June 2019 | Issue #32

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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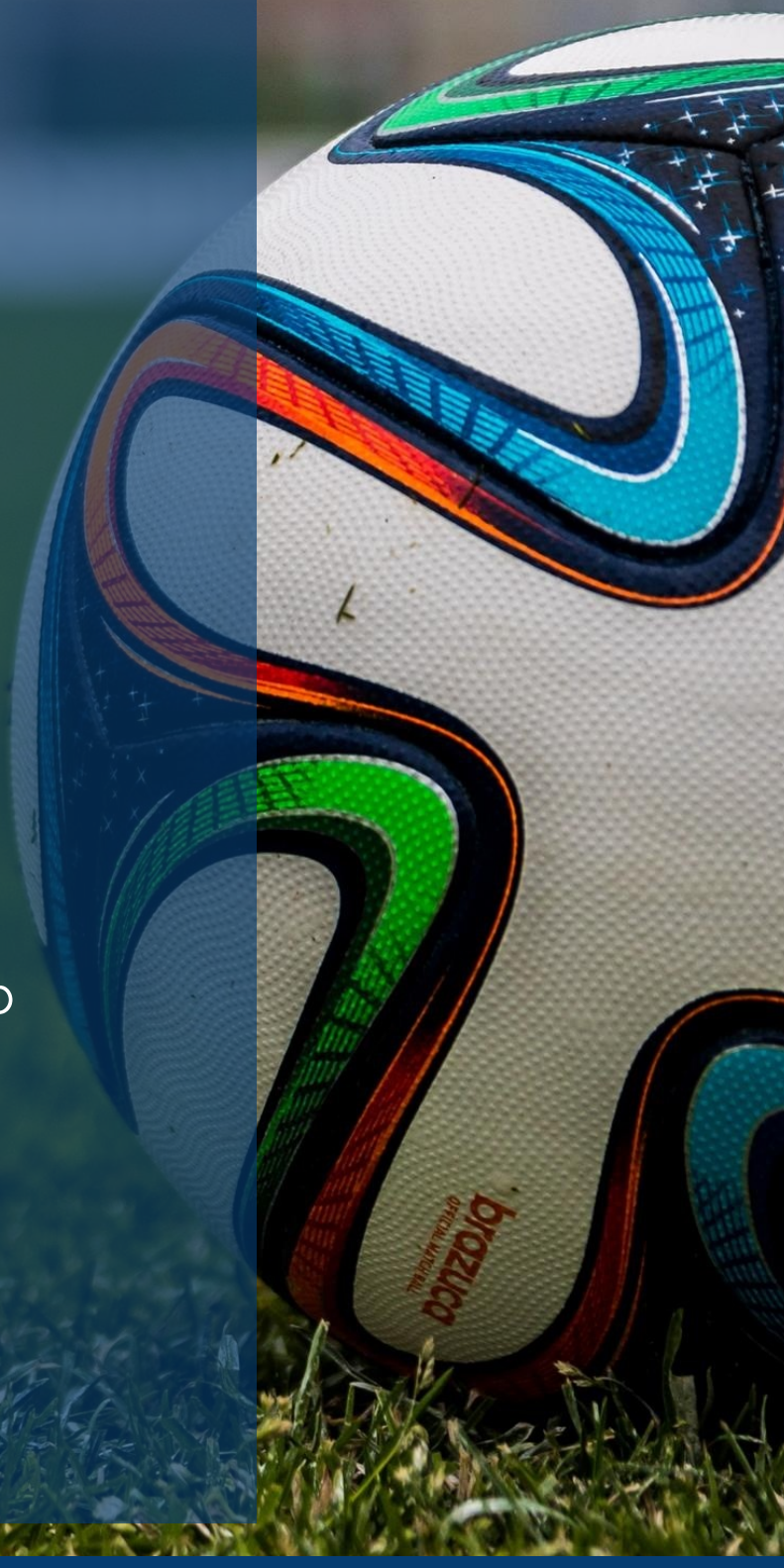

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Research Reviewers

Dr. Will Vickery
PhD

Chief Editor

Will is a former 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.

Dr. Francisco Tavares
PhD CSCS ASCA L2

Fatigue & Recovery

Francisco is the performance coordinator for Sporting Lisbon and has previously worked as a S&C coach in elite ruby with the Chiefs Super Rugby franchise and the PRO14 team, Glasgow Warriors. He holds a PhD from Waikato University and is a published author.

Adam Nichol
PhD Candidate

The Science of Coaching

Adam is an Associate Lecturer/PhD Researcher at Northumbria University: Newcastle upon Tyne. His research focuses on how athletes receive, interpret, and are influenced by coaching practice. He is an experienced coach, operating within representative youth level cricket and with soccer referees. Adam also has experience in shaping national sport policy and delivering research-informed consultancy activity.

Tom Green
MSc UKAD Advisor

Youth Development

Tom is the Head of Athletic Development at St Peters RC High School. He holds a Masters in S&C and has previously worked with West Bromwich Albion FC, Gloucester Rugby club, and Great Britain Equine. Tom is our youth research reviewer at Science for Sport.

James de Lacey
MSc

Strength & Conditioning

James is currently the Head Strength & Conditioning Coach for the Romanian Rugby Union. He has previously worked in America's professional rugby competition Major League Rugby with Austin Elite and 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)

Cody Roberts
MSE

Technology & Monitoring

Cody is a strength and conditioning coach and adjunct lecturer at the University of Iowa. He has an MSE in Exercise Science from the University of Kansas.

Dr. Nicole Surdyka
DPT, CAFS, CSCS

Injury Prevention & Rehab

Nicole is a Physical Therapist and Certified Strength and Conditioning Specialist who runs her own concierge style rehabilitation and performance practice in Los Angeles with her husband, Marc. She is passionate about keeping athletes healthy and performing optimally.

