Welcome to the December 2017 edition! Once, again, thank you to all of you who have emailed me with further feedback on the new format. I have been collecting ideas and the next edition in January 2018 will involve a very slightly different layout that will make the review much easier to read, and further leverage the use of graphics to help explain the study findings. Meanwhile, if you still have feedback, don’t hesitate to get in touch. You can email me: chris@strengthandconditioningresearch.com or just contact me on social media.

This month, there was a lot of really useful research into force-velocity profiles, a couple of really valuable new sprinting studies, and a number of important studies on muscle damage and recovery.

If you are a strength coach working with athletes, you will find some very practical recommendations for improving sprinting performance in both sprinting reviews. You will also hopefully be challenged to reconsider the traditional paradigm of separating training out into “maximum strength” and “power” blocks. Not only is there no real biological rationale for doing this, but we now know that athletes simply bounce from one end of the force-velocity spectrum to the other, depending on the block they are working in. A far better approach would surely be to concurrently develop all necessary qualities, and there is nothing stopping this from happening other than the inertia of tradition.

There is a lot in this edition for hypertrophy enthusiasts. Changes in isometric force seem to be a better proxy for muscle growth than maximum strength gains. This will be useful for tracking progress if you can obtain access to a measuring device. Moving on, a very complete assessment across a range of variables shows that time under tension is likely the key factor determining the amount of muscle damage after a (non-eccentric) workout. So whether you think muscle damage is helpful for hypertrophy or something to be avoided, this will help you tweak your programs accordingly. And finally, you might need to brace yourselves before you read the final study review, which reports (somewhat unbelievably) that massage might actually enhance muscle growth... Let’s hope that this study is followed up quickly by others, and hopefully this will turn out to be true.
## December Edition
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Effects of cluster sets on increases in maximum strength and athletic ability

In cluster sets, short rest periods are taken mid-set (intra-set rest periods) or even between every rep (inter-rep rest periods). By taking these short rest periods, either a heavier weight can be used for the same total number of reps in a set, or a faster average bar speed can be attained over the course of the set. Using heavier weights likely leads to greater gains in maximum strength (through a variety of mechanisms), while lifting with a faster bar speed often causes greater gains in high-velocity strength.

Key findings
In female athletes with no recent strength training experience, cluster sets allowed superior increases in vertical jump height compared to traditional straight sets, but caused similar gains in maximum strength. It is unclear whether the larger gains in jump height arose because of superior improvements in high-velocity strength, or reduced fatigue.

Practical implications
When using the same percentage of 1RM as the training weight, cluster sets can be used to achieve similar gains in maximum strength in female athletes as traditional, straight sets, and may cause greater gains in high-velocity strength.
Cluster sets can allow athletes to lift ↑ loads, or achieve faster bar speeds, or exercise with ↓ RPE, depending on the program goal.

- In cluster sets, short rest periods are taken mid-set (intra-set rest periods) or even between every rep (inter-rep rest periods).
- Heavier loads can be used for the same total reps.
- Reduced cardiovascular stress.
- Maintains technique to a greater degree.
- More effective in stretch-shortening cycle exercises.
- Reduced rating of perceived exertion (RPE).
- Faster average bar speed over a set.
- The effect of ↓ demand on the cardiovascular system during strength training for athletes is unclear, but there are also medical applications.
- A ↓ RPE could be valuable because it allows a greater stimulus to be achieved for the same level of effort.
- The long-term effects of cluster training vs. traditional straight sets training on hypertrophy is unclear. Cluster sets involve a ↓ proximity to failure, but can be used to achieve ↑ volumes, and both these factors are key for maximizing gains in muscle size.

**PRACTICAL IMPLICATIONS**

Cluster sets have important benefits for athletes, because they allow heavier loads to be used (which likely cause greater strength gains), or faster bar speeds (which may transfer better to athletic performance), or ↓ cardiovascular demand and RPE. The benefits for non-athletes are less clear.

**OBJECTIVE**

To compare the effects of a long-term, periodized strength training program of either cluster sets or traditional straight sets) on changes in athletic performance and maximum strength, in female athletes without consistent strength training experience in the preceding 6 months.

**INTERVENTION**

Subjects did 3 workouts per week for 8 weeks. In the first 4 weeks, they did the squat, bench press, deadlift, and overhead press each workout. In the final 4 weeks, they did the jump squat, explosive bench press, deadlift, and power clean. TRAD did 3 sets of 10 reps with 60 – 80% of 1RM in the first 4 weeks, and 3 sets of 3 – 6 reps with 80 – 90% in weeks 5–6; CLUSTER divided the second 2 sets of each workout into 2 clusters. The final 2 weeks involved sets of 1 – 6 reps with 30 – 50% of 1RM.

