting, and (3) offer some recommendations based upon this information.

Research

     There has been quite a bit of activity in the scientific literature in recent years on this topic.  An interesting review of this literature (Carpinelli and Otto, 1998) took a comprehensive look at 35 studies comparing single-set (SS) to multi-set (MS) protocols.

     The results: 33 of the scrutinized 35 studies showed no significant difference in strength or muscular size between the SS and MS groups.  The review inferred that no superiority in results was evident from a compendium of MS schemes ranging from 2 to 15 sets.

     A follow-up review (Carpinelli, 2000) added 12 studies with the same results: no significant difference in strength or muscular size between the SS and MS groups.

     The fact that 45 of the 47 perlustrated studies indicate that SS strength training is just as effective as MS strength training is compelling evidence for the efficacy of the SS protocol.

     Clearly, high-volume strength training is not a requisite for optimal gains in strength and muscle hypertrophy.

     The conclusions of these studies point to quality (i.e., intensity of effort), not quantity, as being the foundation of a successful strength training program.

Population Considerations

     Critics of lower-volume, high-intensity strength training continually make unsubstantiated claims that this approach is only effective in the short-term.

They argue that volume should increase exponentially as individuals progress in a training program, otherwise a point of diminishing returns will surface.  However, these critics provide no definitive scientific data to support this claim.

     Interestingly, a recent study (Hass, et al., 2000) refutes this notion.  This investigation assigned 42 recreational weightlifters (ages ranging from 20-50 yr.), with an average of 6.2 years of strength training experience, to either a SS or MS group.

     After 13 weeks of training, no significant differences were found between the two groups in strength gains or lean body mass (muscle) increases.

     A possible criticism of this study could stem from competitive weightlifters (powerlifters and/or Olympic-style lifters).  And, to a certain degree, their disillusionment would be warranted.

     Can single-set training alone be optimally effective for steady improvements in the competitive lifting arena?  Obviously, the answer is no.

     Competitive lifters need to develop the congruent neural pathways necessary to encode the skill patterns for their lifts. In the weightlifting sports, the lifts *are*the skills.  These skills are specific to weightlifting and, as is the case with any motor skill, they require quality practice.

     Simply put, competitive lifters need to perform multiple sets for skill development, especially with the more intricate lifts.

     However, the majority of the world’s athletes are not weightlifters.  These individuals utilize strength training as a means to improve strength, size, and power for enhanced performance in their sports.  They seek the physiological benefits of strength training – as opposed to becoming proficient in competitive lifts.

     For these athletes, the high-intensity protocol is at least as effective as any other available methodology.

Practical Applications

     In past articles, we have offered numerous variations in rep, set, and volume schemes.  We believe in variety and are constantly searching for new ways to incorporate it.  Changing the set requirements in your workouts is certainly an effective way to accomplish this.

     Unfortunately, science has not been able to define an exact number of sets to be performed.  Nevertheless, the preponderance of currently available literature indicates that the “more is better” school of thought is fallacious.

     Our belief is that the *total* *volume* and the *quality* of the time spent in the weight room are the critical factors in program design.  If your athletes are spending more than an hour in the weight room, we suggest that you take a close look at both of these constituents.

     During the off-season periods, 15-18 total sets per workout for the major muscle compartments (legs, hips, low back, mid-section, chest, upper back, shoulders, arms/forearms) will provide optimal stimulation in a comprehensive fashion.  It is not imperative work every area on each training day, but by the end of a two to three day-a-week rotation, all of these structures should have been addressed.

     If you choose to highlight a certain area or a particular exercise with more sets, you will probably need to reduce the total number of exercises and/or the muscle compartments to be worked on that training day.

     For athletes involved in contact sports, additional work for the neck area should be mandated.

     When all of the timing considerations have been accounted for (e.g., the performance of the sets, rest periods between sets, set-up for the next exercise, etc.), the approximate length of this workout is one hour.

     During the in-season period, we suggest reducing the volume to 12-15 sets.  This abatement is due to the obvious increases in physical stresses that are imposed on the athletes during this time of year.

     If the athletes maintain a steady pace in this format, the in-season workouts should be completed in 45 minutes or less.

Peripheral Considerations

     Other than the time of year, the number of sets performed for each exercise is often influenced by several extraneous factors.

     Some weight rooms have a limited amount of equipment, and thus fewer exercise choices.  To alleviate this problem, the coach may choose to include more sets of the exercises dictated by this equipment handicap.  This is fine, as long as the program is balanced and comprehensive, as mentioned earlier.

     Personal preference also plays a role, as many coaches have a favorite roster of lifts and believe in performing multiple sets of each.  Often, this thinking is a product of past experiences and what has proven to be successful over the years.

     Athletes, as well, will have special training preferences. They simply enjoy performing more sets of certain exercises.  We admire an individual’s willingness to work, and we will respect his personal needs as long as the essentials of our program are kept intact.

     Regardless of these or any other circumstances,however, it is still necessary to use good judgement when drawing-up the workouts.

 **Selye and Stress**

Dr. Hans Selye has taught us that the body has a limited ability to recover from exercise.  In 1956, he proposed a three-stage process known as the General Adaptation Syndrome (G.A.S.), which is a widely accepted strength training tenet.

     Initially, there is the physiological stress placed upon the musculature during strength training, which causes a degree of microtrauma.  This is followed by *compensatory adaptation*, a process by which strength and size are increased.  This will only occur, however, if attention is paid to proper recovery and nutrition.                           If the stress is prolonged without respite, or insufficient recovery time is allotted, progress is limited or ceases.

     Basically, Dr. Selye is telling us that we must budget our source of energy.

     We have seen workouts that prescribe five sets of ten different exercises.  That’s fifty total sets!

     We’ve heard strength and fitness gurus recommend two or more strength workouts per day.

     These approaches and others like them are not necessary to promote progressive overload.  Actually, they may be guilty of thoughtless overkill.

     As coaches, our job is to find the most appropriate dose-response relationship when it comes to exercise. Unlike the previously mentioned competitive lifters, or even the occasional fitness enthusiasts and weekend warriors, our athletes are engaged in much more physical activity than mere strength training.

     Allowances must be made to avoid overtraining and augment the recovery process.

Final Rep

     We have always recommended that coaches do what they know best and believe in with conviction.  There is a fine line between physiology and psychology.  It is difficult to experience success if you do not have confidence in the game plan.  On the field, coaches implement the X’s and O’s that they know best.  In the weight room, most will adopt the same approach.

   However, when determining the appropriate volume in strength training, we are challenged to look at the salient scientific data.  The scientific method dictates that an extraordinary claim must be validated with extraordinary evidence. The notion that high-volume strength training is superior to lower-volume, higher intensity strength training is an extraordinary claim. Currently, the scientific literature fails to support this claim.

     So, who’s the winner?  At the present time, it appears to be a draw.  Both methods are effective, with neither approach being able to claim superiority.

    We suggest that coaches take everything into account before making a decision on which methodology to implement.

References

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