Audio
REVIEW

Nutrition in Rugby League

A recap on what we know and hope to find out from future research.
with James Morehen

WHAT WE DICUSS

In this episode of the "Audio Review", James discusses nutrition and associating factors within rugby league.

In this episode, you will learn:

- Body composition of rugby league players.
- Growing functional muscle mass within rugby league players.
- Energy intake and energy expenditure of rugby league players.
- Muscle damage and inflammation following a rugby league match.
- Case study: professional boxer.

Episode length = 41 min

A bit about **James**

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).

Listen Now

The Science of COACHING

Developing performance and tactical decision-making

[Abstract]

Which coaching methods are most effective to develop sport-specific performance and decision-making for attackers?

INTRODUCTION

Athletes in team-sport activities are often required to cope with complex, rapid, and unpredictable conditions (e.g. location of defenders, speed and angle of passes, positioning of team mates) (see **HERE**). As such, it is important for coaches to consider the most effective methods which can be used to support the development of their athletes to perform well and make effective decisions within match environments. Two main schools of thought have emerged in this area:

1) Traditional 'linear' practice, which involves lots of repeated drills (e.g. passing a ball between a partner and honing technique) and/or demonstrations of practice delivered by the coach with instruction; or

2) Non-linear approaches which encourage athletes to practice in conditions that more closely match what they will face in match-play (e.g. two attackers taking on two defenders aiming to score into a goal) and make their own decisions.

Based within a professional junior football club environment, this study aimed to test the effectiveness of the two approaches to develop performance and decision-making.

WHAT THEY FOUND

Twenty-two youth football players (mean age = 16 years) from a professional academy were split into two groups. One group completed a block of 'linear' training (one 60 min training session, twice per week for four weeks), followed by a block of 'non-linear' training (same number and duration of sessions). The second group started by completing the block of 'non-linear' training and then moved on to the block of 'linear' training.

The researchers found that the non-linear training programme had significantly improved athletes 1v1 performance (where a player is able to maintain possession, beat a defender, and shoot at goal) and decision making when compared to the linear training programme. No meaningful differences were found between the training groups for shooting performance.

WHAT THIS MEANS

Non-linear training sessions provide athletes with an opportunity to process information which is meaningful and relevant to in-game match conditions (e.g. location and number of defenders, space to attack). The authors suggest that non-linear approaches have the advantage over more linear training formats for developing decision-making and performance as an attacker. This is because athletes are able to work out responses based upon the situation presented.

While linear practices can play an important role in developing technique, they often fail to account for how, when, and why the technique can then be applied under changeable pressure match situations. A blend of both practice types may, therefore, be beneficial to develop technique in specific skills and also the application of such skills within a match environment.

Practical Takeaways

Coaches wishing to develop attacking performance and decision-making skills in their athletes could consider the merits of using a non-linear approach to learning. For example, coaches of team sports could consider making training environments, small-sided games or conditioned games, as relevant as possible to what their athletes are likely to encounter in a game. This could involve changing the number of defenders/attackers, making the pitch size smaller to develop decision making under pressure, or using live defenders instead of cones so that athletes are able to respond to the actions of their opponent.

Good coaches will also allow athletes to make their own decisions in these conditions, but understand when support (e.g. feedback or questions) may need to be provided. Importantly, coaches could look to utilise a blend of linear and non-linear approaches to develop technique and the application of technique under specific game circumstances.

Adam Nichol

Adam is an Associate Lecturer/PhD Researcher at Northumbria University: Newcastle upon Tyne.

Strength & Conditioning

This month's top research in strength & conditioning.

STAYING COOL TO REDUCE FATIGUE DURING RUGBY SEVENS

Taylor, et al. (2019) International Journal of Sports Physiology and Performance.

DETRAINING AND STRENGTH: WE CAN RETAIN STRENGTH LONGER THAN YOU THINK

Psilander, et al. (2019) Journal of Applied Physiology.

WHAT'S BETTER FOR IMPROVING STRENGTH AND POWER, CLUSTER SETS OR TRADITIONAL SETS?

Davies, et al. (2019) Journal of Strength and Conditioning Research.

[Abstract]

Staying cool to reduce fatigue during Rugby Sevens

OBJECTIVE

Large increases in core temperature (Tc) during competition may limit physical performance. In Rugby Sevens, multiple warm-ups are needed throughout a day for multiple matches, and as such, Tc may increase in excess of what is desirable (>39˚C) for competing.

The aim of this study was to use a cooling vest (see **HERE**) within elite Rugby Sevens players during the match day warm-up to see how it may influence selected performance, physical, and psychological variables.

WHAT THEY DID

Twelve elite, male Rugby Sevens performed their standardised 30 min match day warm-up, which was performed on two occasions prior to training sessions in near identical environmental conditions (23-27˚C). Two conditions were used, either wearing a cooling vest (VEST) or without a vest (CON) before and during the warm-up. The VEST group wore the cooling vest from 7:00 am and through warm-up (8:10 – 8:40 am) for a total duration of 100 min. The vest was worn under the jersey against the skin. Players completed the warm-up using both conditions, only this was in a different order: Vest then CON or CON then VEST.

Countermovement jump (CMJ) was assessed before and after warm-ups, whereas, GPS and heart rate was collected during warm-ups. Tc was recorded throughout the experimental period, whilst perceptual measures of thermal sensation (TS), thermal comfort (TC), and RPE were also recorded following the warm-up.

