February 2018 | Issue #16

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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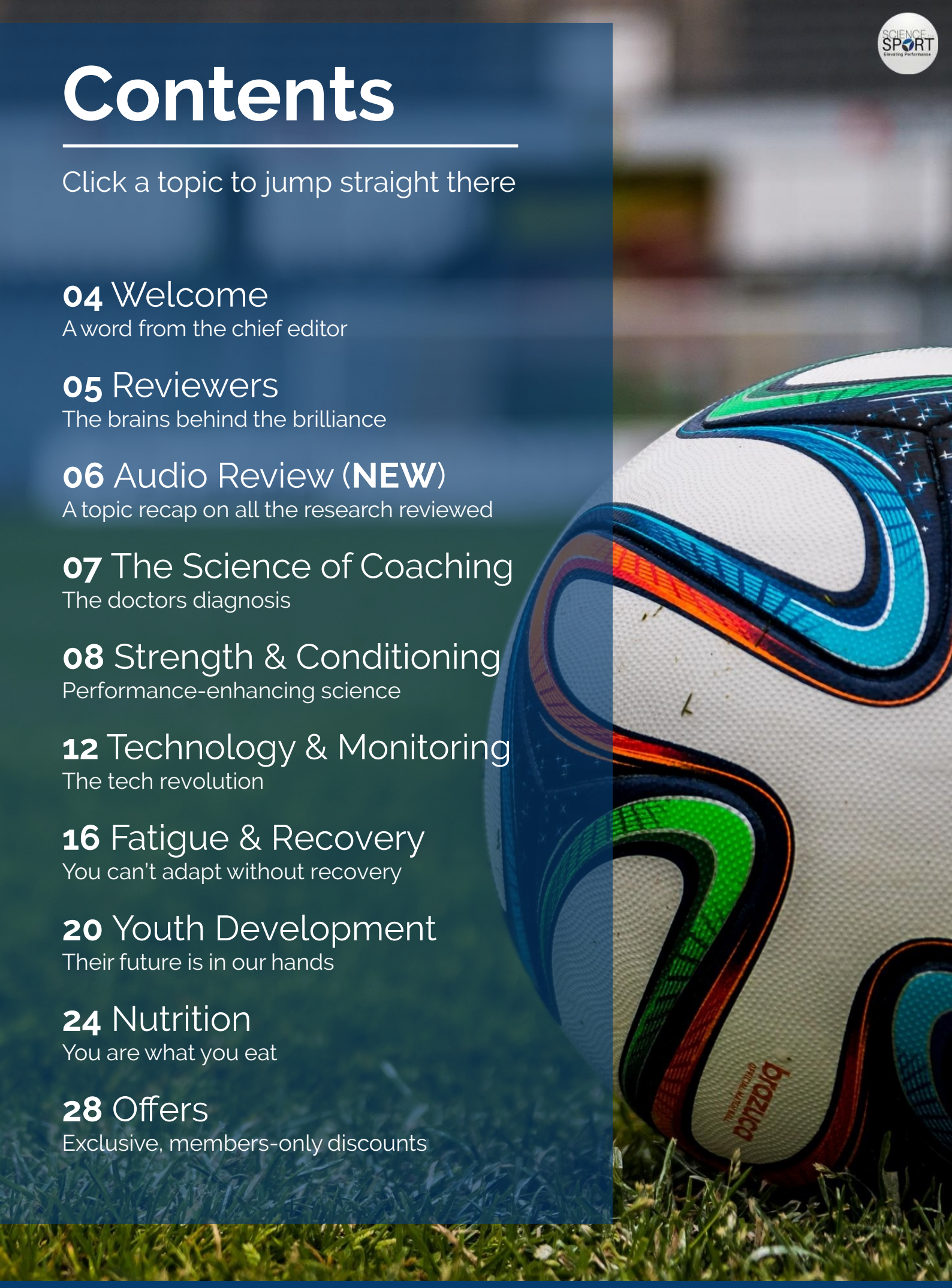

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Welcome to the **PERFORMANCE DIGEST**

OWEN WALKER
Founder and Director of
Science for Sport

If you're reading this right now, then I am seriously honoured you decided to invest in yourself and join the Performance Digest. I am extremely thankful for every single member who chooses to join us on our relentless quest to improve this industry for the better. Without you, this would simply not be possible; so thank you.

So, what's special in this month's issue?

1. **Issue #16**—Despite this issue being called February 2018, it is still issue #16. The last issue published was 'issue #15—December 2017', so you may be thinking: what happened to January's issue? Well, you haven't missed one, that's for certain. This issue is effectively January 2018's issue, but we simply changed the name of it because it didn't make much sense for us to be promoting January's issue during mid-February because it seems like we're "behind on the times". So all we have done is rename this issue to "February 2018", meaning when we promote it to all you members in February, it just seems to make more sense. For example, during February 2018, we'll be saying "February's issue is now online". Hopefully that makes as much sense to you guys as it does to us.

2. **Audio Review** - Secondly, we have included our first 'Audio Review' — you can find it on page #6 — which is a summary of all the research we've reviewed to date on a specific topic. For example, in this issue our 'Fatigue & Recovery' reviewer, Francisco Tavares, will summarise all the research he has reviewed to date on 'Cold Water Immersion' as a recovery modality. We hope these audio reviews will help provide you with a complete understanding of the topic and where we currently sit in regards to evidence-based knowledge; including what research we hope to see in the future in order to improve the service we give to our athletes.

3. **Infographics** - As a result of some unfortunate personal issues, our infographic producer couldn't fulfil us with many infographics this month. I am very sorry for the lack of infographics, but I'm sure you stand with me when I'd like to wish him a more fortunate start to the new year for next month.

Thanks for reading, and for being a member :)
Owen Walker

Reviewers

The research reviewers for The Performance Digest.

Owen Walker
MSc*D CSCS

Chief Editor

Owen is the founder and director of Science for Sport. He was formerly the Head of Academy Sports Science and Strength & Conditioning at Cardiff City Football Club, and an interim Sports Scientist for the Welsh FA.

Dr. Will Vickery
PhD

The Science of Coaching

Will is a Senior Lecturer of Sport Coaching at the University of Northumbria: Newcastle Upon Tyne. Prior to this he has worked with Cricket NSW and Cricket Australia in an array of roles ranging from a sport scientist, development coach and a strength and conditioning coach.

Francisco Tavares
PhD Candidate CSCS ASCA L2

Fatigue & Recovery

Fran is a strength and conditioning coach at the Glasgow Warriors, Scotland. He is also a PhD candidate at Waikato University, New Zealand, a performance consultant to the Portuguese Rugby Union, and a published author.

Tim Rowland
MSc ASCA L2

Strength & Conditioning

Tim is the Head Strength and Conditioning Coach at the Sydney Rays Women's Rugby Sevens Team, and has assisted previously at the Australian Rugby Sevens. He has a Bachelor of Physiotherapy (1st Class Honours), Master of High Performance Sport and ASCA Level 2.

Tom Green
MSc UKAD Advisor

Youth Development

Tom has an MSc in Applied Strength and Conditioning from Hartpury College. He is currently working at Gloucester Rugby Club as an Academy S&C Assistant and has experience in professional boxing, semi-professional football and GB Equine.

James de Lacey
MSc

Technology & Monitoring

James is currently the Head Strength & Conditioning Coach with Austin Elite Rugby. He has previously worked in professional rugby in Romania, and with the NZ Women's National Rugby League Team. He is a published author and has completed a MSc in Sport & Exercise Science from AUT, Auckland, NZ.

James Morehen
PhD Candidate

Nutrition

James is a SENr registered performance nutritionist, currently completing his PhD at Liverpool John Moores University. He is also a Performance Nutritionist for the English Football Association alongside the England national squads (men's and women's)

Audio
REVIEW

Cold Water Immersion (Ice-Baths)

A 1-year recap on what we know and hope to find out from future research.
with Francisco Tavares

WHAT WE DICUSS

In this first trial episode of the "Audio Review", myself (Owen) and Francisco discuss a serious amount of practical information surrounding the use of cold water immersion and what we currently know, and don't know, from the research.

For example, we discuss things from:

- How cold water immersion works.
- How body composition characteristics (e.g. body fat percentages) can impact the effect of the cold water immersion.
- How and why you should be periodising cold water immersion during different phases of the season.
- The acute versus chronic effects of cold water immersion: how it might be useful in short-term recovery, but harmful for long-term adaptation.
- What research we hope to see in the near future.
- Our research paper which is soon to be published in the NSCA's Strength & Conditioning Journal.

