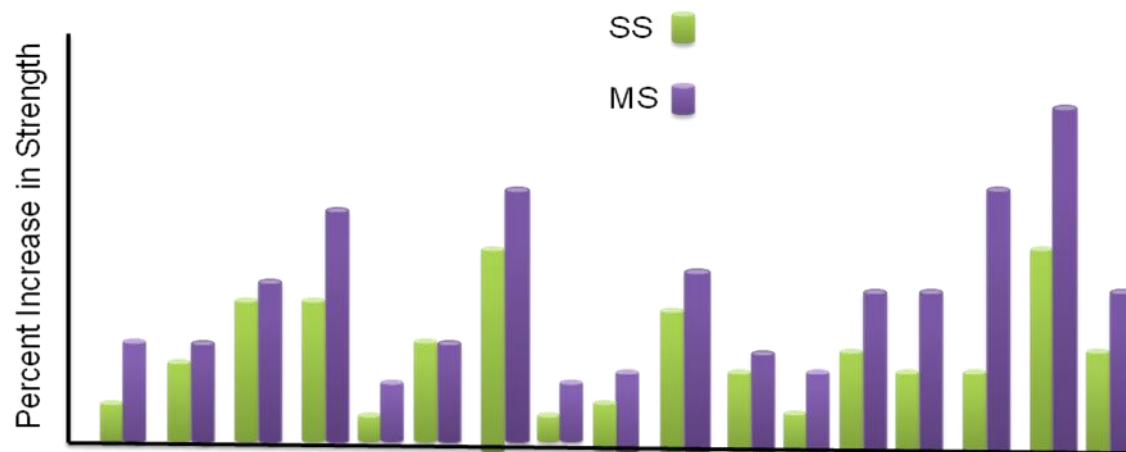


# Acute Training Variables, Muscle Growth, Strength, and Power – Training Volume

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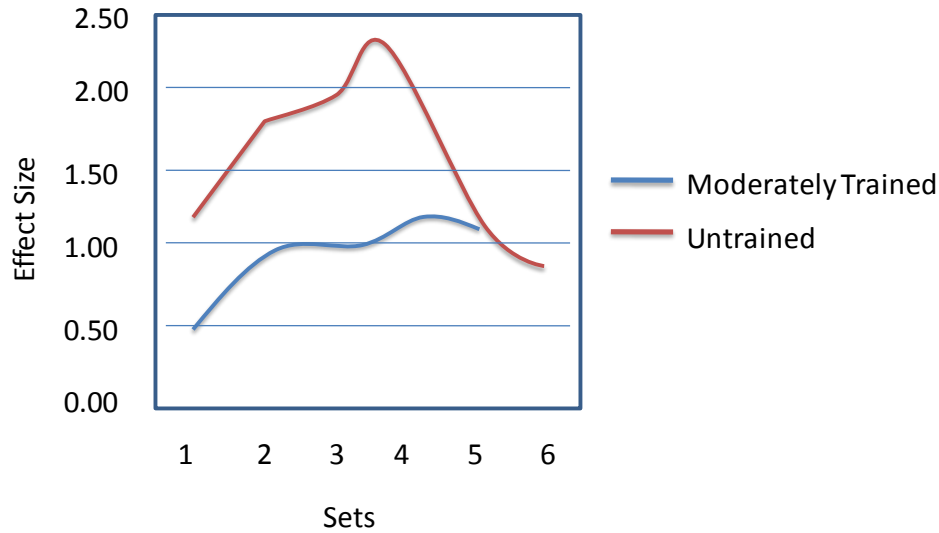
## Training volume



**Figure 7.0** Percent increases in strength across 17 studies in single vs. multiple set protocols. Redrawn from Fleck and Kraemer<sup>1</sup>

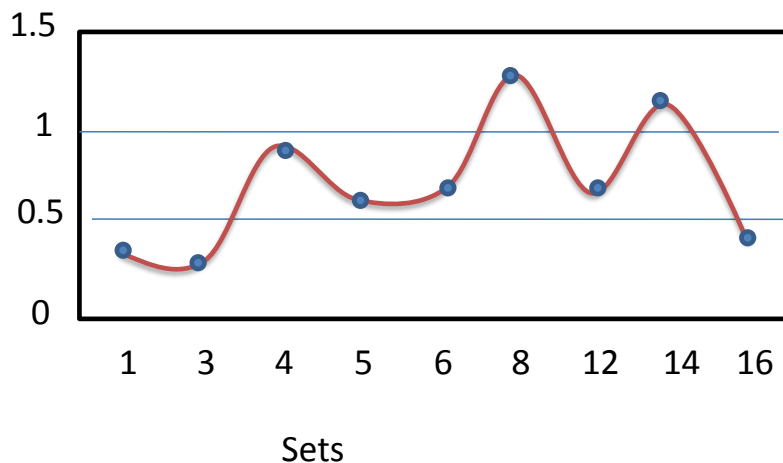
Volume is typically defined as the amount of sets performed multiplied by the number of repetitions done, and the weight lifted per repetition<sup>1</sup>. Just based on repetitions, a hypertrophy repetition zone (6-12 reps, 70-85% 1-RM) will result in higher volume than a strength repetition zone (1-5 repetitions, 86-100%). Numerous studies have investigated the effects of single vs. multiple set training sessions<sup>2-4</sup>. Generally these studies are 1 vs. 3 set experiments, and as can be seen in figure 7.0, greater strength gains result from multiple sets, with similar results for hypertrophy and power<sup>2-4</sup>. The problem however is that there are very few studies which actually examine a greater variety of sets on gains (i.e. 3 vs. 6 vs. 9 sets). Fortunately Dr. Rhea and colleagues<sup>5, 6</sup> have performed a statistical analysis which was able to analyze well over 100 studies from numerous labs and compare the overall increases in strength from various protocols.