WHAT THEY FOUND

The key findings of the study included:

- ⇒ A most likely lower change in Tc and peak Tc occurred before the warm-up compared to after the warm-up when wearing the VEST compared to the CON.
- ⇒ Both conditions had trivial differences in Tc during the pre-warm-up period.
- ⇒ There was a most likely decrease in TS and TC in VEST compared to CON before vs. after the warm-up.
- ⇒ Players in the VEST group had a most likely lower RPE following the warm-up compared to CON.
- ⇒ Both conditions demonstrated a likely increase in CMJ height from pre- to post warm-up with a trivial effect between VEST and CON.
- ⇒ Only trivial differences were seen regardingthe effect of a VEST on all GPS measures.

» Practical Takeaways

Wearing a cooling vest prior to and during a Rugby Sevens warm-up can elicit favourable changes in physiological and perceptual measures without compromising physical performance. These data suggests that practitioners could use this intervention with their athletes to limit the rise in Tc during warm-up, potentially extending the time taken to reach fatigue during match outputs. Previously, it has been reported that a rise in Tc to 39˚C has been associated with reductions in repeated sprint based performance and capacity.

The athletes in this study reported that wearing a vest was not uncomfortable nor did it get in the way of the warm-up drills. Practically, a cooling vest may not have to be worn 70 min before the warm-up as no pre-cooling effect was seen at the commencement of warm-up. However, reductions in TS was found. In the Rugby Sevens setting, a cooling vest could potentially be worn directly prior to the first warm-up to reduce the rise in Tc while subsequent warm-ups could have a cooling vest worn after the previous match recovery to reduce the TS as the heat increases throughout the day.

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

James' **Comments**

"The cooling vest is one method to attenuate the rise in Tc. If you have the resources, ice slushies can be ingested 20-30 min prior to warm-up to create a pre-cooling effect and lower Tc before the commencement of warm-up, essentially having a similar effect in decreasing peak Tc.

Other low-cost methods can also be used such as ice towels and beanies. However, whether these provide a change in Tc is unknown and may instead only provide a positive change to perceptual measures of TS and TC."

[Abstract]

Detraining and strength: we can retain strength longer than you think

OBJECTIVE

It is generally believed that previous strength training facilitates reacquisition of muscle mass even after long periods of inactivity. However, there is little direct evidence for such a memory effect of strength training in humans, although, some studies have shown muscle strength and to some degree, hypertrophy is resilient during detraining and faster gain during retraining periods (see **HERE**).

Therefore, the present study determined whether a previously strength trained leg (mem-leg) would respond differently to a previously untrained contralateral leg (con-leg) during a 5 week training protocol.

WHAT THEY DID

Nineteen healthy, inactive subjects participated in a 35 week training program which included:

⇒ A strength training period for 10 weeks (T1),

⇒ A 20 week detraining period (DT), followed by,

⇒ A 5 week strength training period (T2).

During T1, only unilateral exercise was performed (leg press and leg extension 3x/week) for the mem-leg group. During weeks 4 and 8, blood flow restriction was used to maximise the hypertrophic response. During T2, both legs were trained one at a time in alternating sets. Muscle thickness (MT), and 1 RM unilateral leg extension were measured before and after each period. Muscle biopsies were obtained from the mem-leg pre before and after T1, and from both legs before and after T2.

WHAT THEY FOUND

The main results from this study were:

⇒ Maximal strength (1 RM) improved 20% in the mem-leg after T1 (40 ± 12 to 48 ± 14kg) and 60% of this improvement was still present after the DT period (45 ± 14kg).

⇒ There was a trend for a 5% strength improvement in the con-leg after T1. After T2, both the mem-leg and con-leg improved to the same extent.

⇒ MT increased after T1 in the mem-leg (20.4 ± 3.5 to 22.4 ± 3.7mm), whereas, the con-leg was unaffected.

⇒ The increase in the mem-leg was lost during DT, so both legs had similar MT at the start of T2. After T2, both legs showed similar increase in MT.

⇒ The magnitude of increase (~10%) was similar to that of T1, even though T2 was half as long.

⇒ Neither method showed any significant effect of training or detraining on the number of myonuclei.

⇒ Cross sectional area (CSA) of mem-leg increased ~17% after T1. Both legs remained unchanged during DT and T2.

» Practical Takeaways

"Muscle memory" is potentially unrelated to muscle cell properties and instead should be referred to as "motor learning", as there was a clear "motor learning" effect in this study at the onset of T2 (mem-leg being 10% stronger than con-leg). However, this had no impact on strength gain during the T2 period as both legs responded similarly.

Previous studies using mice, have shown a muscle memory effect associated with the number of myonuclei which was not seen in the present study. While subjects in this study were untrained, there may be potential implications for practitioners when it comes to training and detraining.

⇒ If injured, train the other side of the body for the crossover effect,

⇒ Strength is retained for a longer period of time than we may think.

For example, near the end of a season or during a standalone tournament, traditional maximal strength training could be removed entirely in favour of maximal power/velocity work to keep athletes fresher and allow you to address more "specific" components of your sport. If doing nothing potentially retains 60% of the strength attained during a training period, perhaps the velocity/power work will retain much more strength. A power session absent of traditional maximal strength training may look like:

A1) Extensive Skipping, Rolling Hops, Ankle Pops

B1) Squat Jump @ 30-40% BW or @Optimal Load 4x2+2+2

C1) Clean High Pull @ 60-70% 1 RM 3x3

C2) Lateral Skater Rebound Jumps 3x3/side

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

James' Comments

"The results of this study could be interpreted in a few ways:

⇒ Taking extended time off may not be such a bad thing when it comes to strength.

⇒ Minimal training may be needed to retain the majority of strength attained.

⇒ Time may be better spent on other components of fitness during extended breaks.