Episode length = 28 minutes

Listen Now

Key **Takeaways**

- Cold water immersion is believed (by athletes) to be the most effective recovery modality outside of the big 4 (sleep, food, hydration, and rest).
- Cold water immersion reduces muscle protein synthesis.
- Cold water immersion reduces neural excitability and has an anesthetic effect.
- Higher body fat and lower BSA:BM ratio athletes should spend longer in the water.
- Cold water immersion can affect short-term muscle function.
- Athletes should use cold water immersion only during intense training regimes.
- Athletes should avoid cold water immersion when there is plenty of recovery time.
- Cold water immersion may blunt long-term muscle adaptation (e.g. growth).
- Long-term (chronic) adaptation research which measures markers of muscle growth are needed.

The Science of
COACHING

Refining technical skills in high-level athletes

[Abstract]

How do coaches refine the established skills and technique of high-level athletes?

INTRODUCTION

The role description of any coach includes a number of themes, one of which being the development of the athlete(s) technical skill. In the case of expert-level athletes, they have already learned the majority of their skills and technique throughout their playing career, and as such, the coach may only need to refine their technique as opposed to teaching it. Carson and Collins (2011) proposed the 'Five-A Model' (see **HERE**) which guides coaches on how to facilitate this technical refinement within expert-level athletes:

⇒ Analysis

⇒ Awareness (De-automation)

⇒ Adjustment

⇒ (Re)automation

⇒ Assurance

Based on this model, coaches can use approaches which are based on mental factors (e.g. auditory cues), practice design (e.g. game-based scenarios), and psychosocial factors (e.g. motivation to training) to refine the technique of their athletes. Having said that, it is unclear if applying these approaches is common knowledge amongst current athletic coaches, and as such, this study looked to determine the following using high-level coaches (coached at the Olympic and Commonwealth games level):

1) Whether the tools used by athletics coaches when providing technical guidance and coaching matched that of previously suggested literature.

2) If coaches used a systematic approach when refining technical skill of athletes.

3) How coaches use and gain knowledge in relation to technique refinement.

WHAT THEY FOUND

After interviewing 6 athletics coaches, a number of tools were identified to enable technical refinement:

⇒ Buy-in from athletes

⇒ Part practice

⇒ Automaticity

⇒ Performing under pressure

⇒ Reflection

With regards to the use of a systematic approach for refining technical skill, the authors found that most of the coaches followed a similar pattern, although the order and style in which each coach approached this differed slightly. This included:

⇒ Analysis of the technique

⇒ Technical reshaping

⇒ Athlete involvement

⇒ Preparation for competition

Finally, all the coaches interviewed suggested that they had never been given any formal guidance on mastering technique refinement. Instead, coaches gained this information from an array of sources including:

⇒ Their experience as a former athlete and as a coach.

⇒ The sharing of knowledge between coaches and other support staff.

⇒ Working in different environments.

WHAT THIS MEANS

Although each coach that was interviewed used tools which were based on the 'Five-A Model' first proposed by Carson and Collins (2011) in a systematic manner, none of the coaches in the current study used the complete model. In other words, each coach used a number of the tools, or variations of them, on a regular basis. However, no one coach followed the model from start to finish. Despite the different approaches adopted by these coaches, they still understand the need for this refinement, and, as a result, continue to search for effective approaches in which to ensure their athletes continue to develop and perform at a high-class level.

Practical Takeaways

Coaches, regardless of the environment within which they work are encouraged to use a range of tools when looking to refine the technique and skill of their athletes. It is also encouraged that the process used for refining an athlete's technique should be consistent, regardless of the environment and sport in which these coaches work. In particular, coaches should spend time to make sure this newly refined technique is part of the athlete's automatic movement pattern within both a controlled and unpredictable/competitive environment.

To find out more about the 'Five-A Model', click **HERE**.

Dr. Will Vickery

Will is a Senior Lecturer of Sport Coaching at the University of Northumbria in Newcastle Upon Tyne, U.K.

Strength & Conditioning

This month's top research in strength & conditioning.

MAXIMISING STRENGTH GAINS: VOLUME TRUMPS FREQUENCY?

Colquhoun R, et al. (2018) Journal of Strength and Conditioning Research, 1.

OPTIMISING STRENGTH: HOW LONG SHOULD WE ACTUALLY BE RESTING BETWEEN SETS?

Grgic J. et al., (2017) Sports Medicine, 48(1), 137 -151.

INJURY PREVENTION TRAINING FOR YOUTH ATHLETES: HOW MUCH, HOW OFTEN, AND WHAT TO DO

Steib S. et al., (2017) Frontiers in Physiology, 8.

[Abstract]

Maximising strength gains: Volume trumps frequency?

OBJECTIVE
In the literature to date, there is a paucity of research comparing higher-frequency training to more traditional training frequencies, which makes it difficult to determine whether there might be a benefit to high-frequency training. Therefore, the aim of this study was to examine the effects of high-frequency (6x/week) resistance training versus a traditional resistance training frequency (3x/week) on maximal strength and body composition changes in resistance-trained males.

WHAT THEY DID
28 college-aged, resistance-trained (for > 6 months) males were randomly assigned to either: 3x/week (n = 16) or 6x/week (n = 12) training. Dependent variables (DVs) assessed at baseline and after the 6-week training intervention included: squat 1RM, bench press 1RM, deadlift 1RM, powerlifting total (PLT), Wilk's coefficient (WC; which has been validated as an objective measure of relative strength), fat-free mass (FFM) and fat mass (FM). Body composition was assessed using A-mode ultrasound.

The training programme followed a daily undulating periodisation (DUP) scheme and was powerlifting-specific in terms of its exercise selection. Volume, intensity, and time spent training between groups was equated (i.e. the 6x/week group completed half as much volume as the 3x/week group in each training session [1hr vs 2hr training sessions, respectively]). Auto-regulated progressive resistance exercise (APRE) was also used in this study to apply appropriate progressive overload for both groups.

WHAT THEY FOUND
There was a main effect for time ($p < 0.001$) for squat 1RM (3x: + 16.8 kg; 6x: + 16.7 kg), bench press 1RM (3x: + 7.8kg; 6x: + 8.8 kg), deadlift 1RM (3x: + 19 kg; 6x: + 21 kg), PLT (3x: + 43.6 kg; 6x: + 46.5 kg), WC (3x: + 27; 6x: + 27.1), and FFM (3x: + 1.7 kg; 6x: + 2.6 kg). While there were no statistically significant differences between any of these results, the effect size for the increase in FFM (d = 0.42) favoured the 6x group.

Overall, this study shows that high-frequency (6x/wk) resistance training does not appear to offer additional strength and hypertrophy benefits over lower-frequency training (3x/wk), when volume and intensity are equated.

Practical Takeaways

This study reinforces the idea that volume is the primary driver of strength and hypertrophy. Strength and conditioning coaches and practitioners can therefore expect similar increases in strength and lean body mass with both 3 and 6x/week sessions. Therefore, volume and intensity should be the primary concern for coaches when designing a periodised resistance training programme.

While high-frequency training does not appear to offer any additional benefits beyond that of lower-frequency, volume-equated training, coaches may run into scenarios that necessitate increased training frequency. Some of these situations may include a daily training volume that is no longer manageable for athletes, time constraints in an athlete's schedule, or personal preference for shorter training sessions. Coaches can utilise an increased training frequency to accommodate the schedule and preferences of athletes when other programme variables (i.e. volume and intensity) are held constant, with equal results.

Want to learn more?
Then check these out...

Tim's Comments

"It has been suggested that increasing the frequency of resistance training may accelerate neural adaptations and lead to more rapid strength gains. While past research has shown that 3x a week frequency is superior to 1x a week frequency (when volume equated), frequency appears to follow the law of diminishing returns, as this study shows that 6 weekly training sessions does not appear to confer any additional benefits beyond 3 weekly sessions when training volume and intensity are equated. Accordingly, volume appears to be a more important contributor than frequency to the strength and hypertrophic adaptations observed in response to resistance training.

It is important to note that the body composition data was calculated using A-mode ultrasound. While this is a good method for generally estimating body fat, the lean mass measurement does not distinguish between muscle and water, and so it is not an accurate measure of muscle mass. This means we should interpret any apparent benefit for muscle growth with 6x per week training with caution."

[Abstract]

Optimising strength: How long should we actually be resting between sets?

OBJECTIVE
Most studies examining the effect of rest interval (RI) duration on muscular strength have looked at the acute impact of different result intervals, and it is uncertain if the effect on chronic adaptations can be inferred from these findings. To gain clarity on this topic, a systematic review on the studies that assessed chronic strength adaptations to different RI durations was performed to provide evidence-based recommendations for strength and conditioning coaches and athletes.

