Single Versus Multiple Set Training: What Does the Research Say?

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In the world of strength and conditioning there are many debates regarding optimal training. The question as to the effectiveness of performing a single set of an exercise as opposed to numerous sets is one such debate. The proponents of the single set theory claim that performing one set is just as effective as doing multiple sets if the goal is strength enhancement. The consensus of many sport scientists, researchers, and practitioners is that multiple sets are superior for strength development for strength athletes as well as for beginners beyond the first month or two of training. However, a consensus alone is not enough in the absence of research to support such a claim. While the vast majority of evidence in the form of peer reviewed original research articles, review papers, and meta-analyses do support the notion that multiple set training is superior, there is not a complete lack of support in the scientific literature for the single set side of the debate. Additionally, the lay literature occasionally reports that multiple set training is no more effective than single set training for optimal strength development. This is an important point since many in the general public regard the information in these lay publications as truth when often it simply is not the case. The purpose of this article is to briefly review what the research says related to the single versus multiple set debate.

The consensus within the scientific community today is that beyond the first month or two of training, multiple sets are superior to single sets in eliciting strength gains. The disparity is especially pronounced in well-trained strength athletes. The few scientific studies that advocate single set training generally have similar flaws which makes it difficult to apply the conclusions. The biggest problems with the designs of many of these studies are that: 1) the subjects were untrained, and 2) the duration of the training was not longer than one or two months. The conclusions, therefore, can only be applied to beginners within the first month or two of training. It is not surprising that there were no major differences in the amount of strength gained between the single set groups and the multiple set groups when they trained for one or two months. As a beginner, it does not take too much of a stimulus to elicit strength gains and it does not take a complex designed program that yields positive results for those just starting out. The real trick in strength training program design is constructing a program for people who are no longer beginners and still want to see improvements. According to the American College of Sports Medicine's most recent position stand on this topic (entitled Progression Models in Resistance Training for Healthy Adults), "In resistance trained individuals, though, multiple set programs have been shown to be superior for strength enhancement. No study has shown single-set training to be superior to multiple-set training in either trained or untrained individuals." It goes on to say "Long-term progression-oriented studies support the contention that higher training volume is needed for further improvement." While this position stand (1) was written in 2002 and is five years old at the time of this writing, no new abundance of evidence to the contrary has come to light. Not surprisingly, the NSCA's position statement on the Basic Guidelines for the Resistance Training of Athletes states: "Multiple-set periodized resistance-training programs are superior to single-set, nonperiodized programs for physical development over long-term training programs." (5)

An example of the perpetuation of false information based on misinterpreted research in the lay literature (i.e. meant

for the general public) can be found within the pages of a publication (2) which came out in 2004. It was stated within a chapter of the book that "…a recent review [from 1998] of the scientific literature that examined the effectiveness of multiple-set and single-set training programs found that performing multiple sets aren't more effective for the development of muscular size (hypertrophy) and strength."

In a constantly growing field of research like that of strength and conditioning, a recent review of literature implies within the past few years (five years maximum). It is difficult to believe that a single review paper published in 1998 (4) represents either the "recent scientific literature" (even by 2004 standards) or the "preponderance of scientific research". However, let us say for a moment that it does. This is important because this particular scientific paper (4) which is cited typically makes up the bulk of the argument for those of the single-set mentality.

What is not mentioned by the single-set proponents is that a letter-to-the-editor was written (3) in response to this review paper and published less than a year later in the same journal which critically reviewed and subsequently dismantled the validity of the article and its conclusions. It is interesting that this letter-to-the-editor was authored by 17 of the world's leading exercise science researchers who have between them hundreds of years of practical experience as well as thousands of truly peer-reviewed original research articles among them. Keep in mind that official position stands or consensus papers put out by professional organizations like the American Medical Association or the American Heart Association frequently have fewer than 17 leading scholars as the authors who have disseminated the research. Now why would 17 of the world's leading scientists, practitioners, and researchers take the time to write such a letter-to-the-editor? The answer should be pretty clear.

This article is not intended to convey the notion that there is no place for single set training, even in the program of an experienced strength athlete. There is obviously a huge advantage in terms of time and efficiency with single set training. Additionally, if a person's goal is general health and not maximizing their strength potential (this is the case for many people), single set training offers the benefit of efficiency as well as the possibility for a reduced risk of injury (although this has never been proven) simply because the overall volume and number of repetitions is lower than multiple set training. For the well-trained recreational lifter or strength athlete, this type of training also offers variety, a different kind of training stimulus, and may very well have a place in a yearly training cycle. It could certainly be argued that single set training may be one way to maintain strength levels during the competitive season (e.g. football) when time and energy are at a premium. However, at this point in time it seems clear that the long-term (i.e. years) foundation of any serious strength training program should be comprised mainly of multiple set training if maximal effectiveness is the goal.

This article also brings up an important point when reading research and trying to make conclusions. These days there are so many millions of research articles on every topic imaginable. If more than a few research articles exist on a single topic, it is very likely that conflicting results will exist. If one wants to present a fair and balanced summary of the scientific literature, then all of the research must be presented, not just the research that was cherry picked because it happens to support the argument.

References

1. American College of Sports Medicine. (2002). Position Stand on Progressive Models in Resistance Training for Healthy Adults. *Medicine and Science in Sports and Exercise*, 34(2):364 – 380.

2. Bradley M, Brzycki M, Carlson L, Harrison C, Picone R, Wakeham T. (2004). *The Female Athlete: Train for Success*. Page 42. Terre Haute, IN: Wish Publishing.

3. Byrd R, Chandler TJ, Conley MS, Fry AC, Haff GG, Koch A, Hatfield F, Kirksey KB, McBride J, McBride T, Newton H, O'Bryant HS, Stone MH, Pierce KC, Plisk S, Ritchie-Stone M, Wathen D. (1999). Letter-to-the-Editor Regarding "Strength Training: Single Versus Multiple Sets." *Sports Medicine*, 27(6):409 – 416.

4. Carpinelli RN, Otto RM. (1998). Strength Training: Single Versus Multiple Sets. *Sports Medicine*, 26(2):73 –84.

5. Pearson D, Faigenbaum A, Conley M, Kraemer WJ. (2000). The National Strength and Conditioning Association's Basic Guidelines for the Resistance Training of Athletes. *Strength and Conditioning Journal*, 22(4):14 – 27.

About the Author

Joe Warpeha is an exercise physiologist and strength coach and is currently working on his PhD in exercise physiology at the University of Minnesota-Minneapolis. His current work focuses on NASA-funded research related to the application of innovative technology to manipulate thermoregulatory physiology in humans working, living, and performing in extreme hot and cold environments. Joe teaches several courses at UM including "Advanced Weight Training and Conditioning", "Measurement, Evaluation, and Research in Kinesiology", "Strength Training Program Design" and "Introduction to Kinesiology". He has a master's degree in exercise physiology and certifications through the NSCA, ACSM, USAW, USAPL, USATF, ASEP, and YMCA. He has over 15 years of resistance and aerobic training experience and has been a competitive powerlifter since 1997. Joe is a two-time national bench press champion and holds multiple state and national records in the bench press while competing in the 148, 165, and 181-pound weight classes.

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