Potentially planning a strength emphasis block before an extended break may give you more programming freedom where athletes may not have access to a gym. Knowing that most of the strength will be retained, you are free to focus on other areas of physical development which are likely going to help further retention of strength, such as speed and power."

[Abstract]

What's better for improving strength and power, cluster sets or traditional sets?

OBJECTIVE

Both fast movement velocities and the intention of lifting explosively are both critical stimuli in optimising muscular power output. During traditional resistance training, fatigue will accumulate throughout a set, gradually reducing the velocity and subsequently power output.
Therefore, manipulating training variables to produce higher movement velocities may be advantageous to power development.

The aim of this study was to compare the effects of cluster- and traditional-set structures on bench press movement velocity and muscular power output after high-load resistance training.

WHAT THEY DID

Twenty one resistance trained subjects were randomised into either a cluster set (CLUS) or traditional set (TRAD) group. The intervention consisted of 8 weeks upper/lower body split with both groups following identical programs apart from the bench press. The CLUS group performed 4x5 @ 85% 1 RM with 30 sec rest between reps and 3 min rest between sets. The TRAD group performed the same prescription without inter- rep rest and 5 min inter- set rest. 1 RM bench press and a load/velocity profile was measured before and after the intervention. Barbell velocity was tracked for each bench press session.

WHAT THEY FOUND

1 RM Strength

⇒ Increased by 9.90 ± 3.60% in CLUS and 11.06 ± 7.65% in TRAD.

Peak Velocity and Power

⇒ No significant difference between groups or group by time interactions for any relative load.

⇒ Significant decreases were found for peak velocity at 55% and 65% 1 RM.

Mean Velocity and Power

⇒ No significant difference between groups or group by time interactions for any relative load.

⇒ Significant decreases found for mean velocity at 55% and 65% 1 RM.

Barbell Velocity during Sets

⇒ CLUS group showed superior mean velocity maintenance in sets 1, 2, and 4 compared to TRAD

⇒ CLUS group superior in maintaining peak velocity in

» Practical Takeaways

The results of this study suggest that set structure does not seem to affect changes in movement velocity and muscular power after high-load resistance training, if repetitions are performed with maximum concentric velocity. This may have been due to high loads being used in both groups leading to similar neuromuscular responses.

These findings are similar to the cluster set paper I previously reviewed in Issue #27 of the Performance Digest, which looked at CLUS vs. TRAD training using optimal power load in the squat, where mean velocity and power were similar between groups during the intervention.

For the practitioner, this may provide a periodisation strategy for your sporting season. For example, during the pre-season, traditional set/rep schemes can be used to induce some fatigue while improving maximal strength and/or power output. As the season nears or during in-season, cluster sets can be utilised for variety and, to potentially mitigate fatigue. If we were to take the set/rep scheme from this study, an example 4-week cycle with week 4 falling on the first week of the season could look like this:

Week 1: 4x5 @ 75% 1 RM

Week 2: 4x5 @ 80% 1 RM

Week 3: 4x5 @ 85% 1 RM

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

James' Comments

"What would've been a nice addition to this study is a subjective measure of fatigue after each bench press session. Due to the maintenance of velocity in the CLUS group, one could assume they would give a lower fatigue score than the TRAD group which comes back to the practical application above where reducing fatigue in dense training/match situations could be key when prescribing high loads.

Based on the study reviewed in Issue #27 of the Performance Digest, the same idea can be applied to loads prescribed as optimal peak power. For maximising velocity output, lighter loads are likely better as this study showed that higher prescribed 1 RMs tend to decrease velocity over time at all relative loads."

Technology & Monitoring

This month's top research on technology and monitoring.

CAN A STATIONARY SPRINT TEST BE USED TO ASSESS ANAEROBIC FITNESS?
Limmer, M. et al. (2019) Journal of Strength and Conditioning Research.

A MULTI-DIMENSIONAL APPROACH TO TRAINING LOAD AND PERFORMANCE MONITORING
Clemente, F. M. et al. (2019) The Frontiers in Physiology.

USING LOSS IN REPETITION VELOCITY TO PRESCRIBE RESISTANCE TRAINING
Rodríguez-Rosell, D. et al. (2019) Journal of Strength and Conditioning Research.

[Abstract]

Can a stationary sprint test be used to assess anaerobic fitness?

OBJECTIVE

Assessing anaerobic fitness is challenging because of the limits of factors such as facility space and access to resources. Traditionally, anaerobic power measurements such as the Wingate Anaerobic Test (WAnT) is considered the "gold standard".

Completing the WAnT though is subject to these limitations of anaerobic power testing and, as such, a portable tethered sprint running (PTSR) may be a reliable alternative. The aim of this study was to evaluate the test-retest reliability of the PTSR test, as well as, the relationship with WAnT performance and physiological response.

WHAT THEY DID

Twelve physically active (6 men, 6 women) individuals performed a 60-sec WAnT and two PTSR trials on three separate occasions. The PTSR test provided force data using a load cell combined with an inextensible rope, ï¬xed to a pillar as the subject sprinted in place against the system. Peak power (PP), mean power (MP), and fatigue index (FI) from the WAnT was compared with the peak force (PF), mean force (MF), and FI in the PTSR test. In addition to this, heart rate (HR) and blood lactate concentration ([BLa]max) measurements were recorded to compare the physiological response of athletes to each test.

WHAT THEY FOUND

Test-retest reliability between PTSR trials:

⇒ MF, PF, and HR showed high reliability as parameters for anaerobic performance.

⇒ FI and maximum post-exercise lactate concentration ([BLa]max) have a higher intra-individual variation.

Validity between the PTSR test and the WAnT:

⇒ Significant correlations in MF and PF compared to the MP and PP.

Physiological response,

⇒ A strong correlation was seen for HR and [BLa]max between the two tests, however, the PTSR test yielded a smaller and earlier La response.