WHAT THEY DID
The systematic review was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and included a literature search of the following databases - Scopus, PubMed/MEDLINE, Web of Science, Cochrane Library, and Open Access Theses and Dissertations databases. Methodological quality of the studies was evaluated using a modified version of the Downs and Black checklist. The inclusion criteria for study selection was as follows:

⇒ Study compared the use of different duration RIs in resistance training with all other training variables remaining equal.
⇒ At least one muscular strength test was utilised [all tests up to 10 repetitions maximum (RM) were considered].
⇒ The resistance training protocol lasted for a minimum of 4 weeks, with a minimal frequency of two times per week.

WHAT THEY FOUND
23 studies comprising a total of 491 participants (413 males and 78 females) met the inclusion criteria. All studies included were of moderate to good methodological quality. Overall, the literature shows that significant gains in strength can be achieved even with short RIs of <60 s. However, it seems that longer duration RIs (>2 min) are needed to maximise strength gains in resistance-trained individuals, whereas short to moderate RIs (60–120 s) are sufficient for maximising muscular strength gains in untrained individuals.

Practical Takeaways

While improvements in muscular strength may be achieved with varying RI durations, the evidence suggests that RIs lasting more than 2 min are needed to maximise strength gains in resistance-trained individuals. For individuals without prior experience in resistance training, the current body of evidence indicates that short to moderate duration (60-120 s) rest intervals are sufficient for gains in muscular strength. Therefore, as strength coaches, it is important to alter RI durations depending on the training status of the athlete, lending further credence to the idea to group athletes in the weight room according to their training status.

While highly-trained athletes require longer than 2 min rest for optimal strength gains, it is not always feasible to wait this long between sets when time in the gym is often limited. Therefore, one way to address this issue is to place low-level 'filler' exercises (e.g. mobility, corrective, or prehab exercises) in the rest periods between key lifts in order to fill this time productively. These exercises should not fatigue the athlete, and therefore, shouldn't impact performance in the subsequent exercise.

It is also important to note that there will be a large inter-individual response in terms of optimal rest periods. Therefore, trained individuals might like to auto-regulate their RI duration based on their psychological and physiological readiness, rather than adhering to a pre-determined RI duration. Finally, shorter RIs are more time efficient than longer RIs, and thus, may be appropriate for those who are time-pressed.

Want to learn more?
Then check these out...

Tim's Comments

"This systematic review fills an important gap in the research, as the large majority of studies on this topic have assessed the acute impact of differing rest intervals on strength, and inferences cannot be made about the long-term/chronic impact on strength gains from these studies.

While this review has shed light on optimal RI durations for trained versus untrained individuals, it remains unclear whether combining RIs of different duration - based on exercise selection (e.g. compound vs isolation) - would further enhance gains in muscular strength. Furthermore, it is unclear if RIs >3-4min in duration would provide any additional benefits on strength, as there is a paucity of studies that have investigated such durations. Future research should also be done on auto-regulated versus pre-determined rest periods and their impact on strength in the long-term."

[Abstract]

Injury prevention training for youth athletes: How much, how often, and what to do

OBJECTIVE
Although Neuromuscular Training (NMT) programmes have been shown to reduce injury rates in youth athletic populations, no consistent recommendations can be inferred from the literature with respect to the volume, duration, and frequency of such programmes. Therefore, the aim of this meta-analysis was to investigate dose-response relationships of NMT programmes to prevent lower-limb injuries in adolescent athletes, in order to provide practical recommendations for coaches/physiotherapists.

WHAT THEY DID
A systematic database search for studies on this topic was conducted in five databases (PubMed, Scopus, SPORTDiscus, The Cochrane Library, PEDro) from their inception up until January 2017. Eligible trials: evaluated a NMT program; included athletes of 21 years or younger; had an analytical design (RCTs, quasi-experimental, cohort studies); and provided injury data. Risk of bias of the included studies was analysed using the PEDro scale.

WHAT THEY FOUND
There was an overall injury risk reduction (IRR) of 42% with neuromuscular training. Training frequencies of two or three times per week resulted in the largest risk reduction, and a weekly training volume of more than 30 min tended to be more effective compared to lower volumes. 10-15 min NMT session durations produced effects comparable to longer session durations. Finally, interventions lasting longer than 6 months were not found to be superior to shorter programmes.

Practical Takeaways

The most important takeaway from this study for strength and conditioning coaches is that a significant reduction in injury rates in youth athletes can be achieved with modest volumes of NMT. This is highly relevant for strength and conditioning coaches as reducing injury risk is arguably their most important role.

This meta-analysis shows that NMT performed in short bouts of 10-15 min, 2-3 times per week, with a weekly training volume of 30–60 min is optimal for preventing lower-extremity injuries. This volume can be easily achieved by implementing NMT in the warm-ups for field or gym sessions.

Examples of some of the types of exercises that can be used in NMT programmes include: jump/hop and land exercises (forwards, diagonal, lateral, with rotation, etc), single-leg squats, walking lunges and single-leg bodyweight deadlifts. A simple progression of a knee dominant NMT exercise is: split squat > Bulgarian split squat > single-leg squat to box > single-leg squat (free). As these exercises require minimal equipment, they can also be prescribed as home exercise programmes to be performed 2-3 times a week, if time at training is limited.

Want to learn more?
Then check these out...

Tim's Comments

"Due in part to an increase in sedentary behaviour during childhood, injury rates in youth athletes have risen over the last decade. Therefore, studies like this are critical for reducing injury risk. It is refreshing to see a meta-analysis with outcomes that are directly practically applicable for coaches (i.e. duration, frequency, and volume of NMT needed to achieve the desired effect).

The results of this meta-analysis will not only help coaches in designing NMT programmes, but also increase compliance to such interventions due to the very modest amount of time needed to achieve great results. However, it is important to keep in mind that the data underlying these recommendations are derived from a limited number of studies (16 studies) with mixed methodological quality, which reduces the strength of the recommendations."

Technology & Monitoring

This month's top research on technology and monitoring.

DOES JAW CLENCHING IMPROVE FORCE AND POWER PRODUCTION IN THE GYM?

Allen, C., et al. Journal of Strength and Conditioning Research. 32(1): 237-243, 2018.

APPLE WATCH VS FITBIT CHARGE HR: WHO SHOULD WIN YOUR HEART?

Bai, Y., et al. Journal of Sports Sciences. 2017.

SLED-RESISTED SPRINTING: A NEW WAY TO TEST AND OPTIMISE SPRINT SPEED?

Cross, M., et al. European Journal of Applied Physiology. 2018.

[Abstract]

Does jaw clenching improve force and power production in the gym?

OBJECTIVE
There is a growing body of research demonstrating a relationship between jaw clenching and improvements in force production. Jaw clenching is one example of a remote voluntary contraction (RVC) where an RVC is an isolated muscle activated away from, but synchronised with, a prime mover. The purpose of this study was to examine jaw clenching while wearing a self-adapted, jaw repositioning mouthpiece on force production variables during CMJ and isometric mid -thigh clean pull (IMTP). Additional objectives were to determine whether the effects could be attributed to jaw clenching, jaw alignment, or a combination of clenching and a jaw-repositioning mouthpiece.

WHAT THEY DID
36 recreational, resistance trained males took part in all 3 conditions. The 3 conditions being: self-adapted jaw-repositioning mouth piece, self-adapted traditional mouthguard, and no mouthpiece. A mouthguard is a device with protective properties that fits the upper jaw. A mouthpiece is a device without protective properties that fits to the lower jaw. Each 3 testing sessions were administered in the same sequence (CMJ then IMTP) under 2 different conditions (jaw maximally clenched and jaw relaxed) under each mouthpiece condition (mouthguard, jaw repositioning mouth piece, and no mouthpiece). Assessments during each testing session were CMJ using a Vertec device and an IMTP with straps on a force plate for 3x3sec efforts with a 30sec rest.

WHAT THEY FOUND
There were no improvements in any force variable during either CMJ or IMTP as a result of wearing a jaw-repositioning mouthpiece over the traditional mouthguard and no mouthguard. IMTP showed a significant jaw clenching effect on peak force and rate of force development. Jaw clenching in all 3 conditions led to significant performance differences for the IMTP. No significant differences were seen in CMJ peak force, rate of force development, or CMJ performance with jaw clenching and no clenching.

Practical Takeaways

This study suggests that regardless of the jaw alignment mouthpiece, maximal jaw clenching can have an ergogenic effect on force production, specifically in the IMTP. The use of jaw clenching has the potential to elicit the phenomenon known as 'concurrent activation potentiation' (CAP). Other RVCs such as gripping maximally with the fists and the Valsalva manoeuvre all have the potential to elicit CAP. This specific RVC did not improve CMJ and the authors speculate that a specific level of adaptation to training must be achieved before CAP is potentiated, particularly in highly-explosive force movements (e.g. CMJ).

Even though maximal jaw clenching improved force production in all 3 mouthpiece conditions, doing so with no mouthpiece is not advised due to the potential dental damage. Cheap self-adapted mouthguards can be bought at most local pharmacies and should be used when jaw clenching. Based on this paper, maximal jaw clenching may be best suited to high-force movements such as the IMTP, squatting, deadlifting etc.