**POPULATION**

30 female volleyball players, randomly assigned to 1 of 3 groups: cluster training (CLUSTER), traditional straight sets (TRAD), and a non-training control.

**MEASUREMENTS**

**Athletic performance (countermovement jump (CMJ) height and power output, 20m linear sprint time, and 4 x 9m shuttle run time):** the CMJ involved a self-selected countermovement depth, and height was measured by a Vertec; peak power was estimated from jump height by an equation. Linear and shuttle run times were measured by photocell timing gates.

**Maximum strength:** By one repetition-maximum (1RM) back squat, deadlift, overhead press, and bench press.

**Resting hormone (testosterone, cortisol, and insulin like growth factor [IGF-1]) levels:** By venous blood samples taken 48 hours before starting the training program, and at 48 hours after concluding the training program.

**RESULTS**

None of the groups improved 20m linear sprint or shuttle run sprint times. Both training groups improved CMJ height and power output, but CLUSTER improved both CMJ height and power output to a greater extent than TRAD. The non-training group did not improve CMJ height or power output.

Both training groups improved all 1RM measures similarly, while the non-training group did not.

Both training groups displayed increases in resting testosterone and IGF-1, and decreases in resting cortisol, compared to the non-training group. There were only small differences in the changes in resting hormone levels between the two training groups.

**SUMMARY**

In female athletes with no recent strength training experience, cluster sets allowed superior gains in vertical jump height and power but caused similar increases in maximum strength.
The chart above shows that in these female athletes with no recent strength training experience, cluster sets and traditional sets caused similar gains in maximum strength, but cluster sets allowed superior gains in high-velocity strength, as measured by vertical jump height and power.

The chart below shows that both strength training programs produced alterations in resting hormone levels, while the non-training control group did not. There were some small differences in the effects of cluster set and traditional training methods, but the implications of these differences is hard to interpret.

The cluster training group displayed a slightly smaller increase in testosterone, a slightly larger decrease in cortisol, and a slightly larger increase in IGF-1.
This study in female volleyball athletes with no recent strength training experience found that cluster sets and traditional straight sets produced similar increases in maximum upper and lower body strength, but cluster sets permitted greater improvements in high-velocity strength, as measured by CMJ height and peak power. This difference was accompanied by a smaller increase in resting testosterone, a larger decrease in resting cortisol, and a larger increase in resting IGF-1.

Cluster sets may be valuable for athletes for three reasons. Firstly, they allow heavier weights to be used for the same volume, which would likely produce greater gains in maximum strength. Secondly, they allow faster bar speeds when lifting the same weight, which is expected to cause greater increases in high-velocity strength. Thirdly, training further from failure may cause faster recovery between workouts.

Using heavier loads often leads to greater strength gains, even while changes in muscle size are similar (1,2,3,4). Lifting heavier loads involves producing greater whole muscle forces (albeit not higher forces on individual muscle fibers) and this likely leads to larger improvements in maximum strength because of increases in load-specific coordination, voluntary activation (1), lateral force transmission (5), and tendon stiffness (6). However, it is important to note that the weights prescribed in the cluster set and traditional set training groups were based on percentages of 1RM and were therefore similar. Therefore, in this study, the cluster training method was not used in order to increase the weight on the bar, but rather to permit faster bar speeds and substantially reduce fatigue.

Keeping bar speeds high by stopping sets before fatigue causes velocity to drop below a set level improves high-velocity strength gains (7,8), at least in part because of smaller losses in fast twitch fiber type proportion (7). This makes sense, as strength gains are velocity-specific, with greater increases in high-velocity strength occurring after training with lighter loads and faster bar speeds. Yet, the velocity-based training methods that produce such results involve lower training volume as well as keeping bar speeds high, which makes them hard to compare to clusters.

Long-term studies assessing cluster sets are conflicting. Early studies reported that traditional sets tended to be better for improving power (9,10) but later studies reported the opposite (11,12). Recently, an analysis of changes in force-velocity profile revealed that there were no benefits of using cluster set training for producing high-velocity adaptations (13). This lack of clarity may arise because clusters only produce marginal increases in bar speed compared to traditional sets, and thus the incremental benefit is small. The findings of this study could reflect a true superiority of cluster training on CMJ height and power, or alternatively they may reflect a tendency for the clusters to allow faster recovery than traditional sets, which involve training closer to failure (14), particularly since CMJ height is a very sensitive measure of training status (15).

Conclusions
Cluster sets may produce slightly superior effects on high-velocity strength when using the same percentage of 1RM loads, but this may be because of reduced fatigue and not superior underlying adaptations.
References


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