⇒ No correlation was found between the timepoints for highest post-exercise lactate concentration (TLa)

Practical Takeaways

The PTSR test aims to provide a more specific running-based alternative but tethering an athlete around the waist to a pole has shown to alter the sprinting pattern (e.g. variance in velocity, flight time, stride length, and contact time). Although the PTSR test may mimic a sprinting locomotive action, it is still a unique action and potentially non-transferable to on-ï¬eld running.

Regardless of this limitation, if testing instructions and procedures are implemented properly the PTSR test is a valid and reliable measurement for assessing anaerobic power as it relates to the procedures outlined and performance potential. Along with the benefits of the minimal space and equipment required when using the PTSR, it provides an efficient and practical alternative to assessments that typically require a cycle ergometer or non-motorized treadmill in a laboratory setting.

Lastly, based on the lactate response and fatigue index discrepancy it would suggest that the 60 sec bout was not truly a maximal eï¬€ort and that based on unfamiliarity with the equipment used, the subject could have unconsciously governed or self-preserved their pacing strategy. This suggests that familiarity with the equipment is an important factor with providing accurate result relative to performance capabilities.

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

Cody's Comments

"The setup of attaching an inextensible rope to a pole or pillar and further combining this with a load cell provides reliable, objective measures for force outputs and physiological measures in horizontal-based sprinting actions. This serves as a potential testing and training tool for coaches who must deal with limited space and resources.

As a training tool, there is potential for creating awareness, as well as, providing accountability through the load cell force data within the athlete as to what it means to effectively accelerate and push force into the ground while maintaining an upright forward-leaning posture during a single-leg stance sprinting action.

The efficacy and transferability to improving performance still needs to be investigated. That said, any monitoring tool that can seamlessly be incorporated into training is going to have greater effectiveness as the athlete becomes accustomed to the equipment and the feedback is more consistent throughout the weeks and months of training."

[Abstract]

A multi-dimensional approach to training load and performance monitoring

OBJECTIVE

Collecting and tracking meaningful information regarding an individual's response to training is important when making actionable decisions when considering load prescription.

In this study, the associations between accumulated external load variables and changes in body composition, isokinetic strength, and aerobic capacity over a 10-week pre-season and in-season period were analysed.

WHAT THEY DID

Before and after a 10-week early competition season period, the body composition (via bioelectrical impedance), VO2max (via an incremental treadmill test), and isokinetic strength of quadriceps (QUADS) and hamstrings (HAMS) (via Biodex isokinetic dynamometer) of twenty-three professional soccer players was collected.

Each player wore geolocation (GPS) trackers which were used to collect data on training duration, total distance covered, sprinting distance above 20 $km.h^{-1}$, and acceleration load accumulated from the accelerometer within the GPS device across 47 training sessions and 12 matches.

This training load data was compared with the data concerning body composition and fitness variables.

WHAT THEY FOUND

The primary findings of this study include:

⇒ Possible increases in fat mass (FM) with decreases in lean mass (LM).

⇒ Changes in FM and LM were negatively associated with and strongly correlated with accumulated sprint distance.

⇒ Linkage between activity and cardiovascular adaptation, as VO2max showed a large increase over the 10-week period, correlating highest with the acceleration load.

⇒ Improvements in isokinetic strength variables were observed, primarily in peak torque flexion for HAMS (PTLP, PTRP) and QUADS/HAMS ratios for right and left legs.

⇒ Increases in strength showed correlation between accumulated total distance, sprinting distance, and acceleration sums.

» **Practical** Takeaways

Appropriately dosing and monitoring training loads can have an advantageous impact on performance in the latter part of a competitive season. The results highlight the importance of quality over quantity, suggesting higher intensity actions as opposed to longer duration sessions being the necessary stimulus to beneficial adaptation.

Regarding the dose of load and response of the individual, it is important to ensure that exposure to intensive training (sprinting above 20km.h-1 and sum of acceleration) and management of load over time allows for an increase in mechanical capacity. Identifying variables that can be utilised for measuring and monitoring for readiness during the season is beneficial to improving the confidence in preparation and loads experienced by athletes.

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

Cody's **Comments**

"This study focused on measuring external loads experienced during practice and competition. Although, this is one of many variables that impact player readiness and preparedness, an internal measure would be valuable to provide deeper insight to the dose -response relationship. In addition to this, there was limited auxiliary training that occurred off the pitch.

However, it appears that loads were appropriately progressed through the pre-season training in preparation for competition. The loads experienced in pre-season were generally greater than what was experienced in-season. Lack of injury and improved performance supports the management of load and recovery. The surprising body composition results where that FM increased and LM decreased, yet performance improved. This possibly showcases the limited accuracy of bioelectrical impedance as a measurement device. Regardless, body composition is not a measure of performance and even though the prediction can be associated with performance improvements, measuring multiple variables can provide a clearer picture regarding the response to training and readiness to perform."

[Abstract]

Using loss in repetition velocity to prescribe resistance training

OBJECTIVE

Barbell velocity provides an objective measure of neuromuscular readiness and can be used to quantify training load for resistance training.

The aim of this study was to analyse the relationship between mean propulsive velocity (MPV) and the maximum number of repetitions (MNR) to failure with a range of submaximal loads in the bench press (BP) and back squat (SQ). Further to this, a secondary aim was to quantify the acute fatigue with a velocity-guided pre- and post-MNR test load, specifically examining velocity loss.