Want to learn more?
Then check these out...

James's Comments

"If you keep up with strength sports, you may have seen one of the World's Strongest Man Competitors Brian Shaw use a mouthpiece while he trains and competes. Since most events in strongman require high forces, this seems like the perfect sport to use a maximal jaw clench. I would caution users to be careful the first few times you try this, as jaw muscle soreness could quite easily make eating uncomfortable.

The way I interpret this study, I would avoid jaw clenching for explosive movements. Explosive movements don't just require high-levels of force and rate of force development, but also the ability to synchronise the movement efficiently and allow for reciprocal inhibition. By clenching the jaw, you create whole body tension that makes your body "stiff" when trying to jump. Do an experiment yourself while you read this. Stand up and simulate a jump with a relaxed jaw, and then one with a clenched jaw and you'll feel a difference in where the tension sits. There's a reason sprinters have relaxed faces during races."

[Abstract]

Apple Watch vs Fitbit Charge HR: Who should win your heart?

OBJECTIVE
Wrist-worn fitness trackers are some of the most popular trending pieces of fitness equipment in today's world. Their potential to easily track heart rate and energy expenditure (EE) give them considerable interest in the research community. Therefore, the purpose of this study was to evaluate the validity of EE from the Apple Watch 1 and the Fitbit Charge HR. A secondary purpose was to assess the accuracy of the step count and heart rate estimates.

WHAT THEY DID
41 healthy adults aged 19-60 were tracked for EE, steps and heart rate. This was done by wearing the two fitness watches on the same wrist. Along with the fitness trackers, an Oxycon Mobile 5.0 mask was worn which is a wireless portable metabolic analyser to obtain estimates of EE. A pedometer was also worn to track steps and a Polar H7 HR monitor to track heart rate. Subjects went through an 80-minute protocol consisting of 20-mins sedentary activity while seated at a desk, a 5-min break followed by 25-minutes of aerobic exercise at a self-selected pace on a treadmill. After another 5-min break, 25-minutes of simulated free-living activities followed (sweeping, stretching, moving light boxes etc).

WHAT THEY FOUND
Apple Watch 1 estimated EE with relative accuracy (7.6%), while the Fitbit Charge HR did not (-29.6%). Both watches overestimated step count compared to the pedometer, and did so primarily during the light physical activity. However, both watches had low measurement errors in estimating steps during aerobic work, with the Apple Watch 1 mean percent difference of 0.7% and the Fitbit Charge HR mean percent difference of 4.5%. Step count of the watches also correlated well with the pedometer during aerobic exercise (Apple = 0.91; Fitbit = 0.86). Due to the Apple Watch not being able to automatically measure heart rate at a fixed sampling frequency, only the Fitbit was reported. The Fitbit Charge HR slightly underestimated heart rate (2.3%) during sedentary activity.

Practical Takeaways

While both watches performed similarly for estimated steps, the Fitbit Charge had a much lower validity for estimating EE compared with the Apple Watch, but had relatively high validity for heart rate estimation.

When choosing which fitness tracker to buy, it's going to come down to what you want to get out of the device. Based on this paper, if EE is the main priority, then the Apple Watch is likely to be the better option. In contrast, if heart rate is the main priority, then the Fitbit Charge is likely to be the better option. There are many more devices on the market and I encourage you to read the article link below that looks at more fitness trackers and their error rates. What is also important, but not discussed in this study, is the colour of your skin and the size of your wrist, as both of these factors affect the error rate of these devices. The darker your skin and the thicker your wrist, the less accurate the fitness tracker is going be.

Want to learn more?
Then check these out...

James's Comments

"While this study only looked at two different fitness trackers, it showcases some of the potential problems with choosing a fitness tracker with the large range of devices on the market. Some may be more accurate at one measurement, but poor in others. Again, take a look at the linked article I have written which examines previous research on fitness trackers and their error rates. For a wrist-worn fitness tracker to give the most accurate readings, the desirable traits are having a light skin tone, small wrist circumference, being female, having a low BMI, and performing low-intensity exercise. Furthermore, while this study didn't look at higher intensities of exercise, as intensity increases, the accuracy of heart rate measurement decreases - something to keep in mind if you are planning on wearing one for higher speed sessions."

[Abstract]

Sled-resisted sprinting: A new way to test and optimise sprint speed?

OBJECTIVE
Horizontal force and sprint performance has gathered a lot of research interest in the past decade, along with force-velocity (F-V) profiling. However, most F-V profiling has been studied and used for jumping, and as such, it is not directly translatable for horizontally-emphasised sports. Hence, the aim of this study was to compare F-V relationships determined via multiple resisted sprints to a single unloaded sprint trial. A secondary aim was to examine whether practical resisted sprint loading parameters could be determined from a single sprint.

WHAT THEY DID
12 recreational level mixed-sport athletes and 15 highly-trained sprinters participated. 7 loading protocols were prescribed (unloaded, 20, 40, 60, 80, 100, 120% of body mass). This was to obtain a power-velocity curve where power will peak at a certain velocity; which is inversely related to the load being dragged (i.e. the lighter the load, the faster you run). Distances for each load were as follows: unloaded = 45m, 20% = 40m, 40% = 30m, 60% = 30m, 80% = 30m, 100% = 20m, 120% = 20m. These were obtained by the authors' pilot study where each distance is approximately what would be required to reach maximal velocity under each condition. Load was added until a 50% decrement in maximal velocity was observed.

WHAT THEY FOUND
There were large errors associated with increased horizontal force output (F0) between the two methods. In the calculations for optimal loading, the multiple trial method presented a lesser optimal load by approximately 3.1kg. It is unclear whether or not this practically represents a worthwhile margin of error. Both methods calculated the ability to generate force at high velocities (v0) with almost perfect relation between methods (r = 0.99) while having a small margin of error. The biggest finding was the overall strong association between the F-V relationships determined through free sprinting and multiple trial resisted sprint (r = 0.71 to 0.99).

Practical Takeaways

The strong relationship in calculating optimal velocity provides a potential avenue for assessment and prescription of training load from a single sprint, without the need of multiple taxing resisted sprints. However, it is important to note that for the optimal velocity to be translated into a useable training resistance accurately (i.e. sled load or pulley resistance), surface conditions and equipment would have to be standardised due to changes in friction. Being able to calculate the optimal load to maximise velocity in one single sprint could allow coaches to individualise resisted sprint loads to target a particular side of the F-V relationship.

What is also interesting is the similar nature of the unloaded and resisted sprints, as shown by the strong relationship. Maintaining a maximal sprint effort at a given load may replicate the conditions experienced during an unresisted sprint, but at different parts of the F-V relationship. For example, an athlete towing an individualised optimal load of 82% body mass (load taken from a previous paper) would mimic the moment power is maximised during an unloaded sprint (i.e. steps 2-3 or early acceleration).

Want to learn more?
Then check these out...

James's Comments

"This new paper provides valuable insight for coaches when it comes to sprint training and testing. Rather than the typical speed test where the only information gathered is time, some further calculation (with the right data collecting equipment) can make your data actionable when looking to maximise the velocity side of the F-V relationship. The fact that resisted sprints replicate an unresisted sprint at different parts of the F-V relationship is an exciting finding for the future, especially when the calculation for an optimal horizontal F-V profile gets published later this year and added to apps and devices alike.

This means that ultra-heavy sled-sprinting to maximise the force end of the F-V relationship doesn't have to be vilified as a sprint mechanic destroying exercise. Instead, it opens up the thought process of maximising horizontal force capabilities for athletes who're lacking this quality in order to improve sprint performance."

Fatigue & Recovery

This month's top research on fatigue and recovery.

DO ROLLER MASSAGERS EFFECT NEURAL EXCITABILITY?
Young JD. et al. (2018) Journal of Applied Physiology.

CAN ICE PACKS BE USED AS A PRACTICAL ALTERNATIVE TO ICE BATHS?
Kwiecien SY. Et al., (2018) J Sports Sci. 36 (4):407-413.

COMPRESSION GARMENTS: FULL-LEG VS. SHORTS VS. STOCKINGS
Marqués-Jiménez D. et al., (2018) 26(1):27-42.

[Abstract]

Do roller massagers effect neural excitability?

OBJECTIVE
Roller massage (RM), which is different to foam rolling, is widely used among athletes to increase range of motion (ROM) and pain threshold. Nevertheless, it is unknown if the effects are associated to neural or muscular responses. Therefore, the aim of this study was to evaluate the effect of afferent input via application of RM on spinal excitability.

