

Research review

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Welcome to Research review, a round-up of the latest research in sport and exercise science. The ultimate aim of sport and exercise research should be a practical application, and this column offers fresh insights every issue, with data from the latest studies to help you stay one step ahead of the rest.

This issue covers the disciplines of physiology, biomechanics and nutrition, with research including long-term athlete development, cold water immersion and performance mouth guards. Hopefully, you will be inspired to test out some of these ideas for yourself, get involved and give us your questions and opinions!

Check out the website for more practical insights and additional commentary on the research we've featured in this edition of **Performance**.

Remember: Train hard, train SMART!

Study 1

Unilateral versus bilateral squats

The majority of strength and conditioning programmes are built around compound, bilateral exercises such as squats and deadlifts. The importance of unilateral exercises is fairly well established – because bilateral strength is not a strong predictor of unilateral strength. Nevertheless, they are generally seen as 'assistance' exercises. But could unilateral exercises actually carry the potential to replace bilateral exercises entirely? A team of American researchers have assessed how they match up.

The research compared the muscle activation and hormonal responses elicited by the unilateral pitcher squat (commonly referred to as a rear foot elevated, or 'Bulgarian', split squat) to the bilateral back squat in 10 male college athletes. For the unilateral exercise, repetitions were performed on the right side alone. Testosterone responses were measured following the performance of four sets of the given exercise at pre-determined 10 RM load. Muscle activity was similar in both exercises, with the erector spinae, biceps femoris, gluteus medius and vastus lateralis all evaluated. Despite the large discrepancy in the amount of work performed, the unilateral exercise produced a similar testosterone response to the bilateral exercise.

- **Outcome:** the rear foot elevated split squat appears to elicit a comparable neuromuscular and hormonal response to the standard back squat. This would suggest that unilateral exercise may be as effective as bilateral exercise for training strength and hypertrophy.

Reference

Jones MT, Ambegaonkar JP, Nindl BC *et al.* Effects of unilateral and bilateral lower-body heavy resistance exercise on muscle activity and testosterone responses. *J Strength Cond Res*, 2012, **26**, 1094–1100.

Study 2

Mouth guards on force and power production

The popularity of performance mouth guards has been increasing steadily over the past few years. This study considered how over-the-counter mouth guards match up to their performance counterparts.

26 male and 24 female resistance trained athletes participated in a series of fitness tests whilst wearing a performance mouth guard, regular mouth guard and a control of no mouth guard. Upper body force and power output (measured during a bench press throw) were improved by the performance mouth guard in both males and females. Lower body force and power output (determined by plyo press power quotient test) were improved by the performance mouth guard

THE SCIENCE

One of the theories behind the performance-enhancing effect of performance mouth guards relates to 'concurrent activation potentiation' (CAP), which refers to the process of performing a remote voluntary contraction in order to potentiate the concurrent contraction of a prime mover. An example would be biting down on a mouth guard, to activate the musculature responsible for mastication, with a view to improving performance in a bench press throw. CAP is believed to work through potentiation of the H-reflex, a measure of neural excitation, and cortical overflow [1].

1. Ebben, WP. A brief review of concurrent activation potentiation: theoretical and practical constructs. *J Strength Cond Res*, 2006, **20**, 985–991.

in males but not females. The rate of power development during the vertical jump was also improved by the performance mouth guard in males. No differences in sprint time, reaction time, balance and flexibility were observed. None of the performance measures were affected by the over-the-counter mouth guard.

- **Outcome:** performance mouth guards may carry an ergogenic potential to athletes of both genders competing in sports with a demand for upper body power, and to male athletes requiring repetitive lower body power.

Reference

Dunn-Lewis B, Luk HY, Comstock, BA *et al.* The effects of a customized over-the-counter mouth guard on neuromuscular force and power production in trained men and women. *J Strength Cond Res*, 2012, **26**, 1085–1093.

Study 3

Early diversification enhances motor development

Long-term athlete development is a contentious issue in many circles. Some coaches believe that specialisation in a single sport is required from an early age to reach an expert level of performance. Opponents to early specialisation argue that participation in multiple sports and activities provides a richer cognitive and physical stimulus and is more beneficial for the future athlete. Frandsen *et al.* looked at the effects of early

specialisation versus early diversification on subsequent motor development.