WHAT THEY DID

Twenty men performed BP and SQ 1 RM testing with a Smith machine and load-velocity profiling with a linear velocity transducer. After this, each participant then completed eight additional sessions in which one exercise at a submaximal load (50, 60, 70, and 80% 1 RM) was taken to failure. A load that moved a MPV of ~1.00 $m.s^{-1}$ (V1 $m.s^{-1}$) was used for 3 repetitions immediately before and then again after the MNR test, to determine the acute fatigue experienced based on the velocity loss before and after the test.

WHAT THEY FOUND

The results of the study include:

⇒ Repetitions to failure and MPV loss are specific to the exercise performed (BP or SQ).

⇒ The BP produced greater repetitions to failure and magnitude of MPV across the MNR set.

⇒ Acute fatigue after an MNR set was related to the percentage of MPV loss experienced.

⇒ Strong relationship between relative MPV loss and the percentage of repetitions completed across the MNR set with all loads in both BP and SQ.

⇒ The percentage of MPV loss seen in the V1 $m.s^{-1}$ before and after exercise is independent of the number of repetitions completed.

» **Practical** Takeaways

Considering the relationships found between the percentage of velocity loss during a set and the percentage of repetitions completed relative to failure, S&C professionals can gain insight into monitoring and prescribing the load of resistance training. Percentage-based training or prescribing a specific number of repetitions does not respect the individuality of exercises and athletes. Coaches can prescribe training based on the relative loss in repetition velocity from the fastest to the slowest repetition of each set to appropriately and consistently monitor training volume. This approach also allows for measurement of effort level based on repetitions left in reserve and creates potentially standardised training stress across a group of athletes.

The results of this study aim to limit the variability of stress endured by prescribing sets based upon a limit of velocity loss reached in a set (e.g. 15, 30, 40%) compared to a predetermined number of repetitions. However, practitioners must consider the variability between exercises as it relates to each specific individual and the number of repetitions that can be completed at various intensities. By considering these differences and encouraging consistency across the implementation of velocity loss-based training allows for a productive monitoring technique and proper regulation of training based on readiness and performance.

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

Cody's **Comments**

"Velocity-based training (VBT) provides valuable feedback and allows for a more precise training target, as it holds the athlete accountable to their effort. As with all training, VBT has its time and place in working towards the optimisation of training. Proper loading in both timing and volume is the goal of any S&C coach. Based on the reliability of velocity measurements within exercises, static barbell exercises such as the BP and SQ utilised in this study, as well as, the deadlift or overhead press would likely be the most valid and reliable options.

Establishing proper and consistent technique is the first step in providing accurate measurements, and once a level of mastery is established by the athlete, velocity-loss can be a great way to both encourage and control effort level in a team setting."

Fatigue & Recovery

This month's top research on fatigue and recovery.

CAN THERMONEUTRAL WATER IMMERSION BE USED AS A RECOVERY MODALITY?

Ahokas, E. K. et al. (2019) Journal of Strength and Conditioning Research.

WHAT IS THE IMPACT OF FOAM ROLLING ON RANGE OF MOTION AND SPRINT PERFORMANCE?

Wiewelhove, T. et al. (2019) Frontiers in Physiology.

INDIVIDUALISED SLEEP HYGIENE MAY IMPROVE THE SLEEP QUALITY OF ELITE ATHLETES

Driller, M. W. et al. (2019) Journal of Sports Sciences.

[Abstract]

Can thermoneutral water immersion be used as a recovery modality?

OBJECTIVE

A variety of hydrotherapies are widely implemented for the purpose of recovery following exercise in the performance sport environment. Although literature comparing these different protocols is scarce, and therefore, limits the understanding of which type of hydrotherapy is most effective.

This study compared the effects of cold-water immersion (CWI), thermoneutral water immersion (TWI), and contrast water therapy (CWT) on physical and mental recovery.

WHAT THEY DID

Nine physically active men were randomly allocated to a different recovery method following an intense exercise protocol (45 min including long jumps, 60 m and 200 m runs):

⇒ CWT (10 min in total, alternating between 1 min at 10°C and 1 min at 38°C),

⇒ CWI (10 min at 10°C),

⇒ TWI (10 min at 24°C), or

⇒ Control (CON; 10 min on an empty bath).

The measures obtained were:

⇒ Hormones and biochemical markers of muscle damage at baseline, 5-, 40-, and 60 min after exercise, and 24-, 48-, and 96 hr after recovery.

⇒ Perceptual (soreness and feeling of relaxation), as well as, performance (30-m sprint, isometric leg press and countermovement jump) at baseline and 24-, 48-, and 96 hr after recovery.

WHAT THEY FOUND

The main findings of this study were:

⇒ CWI and CWT improve the sensation of relaxation in comparison to CON and TWI.

⇒ TWI improves speed and power capabilities in comparison to CWT, CWI, and CON.

⇒ No meaningful differences between recovery modalities were observed for cortisol, testosterone, catecholamines (i.e. epinephrine and norepinephrine), creatine kinase, and perceived muscle soreness.

⇒ Muscle soreness was significantly higher 60 min after exercise in the CON.

⇒ CMJ and 30-m time were significantly worst 24 h after exercise in the CON.

⇒ 30-m time was significantly worst 24- and 48 h after exercise in CWT.

» Practical Takeaways

The main practical takeaways from this study are:

⇒ CWI and CWT acutely enhance the feeling of relaxation.

⇒ CWI, CWT, and TWI may be more beneficial compared to CON for muscle soreness.

⇒ CWI and TWI may be beneficial compared to CON and CWT in speed and power actions.

⇒ The findings of this study demonstrate that various water therapy methods only provide small-to-little benefits, enhancing recovery between training sessions.

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

Francisco's **Comments**

"This is a very controversial topic, with previous research demonstrating the superiority of CWI in comparison to TWI, CWT, and control. This study demonstrated that all the modalities, CWI was the only one that may lead to the feeling of relaxation, as well as, decrease muscle soreness, and improve speed and power actions.