WHAT THEY DID
In a randomised crossover order, 18 adult subjects were exposed to 3 different RM intensities on the plantar flexors of the dominant leg: 1) high-intensity pain condition (HIGH), 2) moderate-intensity pain condition (MOD), and 3) low-moderate intensity pain condition (LOW). Each condition was performed with one day apart and consisted of 3 sets of 30-sec of RM with 30-sec of rest between sets.

At the beginning of each session, recruitment curves of M-waves and H-reflex were obtained at rest and during different stimulation intensities. Stimulation intensity corresponding to 50% of the stimulation that elicited maximal M-wave was used to test the H-reflex during the RM, and 1 minute and 3 minutes after the intervention.

WHAT THEY FOUND
The major finding of this study was that RM significantly reduced H-reflex amplitude. Moreover, reduction in H-reflex was dependent on the intensity used during RM. High-intensity, moderate-intensity, and low-intensity conditions decreased soleus H-reflex amplitudes by 58%, 43%, and 19%, respectively. The effects of RM decreasing the H-reflex were significantly greater in the HIGH in comparison to the MOD and LOW during the RM intervention. However, these effects were transient with H-reflex immediately returning to baseline values following RM.

Practical Takeaways

The results of the present study provide strong evidence for neural modulation of spinal excitability to the soleus during RM. Given the fact that the effects returned to baseline values shortly after rolling, from a neural modulation standpoint, there seems to be no strong rationale to implement RM in athletes. However, as suggested by the authors, further research should explore the effects of multiple bouts of RM and the combination of RM with other techniques (e.g. static stretching), in order to prolong the reflex inhibition.

Want to learn more?
Then check these out...

Francisco's Comments

"The findings from this study demonstrate that a higher RM pressure and pain elicit a stronger stimulus (i.e. increasing afferent input and levels of presynaptic inhibition), therefore reducing spinal excitability. Given the transient nature of the effects, it is likely that the vulgarly reported changed in ROM after the RM is not primarily dependent on neural inhibition. As a result, other theories may explain the commonly observed changes in ROM.

These findings should not discourage practitioners to use RM or foam roller techniques, as both techniques have been previously demonstrated to enhance ROM and performance (see attached article)."

[Abstract]

Can ice packs be used as a practical alternative to ice baths?

OBJECTIVE
Cold recovery modalities are widely used by athletes, and as a result, the efficacy of different protocols and techniques are frequently being challenged within the research. Whilst cold-water immersion is the most common cold modality used by athletes, it can be unpractical to implement in an applied setting. Therefore, the goal of this study was to investigate the effects of cooling packs on exercise-induced muscle damage (EIMD).

WHAT THEY DID
Eight participants were exposed to an EIMD protocol that consisted on 120 bilateral eccentric quadriceps (12x10 reps) performed on an isokinetic dynamometer. Both legs were exposed to the EIMD protocol and after exercise only one of the limbs was exposed to cold phase change material (PCM) pack. Five months later, the protocol was repeated, but instead, this time, room-temperature packs were used on both legs. Therefore, there were three groups: 1) legs treated with cold PCM packs (direct cooling group [COLD]), 2) legs treated with room temperature PCM packs contralateral to the 15˚C PCM packs (systemic cooling [SC]), and 3) legs tested 5 months later and both treated with room temperature PCM packs (control [CON]). 15˚C cold PCM packs were used for 3-hours and then substituted for new ones at the same temperature (15˚C) that were then used for another 3-hours. Basically they used 8 participants and on those 8 one of the legs used cold packs and the other leg used room temperature packs. They considered each leg as a group. After 5 months they repeated the protocol with just room temperature (so there is no systemic effect).

a. Cold packs
b. Room temp packs (but with systemic effect as the other leg was receiving cold)
c. Room temp packs (with the other leg receiving room temp pack also)

Measures of maximal isometric contractions (MVC) of the knee extensors were obtained at 30, 50, and 70˚ of knee flexion on an isokinetic dynamometer. Quadriceps pain were obtained during an isometric squat, with participants reporting discomfort in a 0-10 scale. These measures were obtained before, 24, 48, 72, and 96 hours after exercise.

WHAT THEY FOUND
Strength loss was significantly higher on the CON in comparison to COLD at 24 hours after the EIMD exercise. Pain was significantly lower on COLD in comparison to CON at 72 and 92 hours after exercise. In conclusion, administration of cold PCM packs seem to have a beneficial effect on recovery from EIMD.

Practical Takeaways

This study demonstrated PCM cooling using frozen ice packs at 15˚C can be an effective method for reducing muscle soreness and losses in strength in a single muscle group. Having said that, it's important to understand that this study only looked at their impact on a single muscle group and not multiple muscles or systemically.

Therefore, 6 hours of direct frozen state PCM cooling may be used to accelerate muscle damage recovery in a single muscle after intense physical activity. Although this is the first study to investigate this topic, if future findings report similar results, this could lead to a useful and very practical recovery modality after training and/or competition.

For example, during away games in football or rugby, it can be tricky to administer cold modalities such as cold water immersion. With the use of PCM packs, however, these could be administered on the travel bus when returning home after the game.

Want to learn more?
Then check these out...

Francisco's Comments

"Although this was a pilot study, with a small sample being investigated, the findings from this study demonstrate some promising effects of cold PCM packs attenuating the effects of EIMD.

For me, these findings have two major implications: 1) cold PCM packs can be individually implemented by each athlete which can facilitate the administration in comparison to other modalities (e.g. cold-water immersion); and 2) given that the cooling rate using cold PCM packs (at 15˚C) is inferior to the cooling rates observed when using cold-water immersion, the harmful effects on protein synthesis may be lower. In other words, we may still get the beneficial effects of cold modalities on muscle soreness, but without the negative impact of reducing potential muscle repair and growth.

Future research should look to compare the effects of cold PCM packs vs. other cold modalities (e.g. cold-water immersion and contrast baths) and include measures of changes in body temperature (e.g. skin and muscle temperature)."

[Abstract]

Compression garments: Full-leg vs. shorts vs. stockings

OBJECTIVE
Compression garments have been demonstrated to have a beneficial effect for attenuating different markers of exercise induced muscle damage. While the majority of the research has investigated the effects of full-leg compression garments, no research to date has compared the effects between compression garments covering different areas of the lower body. Therefore, the goal of this study was to investigate the influence of different types of compression garments (full leg compression, compression shorts, and compression stockings) on exercise-induced muscle damage.

WHAT THEY DID
Eighteen semi-professional football athletes were used to investigate the effects of different compression garments on different markers obtained at half-time and after a friendly football match. The athletes were divided into 3 groups: Stocking group (SG; n = 6), full-leg group (FLG; n = 6), shorts group (QC; n = 6). These athletes wore the compression garments during the friendly match and for 7 hours a day on the following three days. Ten of the eighteen players served as a control group (CG, wearing no compression garments) on a separate occasion.

Biomarkers of muscle damage, delayed onset muscle soreness (DOMS) of the lower-limbs (calf [CS], hamstring [HS], quadriceps [QS], tibialis [TS]), swelling (maximum circumference) of the calf and medial thigh were obtained. All measures were obtained before the match, at half-time, immediately after, and 24, 48, and 72 hours after the match, apart from biomarkers of muscle damage that were obtained 72 hours after the match.

WHAT THEY FOUND
A large effect for reducing muscle swelling was observed in the different experimental conditions in comparison to the control, both at half-time and after the match (for up to 72 hours). The effect was only evident in the areas covered by the different compression garments (e.g. calf, thigh, or both).

The usage of different compression garments may provide a beneficial effect on different biomarkers of muscle damage, as demonstrated by the non-significant increases in the experimental groups when comparing to baseline values. In contrast, in the CG the biomarkers increased significantly. Effect sizes also revealed the efficacy of compression garments, in particular FLG and QG, decreasing EIMD biomarkers.

The experimental conditions also demonstrated a beneficial effect for reducing muscle soreness, particularly between 24-48 hours after exercise. Again, the effects were more evident in the areas covered by the compression garment.

Practical Takeaways

The findings from this study demonstrate the beneficial effects of compression garments for EIMD muscle swelling, DOMS, and markers of muscle damage; ultimately suggesting that compression garments should be implemented by athletes. Given that the effect was more (or only) evident on the muscles exposed to the compression garment, FLG should be implemented. Moreover, as suggested by the authors, players are advised to use compression garments during periods of both high training intensities and volumes.

Want to learn more?
Then check these out...

Francisco's Comments

"I found this article very interesting as it compares the effects of different types of compression garments on recovery. Not surprisingly, the effects are more evident on the muscles covered by the garment. Therefore, one can easily understand that full leg compression garments may have a beneficial effect in comparison to garments that cover less muscles (e.g. stocking garments). So based on this knowledge, FLG should be implemented.