The study sampled a total of 735 boys from three different age groups: 6–8 years, 8–10 years and 10–12 years. All youngsters completed an electronic questionnaire to obtain data on their participation in various sports and completed a fitness testing battery to gauge their physical development. In the 10–12 years age group, boys who had participated in multiple sports performed better in the standing broad jump, kneeling push-up, speed/agility and gross motor development tests. The motor development test had four components: walking backwards on a beam, moving sideways on boxes, hopping for height on one foot and jumping sideways.

■ **Outcome:** the study suggests that an early diversification approach should be encouraged with children under the age of 12.

Reference

Fransen J, Pion J, Vandendriessche J *et al.* Differences in physical fitness and gross motor coordination in boys aged 6–12 years specializing in one versus sampling more than one sport. *J Sport Sci*, 2012, **30**, 379–386.

Study 4

Cold water immersion improves recovery following rugby simulation

The jury is still out on the effectiveness of cold water immersion, commonly referred to as ice baths, with many studies divulging contrasting results. This was the first study to isolate the effects of cold water immersion on recovery following a contact sport simulation.

Ten male rugby union/league athletes completed an intermittent sprint protocol (two sets of 30 minutes) with either tackling or no tackling; this was designed to replicate the demands of their sport. These exercise protocols were then followed by either 20 minutes of cold water immersion or seated, passive recovery. Subjects' recuperation was evaluated immediately following the recovery protocol and then at 2 and 24 hours post recovery. The introduction of contact acutely impaired performance during the exercise simulation as well as increasing subsequent muscle damage and muscle soreness. Cold water immersion improved the recovery of muscular function immediately following the recovery procedure and reduced muscle soreness at 2 hours post recovery. Recuperation at 24 hours post recovery was similar between conditions.

■ **Outcome:** cold water immersion appears to confer a short-term benefit to recovery following a contact sport simulation.

Reference

Pointon M, Duffield R. Cold water immersion recovery after simulated collision sport exercise. *Med Sci Sports Exerc*, 2012, **44**, 206–216.

Study 5

Glute pre-activation improves power output during jumping

Low-load pre-activation exercises are commonly prescribed as part of an athletic warm-up, the rationale being that these exercises can 'switch on' specific muscles or muscle groups which we may not utilise effectively during daily living. One such example is the gluteal muscle group. Over-activity of the hip flexors has an

inhibitory effect on the glutes, a problem prevalent in the majority of the population. Researchers from Melbourne, Australia sought to examine the effect of a glute pre-activation warm-up on power production.

The power output of 22 elite Australian Football players was measured following the performance of each warm-up condition; power output was calculated during a countermovement jump test performed on a Smith machine. Three warm-ups were compared: a low-load glute pre-activation routine, 45 seconds of whole-body vibration and a control of no warm-up. Peak power output was 4.2% greater following the glute pre-activation warm-up. No significant effect of whole-body vibration was observed although performances were an average of 2.4% lower than the control.

■ **Outcome:** a warm-up targeting glute pre-activation appears to acutely enhance lower body power output.

Reference

Crow JF, Buttifant D, Kearny SG *et al.* Low load exercises targeting the gluteal muscle group acutely enhance explosive power output in elite athletes. *J Strength Cond Res*, 2012, **26**, 438–442.

Study 6

Coconut water or sports drink for rehydration?

Coconut water now features on the shelves of many of our supermarkets and is making big waves in the sports drinks market. The appeal of coconut water is that it is naturally rich in electrolytes, important for rehydration, without the need for artificial additives. So, how does it match up to traditional carbohydrate-based sports drinks and good old-fashioned bottled water?

Twelve exercise-trained males completed a 60-minute dehydration protocol on a treadmill before receiving pure coconut water, coconut water from concentrate, sports drink or bottled water. An average of 2% body mass was lost during the exercise protocol; these losses were used to calculate the volume of fluid that would be consumed. Subjects were allowed 60 minutes to consume their beverage. A subsequent performance test was undertaken 3 hours following the dehydration protocol. No differences in measures of rehydration or exercise performance were reported between the four conditions. The two coconut water conditions resulted in greater stomach upset 3 hours after the dehydration protocol.

■ **Outcome:** water is as effective as coconut water and sports drinks for rehydrating following prolonged exercise.

Reference

Kalman DS, Feldman S, Krieger DR *et al.* Comparison of coconut water and a carbohydrate-electrolyte sport drink on measures of hydration and physical performance in exercise-trained men. *J Int Soc Sports Nutr*, 2012, **9**, 1.

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