I was surprised that the authors decided not to report any small or moderate effect sizes, as when designing training/recovery programs, small changes can still yield meaningful results for performance.

Interestingly, TWI demonstrated that it was beneficial at enhancing recovery, possibly due to the hydrostatic pression. Given that no harmful effects have been demonstrated from the use of TWI, and following the weekly recovery modalities planning that was presented on the #18 issue of the Performance Digest (April 2018), this recovery modality can be used early in the week to enhance recovery from training without compromising adaptations."

[Abstract]

What is the impact of foam rolling on range of motion and sprint performance?

OBJECTIVE

Foam rolling (FR) is widely implemented before exercise to improve an athlete's range of motion (ROM), and endurance, and neuromuscular performance. In addition to this, it is often used after exercise to enhance recovery. Nevertheless, results from research are inconclusive concerning the benefits of using FR before or after exercise.

This meta-analysis looked to determine the effects of FR when implemented before and after exercise.

WHAT THEY DID

Twenty-one studies published until December 2017 were obtained from a search conducted in PubMed, Google Scholar, PEDro, and Cochrane Library and included for analysis. Each of the studies were categorised as either the effects of foam roller massage (FR) before (i.e. part of the warmup; n=14) and after (i.e. as a recovery strategy; n=7).

Analysis of each of these studies included the impact of FR on performance of athlete's sprints, jumps, strength performance, flexibility, and the impact on muscle pain.

WHAT THEY FOUND

The main findings of this study were:

⇒ FR acutely improved ROM and sprint performance, but not jump or strength performance.
⇒ FR improved perceived muscle pain.
⇒ FR improved recovery of sprint (+3.1%) and strength (+3.9%) performance.
⇒ FR provided a greater effect in comparison to a roller massage (RM) when applied after exercise.

» **Practical** Takeaways

Although small, the effects of FR can be relevant to increase ROM and sprint performance, especially when used during warm-up to prepare for subsequent exercise.

Being the effects of FR were reported to be small, practitioners can ask the players to try implementing this technique as a preparation to training, or for recovery from training. If the athletes perceive FR as beneficial, they can add it to the toolbox. Although not discussed in this article, an example of a protocol that can be used is 2-3 sets of 30-45 sec per muscle area.

Given the limited research and understanding of the physiological mechanisms elicited by FR, athletes who do not perceive FR to be beneficial for their preparation or recovery should not be forced to use it. Furthermore, some care must be taken for some potential harmful effects of FR in performance (i.e. jump performance) and health due to compression of the structures (see **HERE** and **HERE**).

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

Francisco's **Comments**

"Literature investigating the effects of FR is limited. Although this meta-analysis is a step forward, the differences in the protocols of each study will likely influence the results. Personally, I'm a fan of creating opportunities in the training schedule for the athletes to use modalities/techniques that they perceive as useful for their performance or recovery.

A 10-20 min slot before the first session and another slot after the last session during a training session, may lead to benefits for future performance and recovery. During these sessions'players can be educated to use a variety of techniques beyond just FR, such as RM, trigger point balls, or stretching (static to dynamic before exercise and static after exercise).

For younger or less experienced athletes, when preparing for sessions, I normally create a list of target areas according to the muscles/ joints that will be used during the session allowing them to experience and report how they perceive the use of such techniques. Furthermore, when these opportunities exist before exercise, I like my athletes to progress to some general movements followed by specific (to the session) skills."

[Abstract]

Individualised sleep hygiene may improve the sleep quality of elite athletes

OBJECTIVE

Sleep is well accepted to be a key component of recovery and adaptation from training. Through sleep hygiene education, practitioners try to improve sleep within their athletes. Nevertheless, research investigating the effects that sleep hygiene interventions have on sleep quality and duration are limited.

The goal of this study was to assess changes in subjective and objective sleep quality markers in elite athletes after individualising sleep hygiene education.

WHAT THEY DID

Nine elite cricketers wore an actigraph during sleep for six weeks. This period of six weeks was split into two periods of three weeks, with a sleep hygiene education session included between the two periods. This session consisted of a 50-min group session on the importance of sleep and were asked to consider this information in the next three-week period. In addition to this, each player met with a sleep specialist for a 30-min, 1-on-1 session to discuss their individual results from the actigraph and questionnaires

Regarding the data collected during this 6-week period, after week three (PRE) and week six (POST), the athletes completed three questionnaires (Athlete Sleep Behaviour Questionnaire (ASBQ), Epworth Sleepiness Scale (ESS), and Pittsburgh Sleep Quality Index (PSQI)). The actigraph was also analysed for a number of sleep variables.

WHAT THEY FOUND

The main results of this study from the pre-education measures to the post-education measures were:

⇒ Sleep education resulted in significant improvements in the ESS and PSQI, but a small, non-significant change in ASBQ.

⇒ Sleep education significantly improved sleep efficiency, sleep latency, and sleep onset time. Furthermore, small non-significant improvements were observed for total sleep time, total time in bed, wake time, and wake variance.

» **Practical** Takeaways

The findings from this study support the use of sleep hygiene education to improve sleep quality and quantity amongst athletes.

Practitioners can focus the sleep hygiene education intervention in the five practical tips used in this study:

⇒ Maintaining a regular bed- and wake-time.

⇒ Ensuring a quiet, cool, and dark bedroom environment.

⇒ Avoidance of caffeine and other stimulants prior to sleep.

⇒ Avoidance of light-emitting technology devices in the hours prior to sleep.