## Strength

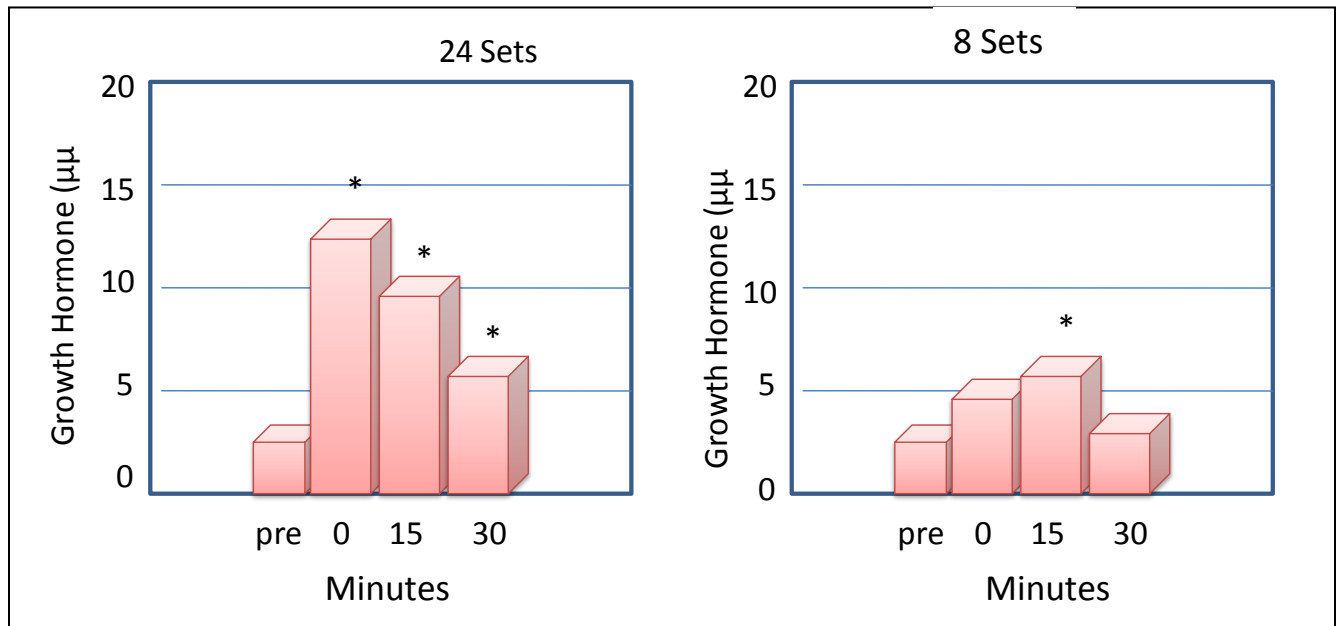


**Figure 8.0** Gains in strength in moderately trained (1-2 years) and untrained lifters.

Rhea et al.<sup>5</sup> performed their statistical analysis (meta-analysis) by looking at the dose dependent effects of sets on strength. They did not look at hypertrophy. They found that 4 sets per body part for both untrained and moderately trained individuals were optimal for strength (Figure 8.0), while highly trained athletes required 8 sets (Figure 9.0). Generally, power training requires a similar volume as strength training<sup>3</sup>.



**Figure 9.0** Gains in strength in highly trained lifters. Redrawn from Peterson et al.<sup>6</sup>



**Figure 10.0** Growth hormone responses at 0-30 min following two different exercise protocols. Redrawn from Mulligen et al. <sup>7</sup>

Unfortunately not enough data has been compiled on the relationship between sets performed and muscle growth. One study compared 8 sets of exercise working all of the major body parts to 24 sets and found a greater GH response at all time points for the 24 set workout than the 8 set workout. This would suggest that 24 sets will provide a greater hypertrophy response than 8. However this is a multiple body part study, so it does not give us a direct prescription for what each body part needs for optimal growth.

However, we may be able to partially estimate the optimal volume from the strength data provided by Rhea and colleagues<sup>5</sup>. As you recall in untrained and moderately trained 4 sets was optimal. In this population, many of the gains in strength are neural in nature. However in highly trained lifters the majority of strength gains are explained by muscle

growth<sup>1</sup> suggesting that 8 sets per body part may be optimal. Note however that similar increases in muscle were found in the 14 set protocols, which has the advantage of incorporating more variety during training and therefore more completely developing each muscle group. In conclusion, we do not currently have enough data to provide an optimal prescription for volume, at least as sets are concerned for muscle growth. What we do know is that multiple set training protocols provide a greater muscle growth effect than single set protocols<sup>3</sup>.

### **Table 1.0 The effects of volume on hypertrophy, strength, and power**

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<b>❖ For untrained and moderately trained individuals 4 sets per body part should produce optimal strength gains</b>
<b>❖ For advanced athletes (at least 3 years of serious training) 8 sets per body part appears optimal</b>
<b>❖ Power gains should follow similar increases following a given number of sets</b>
<b>❖ For hypertrophy the only thing we know for sure is that multiple set training produces greater growth than single set training.</b>
<b>❖ Because advanced lifters generally gain strength primarily through gains in muscle growth it is possible that 8-14 sets per body part produces optimal hypertrophy. However, this remains speculative at present.</b>

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## References

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