As I have previously discussed, while some recovery modalities (e.g. cold-water immersion) may have a harmful effect on adaptation from training as they negatively influence protein synthesis (listen this month's "Audio Review" on cold water immersion), no harmful effects have been reported from the usage of compression garments. Therefore, compression garments should be used for extend periods of the training and recovery days. If compression garments interfere with sleep quality due to an increase in body temperature, athletes should be advised to only wear them during the day."

Youth Development

This month's top research on youth development.

CONTRAST TRAINING FOR IMPROVING SPRINT, JUMP, AND AGILITY PERFORMANCE IN PREPUBERTAL ATHLETES
Román, P.Á., et al. 2017. Journal of sports sciences, 36(7), pp.802-808.

POWER PUSH-UP TEST FOR YOUNG ATHLETES: GOOD OR NOT SO GOOD?
Gillen, Z.M., et al. 2018. The Journal of Strength & Conditioning Research, 32 (1), pp.83-96.

THE 'ATHLETIC SKILLS TRACK' MOVEMENT TEST: SHOULD WE BE USING IT TO ASSESS MOVEMENT QUALITY?
Hoeboer, J., et al. 2017. Journal of sports sciences, pp.1-7.

[Abstract]

Contrast training for improving sprint, jump, and agility performance in prepubertal athletes

OBJECTIVE
Basketball is predominantly an anaerobic sport. As a result of this, exercise programming must reflect the demands of the sport by developing strength, power, and change of direction (COD) ability. With this in mind, this study investigated the effects of contrast training (see attached video) on jump, sprint, and agility performance in prepubertal basketball players.

WHAT THEY DID
58 children (age: 8.72 ± 0.97 years) from a basketball academy were selected to take part in this study. All participants were assessed as being at the same maturation stage (Tanner Stage 1). Participants were randomly assigned to either a control group (CG) or a contrast training group (CT). Those in the CT group performed two additional sessions per week lasting between 10-29 minutes for 10 weeks. Baseline values were collected for: squat jump (SJ), countermovement jump (CMJ), drop jump (DJ), and standing long jump (SLJ) using an Optogait system and 25m sprint test and agility T-Test using 2 double-light barriers.

WHAT THEY FOUND
This study found that a 10 week contrast training programme was successful in creating beneficial adaptations in vertical jump, sprint, and agility performance. More specific findings can be found below and are presented as a mean to demonstrate the effectiveness of this programme from pre- to post-tests:

Test	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Change
CMJ (cm)	17.47 (3.93)	18.51 (4.24)	+1.04
25 Sprint Test (s)	5.91	5.15	-0.76
T-Tests (s)	15.98	14.57	-1.41

These results were for the contrast training group. However, more tests were conducted in the study (see what they did). In conclusion, the CT group improved in all jump (SJ, CMJ, SSC, DJ), sprint, and agility performance measures after the 10 weeks of training. Some explanations for improvements from CT have been discussed in-depth in the attached article, where the reader is directed specifically to Page 555.

Practical Takeaways

This study has shown a 10-week CT program performed twice a week for roughly 10-29 minutes per session can support performance in youth athletes. Contrast training sets typically consist of a heavy exercise (Squat @70% +1RM) coupled with a similar unweighted, explosive exercise such as a vertical jump. The mechanisms responsible are the same as for post-activation potentiation (PAP), where increased neural excitability or 'readiness' to perform benefit the subsequent repetition.

In this study, the researchers paired a 90˚ isometric wall squat with a partner sitting on their thighs to depth and vertical jumps from a seated position. Isometric wall times varied from 40-70 seconds, and jumps were very voluminous, increasing somewhat randomly from weeks 1 (10-50 jumps) to week 10 (29-130 jumps). These can be used in your own programme with very young athletes (8+ years), assuming good technique and physical ability are present.

Want to learn more?
Then check these out...

Tom's Comments

"This study shows that a contrast training programme, when performed with normal training can improve jump, agility, and sprint abilities. However, there are many limitations to this study. For example, the sample was selected from one academy, where previous training and current fitness levels may be unique. Furthermore, there can be many issues when assessing a maturation stage based on the tanner scale, especially with both girls and boys analysed.

Although the data has shown an improvement in performance after a CT intervention, the athletes in the CT intervention received an additional 10 hours of physical activity compared to the control group. In light of this, we are still unaware if CT is more beneficial to the athlete than regular training (+ 10 hours of additional training) at improving agility, strength etc. Future studies should therefore look to compare equal volumes (i.e. time) between normal training and contrast training so that the authors can truly pinpoint the best methods for enhancing performance in a larger sample. This would help to mitigate the fact that performance could have just improved as a result of a higher exercise volume. Finally, a consideration that hasn't been mentioned is how 'fun' is this for children ages 8-9? I will leave that to you the reader to decide."

[Abstract]

Power Push-Up test for young athletes: Good or not so good?

OBJECTIVE
In the U.S. the power push-up test (PPU) is a common test performed on a force plate and is currently used in many high schools to measure upper-body explosive power. Due to the increase in S&C monitoring/testing tools being introduced into schools, the purpose of this study was to quantify the reliability of PPU based on age and starting position (knees vs. toes) in young athletes.

WHAT THEY DID
Gillen and colleagues tested a sample of sixty-eight boys twice over five days. A cross-sectional design was used to compare PPU test results in three groups. These were:

⇒ Young (6-9 years)
⇒ Middle (10-11 years)
⇒ Old (12-15 years)

All sixty eight boys were also assessed for height, weight, body fat (BF %), fat-free mass (FFM), and arm circumferences.

WHAT THEY FOUND
The PPU test may be a reliable (ICC ≥ 0.80) and sensitive measure of upper-body strength in 10-15 year old boys. Rate of force development also proved reliable, but less sensitive (CV = 30-38%) at detecting notable change. The measures of power from the force plate (average and peak power) were not reliable for any age group. In addition, none of the tests proved reliable for children aged between 6 to 9 years.

» Practical Takeaways

From this research, it may be suggested that the PPU is a reliable and sensitive measure of upper-body strength in older boys, but not for younger children (e.g. 6-9 years). For example, older children demonstrate an increase in peak force, height, weight, and fat-free mass compared to younger children. Younger children (pre-PHV) demonstrate high-levels of variability in terms of ability, body composition, and their stage of development. To alleviate these issues, you may wish to create a "cut-off point" prior to PHV by tracking maturation to know when this test is applicable for the individual (i.e. post -PHV). However, due to the cost of this equipment (e.g. force plate) and time taken to conduct this test, it may be reasonable to question if this is the best allocation of time and resources when other methods (e.g. sprint time, push-up test, or strength tracking) are available.

Want to learn more?
Then check these out...

Tom's Comments

"The position of youth strength and conditioning research is really interesting. On one hand, research provides the coach with informed and reliable practice to better support young athletes. However, declarative knowledge may be a double-edged sword to the practitioner. Research, such as this piece provides the reader with information regarding a test, but the real question for me is: are they needed?

Does a 6-15 year old really need regular and laborious testing? Are we somehow as a discipline missing the benefits of free, unstructured, and constraint-led practice in the pursuit of numbers and facts? When a child is desk-bound, lacking in movement competency, or general enjoyment in sport, are our invested interest in rate of force development, RSI, or other performance variables misplaced?

Instead, I believe that our time invested in publishing youth content could be better spent devising workshops, ideas, games, and inclusive, fun practice to help those in need. From this study, I would not personally use the PPU test in a young cohort of athletes. I think I'd rather just teach them to do a push-up and "track them" based on progress and enjoyment."

[Abstract]

The 'Athletic Skills Track' movement test: Should we be using it to assess movement quality?

OBJECTIVE

A motor skill can be defined as either 'gross' (large body movements [e.g. running]) or 'fine' (smaller tasks [e.g. throwing]). Developing these skills throughout childhood can not only enhance an individual's ability in sport, but contribute to a healthy and active lifestyle. In recent years, a drop in motor skill competence has seen a rise in test and interventions designed to identify baseline scores and track an individual's progress. Therefore, the objective of this study was to examine the test-retest reliability and validity of the athletic skills track (AST) motor skill competence test.

WHAT THEY DID

Hoeboer and colleagues split their study into two sub-studies. Study 1 consisted of 10 schools and investigated the test-retest reliability, whereas study 2 used 4 schools and examined the internal consistency and concurrent validity of age-related AST test. For a copy of the test protocol, click **HERE**. In study 1, the same teacher performed the test once in February and once again in March. In study 2, a Freelap timing system was used to ensure the accuracy of completion. In total, 1284 children aged between 4-12 years took part in this study. The test was altered according to age-related competence (AST 1, 4-6 YO; AST 2, 6-9 YO; and AST 3, 9-12 YO). Where YO = years old.

WHAT THEY FOUND

This study found that there was high test-retest reliability between all groups. Intraclass correlation coefficient between trials 1 and 2 was 0.881 (AST 1); 0.802 (AST 2); and 0.800 (AST 3) at a 95% confidence interval. With regards to internal consistency and validity (study 2), between-test scores were deemed acceptable, suggesting that they were both consistent and valid over repeated measures. In other words, an altered AST for age bands was a reliable and valid method to assess motor skill competence in this study.

Practical Takeaways

The AST has proven to be a low-cost, reliable, and valid measure of motor skill competence that can be used in children between the ages of 4 to 12. More importantly, this can be used in a physical education setting.

When compared to other motor skill tests (Körperkoordination-Test für Kinder [KTK], Test of Gross Motor Development [TGMD], and the Bruininks-Oseretsky test of Motor Proficiency [BOTMP]) which can take roughly 20 minutes per child, the AST can be completed in 50 minutes for a class of 25-30 children (1.6-2 minutes per child). This is an important consideration when working with young athletes, who can be easily distracted by tedious environments, especially if they perceive they are under test conditions. Another benefit to the practitioner is that the movements used (rolling, crawling, walking etc.) are relatively easy to perform and do not require extensive knowledge of movement criteria.

Want to learn more?
Then check these out...

Tom's Comments

"As an S&C/sports coach who is currently working in roughly 3-4 infant schools per day, I am always looking for time efficient ways to baseline and measure progress. As such, initiatives such as the AST are not only an easy way to assess movement competence, but can be collected at a relatively low cost.

Some issues that I can foresee when carrying out this test falls under the fact that this test is assessed based on 'time-to-complete'. An issue with this, is that the 'speed' of a movement may negatively affect the quality of it. On the other hand, the speed at which a child can complete this course may represent their confidence or ability to process and produce fine movement skills. In my opinion, this needs to be investigated in future studies. In addition to these concerns, I also question if physical education teachers and S&C coaches receive adequate training with regards to movement quality (e.g. rolling and clambering technique). In the future, I would therefore like to see more information regarding what makes a "good" and "bad" performance in the test used within this study."

Nutrition

This month's top research on nutrition.

DOES BOVINE COLOSTRUM SUPPLEMENTATION IMPROVE IMMUNE FUNCTION AND PREVENT ATHLETE SICKNESS?

Jones, et al. (2017). European Journal of Nutrition, 22, pp.1-10.

DO ELITE ATHLETES UNDER-EAT AND PREVENT POSSIBLE ADAPTATION AND THEIR ABILITY TO PERFORM?

Anderson, L., et al. (2017). Journal of Sport Nutrition and Exercise Metabolism, 27 (6), pp.491-498.

CAN BEETROOT JUICE IMPROVE MODERATE-INTENSITY EXERCISE PERFORMANCE?

Tan, R., et al. 2018. Journal of Applied Physiology.

[Abstract]

Does bovine colostrum supplementation improve immune function and prevent athlete sickness?

OBJECTIVE
It is well-known that exercise of strenuous and/or prolonged nature can impair immune function for up to several hours after exercise. Immune alterations that occur after intense exercise may contribute to increased susceptibility to upper respiratory tract symptoms (URS) in athletes at major sporting events. Bovine colostrum (COL) has been advocated as a nutritional countermeasure to exercise-induced immune dysfunction through reducing perturbations in cellular immunity and potentially reducing the incidence of URS occurring. However, to date, the influence of bovine colostrum on the in vivo immune response to a novel antigen following prolonged exercise remains unclear.

WHAT THEY DID
In a double-blinded study design, 34 recreational healthy males were randomly assigned to COL (20g.day.1) or placebo (PLA) for 58 days. Following a familiarisation period, participants were instructed to run for 2 hours at 60% VO2max on day 28 and received a primary diphenylcyclopropenone (DPCP) single patch exposure (sensitisation) 20 minutes later. The patch remained in place for exactly 48 hours.

On day 56, participants received a series of low-dose DPCP patches to evoke recall of in vivo immune-specific memory, and all were subsequently removed after 6 hours. For cutaneous responses, skinfold thickness assessment was performed at 24 and 48 hours after the application of the patches. Dose-response curves were used to analyse the minimum dose required to achieve a positive response (e.g. sensitivity).

WHAT THEY FOUND
Overall, COL supplementation did not significantly affect the summed skinfold response to DPCP, however, it did induce greater sensitivity of the antigen-specific memory recalled 4 weeks following the initial sensitisation. A greater contact hypersensitivity response to the lowest DPCP dose was also evident in the COL group, but there was no difference at the higher doses. This investigation provides further evidence that COL, as a supplementation regimen that induces clinical benefits to immune health, does not increase circulating concentrations of IGF-I compared to an isoenergetic/isomacronutrient placebo.

Practical Takeaways

Human colostrum for the development of the neonate immune system is well-recognised, and the presence of immune bioactive components in bovine colostrum has led to the use of the supplementation to prevent infectious diseases in humans. Several nutritional interventions have been proposed to act as a countermeasure to exercise-induced immune dysfunction, however, oral ingestion of bovine colostrum may reduce the incidence and days of (URS) in adults involved in strenuous exercise training. The mechanisms behind such effects is unclear, but it is possible that COL reduces perturbations in cellular immunity following prolonged exercise as the authors have suggested.

Although no changes were found in circulating concentrations of IGF-I in the current study and COL is not on the World Anti-Doping Agency list of banned substances, this supplementation is not recommended to the elite athlete by the governing body due to the presence of growth factors (e.g. IGF-I) that may influence anti-doping policy tests. Therefore, we recommend that the elite athlete ensure to check and confirm whether the COL supplementation is registered with 'Informed Sport' and they obtain the certification if they choose to consume bovine colostrum.

Want to learn more?
Then check these out...

James's Comments

"Although the use of in vivo measures is considered more clinically relevant in this field of research, a limitation of the current study was that they did not measure circulating cytokines and in vitro measures of immunity alongside in vivo immunity. Such measures may have provided the authors with further mechanistic insights of the action and effects of the COL on signals that may have triggered the migration and maturation of cells involved in the in vivo response.

To summarise, this is an exciting area of research moving forward in regards to immunity and health, in particular for those athletes constantly on the move and travelling to different locations over the globe."

[Abstract]

Do elite athletes under-eat and prevent possible adaptation and their ability to perform?

OBJECTIVE
The intensity of a professional footballers season is increasing every year, with additional pressures from clubs, media, and fans to see more games. With this comes increased energy expenditure from training and match time. As a result, it becomes obvious how important energy intakes are during in-season periods to not only fuel for performance, but also recovery.

WHAT THEY DID
During the in-season English Premier League 2015-2016, six male professional soccer players from an English Premier League team self-reported dietary intake using 7-day food diaries on both training and match days. On the day prior to data collection, the procedures of food diaries were explained to the players by the lead researcher and an initial dietary habit questionnaire (24 h food recall) was also performed in order to establish habitual eating patterns and allow any information that players may have missed on their food diary input.

During the data collection period, in order to assist with the estimation of energy and macronutrient intake, the remote food photographic method was used to support food diaries. This was to gain a greater understanding of the portion sizes and/or retrieve any information that may have been missed in the food diaries. To further enhance reliability, 24-hour recall by the lead researcher after one day of entries were also performed. Overall, three sources of dietary methods were used to estimate daily energy and macronutrient intake/distribution.

WHAT THEY FOUND
Researchers observed that players adopt a skewed and sub-optimal approach to feeding on training days, such as carbohydrate and protein intake was consumed in a hierarchical manner of dinner>lunch>breakfast>snacks. Furthermore, on match days, carbohydrate content of the pre-match (<1.5g.kg-1 body mass) and post-match (1 g.kg-1 body mass) meals were alike, and lower than the current carbohydrate guidelines that is considered to be optimal for pre-match carbohydrate intake and post-match recovery in aspects of physical, technical, and cognitive performance in team-sports. Similar to carbohydrate intake, a skewed pattern of daily protein intake was observed on training days in agreement with previous research on food intake in football players (**HERE** and **HERE**).

Practical Takeaways

Typically, elite professional soccer players will play two games as well as perform 3-5 training sessions per week in the competition season. Therefore, it is a primary goal of the sport nutritionist to ensure the players have sufficient energy intake in order to maximise physical performance and recovery. Given that the present study conducted a "real-world" scenario of a two games per week schedule, sub-optimal carbohydrate intake in regard to maximising match day (<1.5g.kg-1 body mass) and CHO feeding during match play (~30 g.hr-1) presented as an issue. In order to induce physiological benefits of high pre-exercise glycogen stores, maintenance of plasma glucose/CHO oxidation during exercise and muscle glycogen sparing in high-intensity intermittent exercise, authors suggested higher carbohydrate intakes (2-3g.kg-1 body mass and 60 g.hr-1, respectively).

Furthermore, the study reported intakes of <1g.kg-1 in the immediate period after match day 1. Such post-match energy intake combined with relatively low absolute daily intake (i.e. 4g.kg-1) on the following day would suggest muscle glycogen re-synthesis was likely to be compromised, and as such, potentially entering subsequent training sessions or games carrying residual fatigue.

Timing and even daily doses of proteins may have a potential role in modulating muscle protein synthesis. Therefore, authors suggest that breakfast, mid-morning, afternoon, and bedtime snacks are key time points to consume protein for this specific population in accordance with training sessions, training load and individual training goals.

Want to learn more?
Then check these out...

James's Comments

"Despite the study's practical application at an elite level, with players using a study design of two games a week scenario, the study is reflective of only six players from one elite team of the English Premier League. As a result, this may not be representative of the nutritional patterns of other teams and applicable to players of lower levels.

Moreover, as similar to all dietary intake studies, there is potential variability and under-reporting effects of self-reporting information. However, it's clear to see the authors were aware of this and, as such, they used three different dietary assessment methods to enhance the reliability of habitual eating patterns in the professional football players. The readers may also consider that dietary behaviours are likely to be influenced by the coaching philosophy and catering staff, and therefore can differ by club culture, as reported by the authors.

Finally, this manuscript provides strong evidence of just how important it is for nutritionists and conditioning/fitness coaches within professional football to marry together periods of intense training or gym work with increased energy intake for players and vice versa to maximise adaptation and/or performance/recovery."

[Abstract]

Can beetroot juice improve moderate-intensity exercise performance?

OBJECTIVE
Research into beetroot is a growing area with its known benefits to not only health, but now potentially performance. Dietary nitrate supplementation, typically from beetroot juice, has been shown to reduce the oxygen cost of low-intensity exercise and to increase the time-to-exhaustion during high-intensity continuous and intermittent exercise.

Therefore, researchers from the University of Exeter sought to determine whether ingestion of nitrate-rich beetroot juice (BR) before and during prolonged moderate-intensity exercise would: a) maintain an elevated plasma nitrite concentration (NO_2^-); b) attenuate the expected progressive increase in oxygen consumption (VO_2) over time; and c) improve performance in a time-trial compared to a placebo (PL) group and a group of subjects who only ingestion BR before the exercise.

WHAT THEY DID
12 recreationally active males in their early twenties volunteered for the study. In a double-blind, randomised, crossover study design, subjects were assigned to one of three conditions: BRBR, BRPL, and PLPL (ingestion of BR both before and during exercise, ingestion of BR before exercise and PL during exercise, ingestion of PL before and during exercise, respectively.) Subjects supplemented their allocated 70ml beverage (BR or PL) twice daily for two days and on the experimental day supplemented twice in the morning (2.5hrs prior to exercise) and once 1hr into the 2hr exercise period.

WHAT THEY FOUND
After 2hrs of moderate exercise, plasma NO_2^- was significantly higher in BRBR compared to both BRPL and PLPL. VO_2 did not differ between conditions until after 90mins of exercise at which point it was lower in BRBR compared to BRPL and PLPL. Time-trial performance did not significantly differ among the three conditions. Researchers also measured muscle glycogen decline over the exercise bout and this was significantly attenuated in BRBR (approximately 28% decline) compared to BRPL and PLPL (both around 44% decline).

Practical Takeaways

In terms of physical performance, the ingestion of beetroot juice had no significant effect in this particular piece of research. However, there are findings in this study that should not be ignored. The attenuation of VO_2 increase and muscle glycogen decrease as a result of supplementation were significant and, had the exercise duration been longer, may have had a significant effect on time-trial performance. Having more glycogen available in the muscles as exercise duration progresses is undoubtedly a positive and should be considered for athletes undertaking moderate intensity exercise over long durations (marathons, cycle events etc.). This research also demonstrates how supplementation during exercise can be implemented to maintain concentrations of the given supplement throughout and prevent depletion. A quick internet search reveals that beetroot juice is readily available and cheap compared to other ergogenic aids.

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James's Comments

"Research into beetroot juice and its positive effects on exercise and physiological variables is abundant and detailed. That being said, this study is one of few investigating its effects on moderate- rather than high-intensity exercise, and to my knowledge, the only one to experiment with supplementation of the beetroot juice during the exercise protocol. The study design is excellent and things such as diet were controlled to minimise the ingestion of other food sources of nitrate, the researchers even asked the subjects to not use certain mouthwashes as this can affect how nitrate is broken down in the oral cavity. The pattern of supplementation used in the study is relevant and valid as it reflects the pattern likely used by athletes in the days preceding a match or competition."

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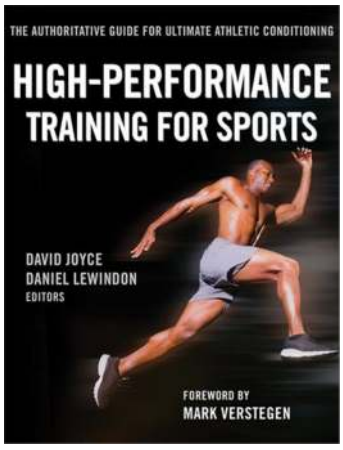

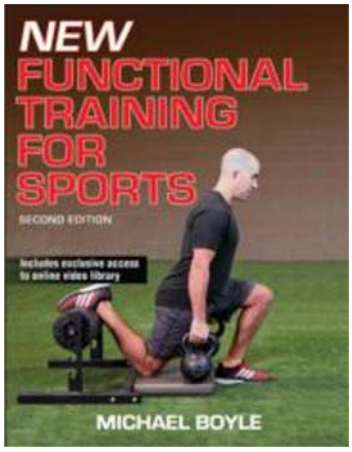

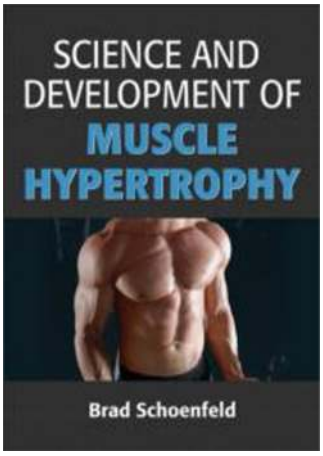

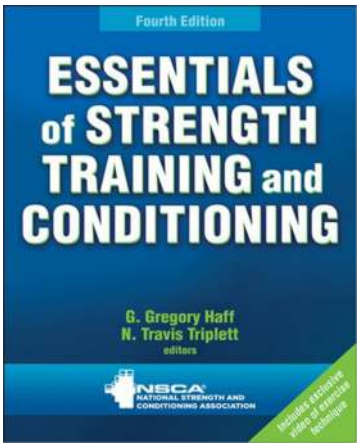

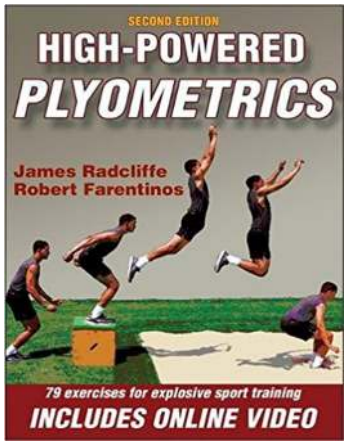

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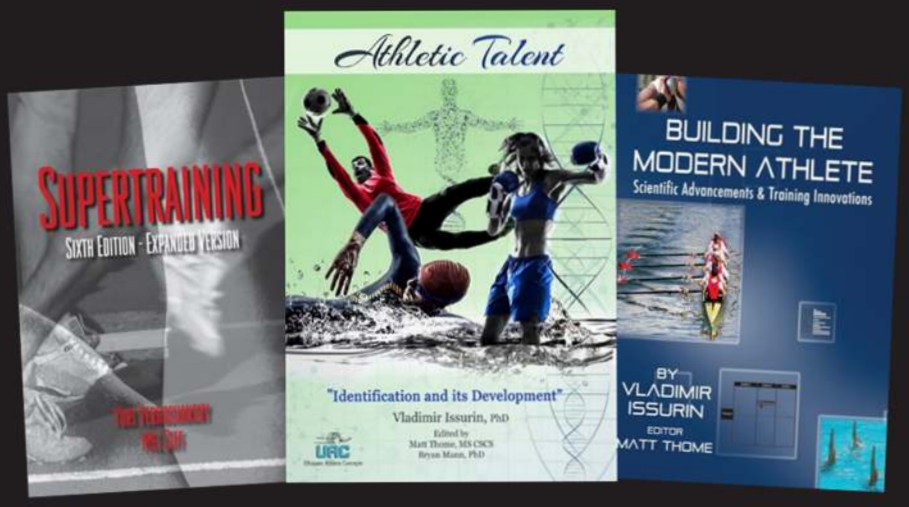

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Warm Regards
Science for Sport