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

Francisco's **Comments**

"This is a very interesting study highlighting, what for me, is a key factor for the success of an athlete –education around sleep that can lead to a positive training response. In this study, education was provided in a group session and in a 1-on-1 situation. The 40-min group education session focused on the importance of sleep for athletes (in relation to recovery from exercise, relationship with cognitive performance, mood, and health), sleep physiology, and sleep hygiene. The 30-min, 1-on-1 session focused on the individual issues observed essentially from the ASBQ (see Performance Digest Issue #20 for more information).

I have mentioned several times in previous issues of the Performance Digest on the importance that education plays in the athletic success. I can see this type of education strategy being implemented in most environments. This might include:

⇒ Schedule 2-3 group sessions throughout the training session on general sleep physiology.

⇒ Continually monitor sleep duration and quality (i.e. one question for each item).

⇒ Extend the analysis with a questionnaire for those that report sleep issues (e.g. ASBQ)."

Youth Development

This month's top research on youth development.

THE HAMSTRING AT LENGTH: THE "MORE VS. LESS" CONUNDRUM
Lacome, M. et al. (2019) International Journal of Sports Physiology and Performance.

SMALL-SIDED GAMES: THE SOLUTION FOR ENDURANCE TRAINING IN SOCCER?
Moran, J. et al. (2019) Sports Medicine.

TO MOVE OR NOT TO MOVE? EXPLORING ACTIVE VS. PASSIVE RECOVERY STRATEGIES IN CHILDREN
Baquet, G. et al. (2019) Pediatric Exercise Science.

[Abstract]

The hamstring at length: the "more vs. less" conundrum

OBJECTIVE

In the past 10 years, sprint distance (35%) and the number of sprints (85%) performed in a match have increased in football match-play, which places players at a high risk of injury to the posterior chain. Such injuries can be prevented, but unfortunately, few studies have investigated the child-adult differences to the hamstring muscle group to support programming.

The main aim of this study was to compare a low vs. high volume of hamstring programs in young elite soccer players.

WHAT THEY DID

Nineteen elite youth soccer players (17.2 ± 0.7 y) from an elite French academy were randomly assigned into two sub-groups. One group performed a low (32 repetitions) or a high (40 repetitions) eccentric training programme that consisted of a Nordic hamstring exercise (NHE) and stiff-legged deadlift (SLDL). Anthropometric values such as age, height, and body mass were collected.

In addition, a Nordbord was used to measure eccentric knee flexor strength (N). To monitor fascicle change (read more **HERE**), an ultrasound scanner was used to monitor adaptations to the biceps femoris long head (BFlh) and semimembranosus (SM) of the hamstring muscle complex.

WHAT THEY FOUND

This study found that a low-volume, 6 week eccentric-based programme resulted in moderate to large improvements in knee flexor strength (pre 325 ± 26 N, post 362 ± 46 N), and possible improvements in BFlh and SM fascicle length (+0.5 cm).

Secondly, the effects of the low vs. high volume programme were similar despite as many as four times the repetitions (PRE 326 ± 48, POST 361 ± 30).

Finally, after 6 weeks of training, the low volume training group did not result in further strength gains or fascicle length, suggesting that there may be a ceiling effect for adaptation.

» **Practical** Takeaways

The practical takeaways from this study are as follows:

⇒ The hamstring muscle complex plays a vital role in acceleration, deceleration, linear sprinting, and other sporting activities. Kieran O'Sullivan (refer to podcast below) suggests that strength, prevention, and rehabilitation are key to support performance.

⇒ Improving fascicle length is important and can be achieved by utilising the NHE (knee dominant) and SLDL (hip dominant) in training. More specifically, players with short hamstring muscles (<10.5cm) are 4.1 times more likely to develop a hamstring injury than those with longer fascicles.

⇒ With hamstring interventions, a period of familiarisation period of roughly 3 weeks to reduce subsequent injury risk.

⇒ Whilst these exercises may produce favourable changes in muscle architecture, it may reduce in-session intensity due to soreness or fatigue.

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

Tom's **Comments**

"This research was a great read that firmly cemented that eccentric training is both an effective method for strength development and improving fascicle length. In future research, I'd like to see eccentric exercises completed pre, mid, and post peak height velocity (PHV) to establish the minimal effective dose and understand an athletes ability to tolerate load at different biological stages. In addition, the age of these athletes (17.2 ± 0.7y), may not represent the most effective age to start loaded eccentric contractions at, where a broader age range could support the earlier inclusion of eccentric contractions, if suitable.

A follow-up study could look at SLDL vs. NHE vs. NHE and SLDL. From this, the reader could ascertain if certain movements were necessary, and if a certain exercise (i.e. SLDL) is needed/not needed at an earlier stage. In my personal experience, I would always start with low-level hamstring work (see video below) and progress when form could be maintained for 10-15 reps in a youth athlete. In addition, it is vital that children understand the relationship between eccentric training and muscle soreness prior to engaging in such exercise to avoid any complaints."

[Abstract]

Small-sided games: the solution for endurance training in soccer?

OBJECTIVE

Small-sided games (SSG) have been considered as a practical replacement for conventional endurance-based training in young soccer players. A games-based approach may support higher levels of motivation, participation, and effort in a given task.

The aim of this meta-analysis was to compare male youth soccer players' adaptations to SSG to conventional endurance training to support coaches who are working with youth.

WHAT THEY DID

This meta-analysis was conducted in May 2018, but considered research with no date restrictions. The searches performed used the following terms: "youth", "training", "small-sided games", "soccer", "football", "skill", and "endurance" in the search databases of Google Scholar, PubMed and Microsoft Academic.

Studies were eligible for review if they were:

⇒ Written in English, and;

⇒ If the interventions were carried out in male soccer players (aged <18 years).

In total, this search found 1079, which were refined by removing duplicates and irrelevant interventions. After this process, the mean, standard deviation, and effect sizes were collected, contrasts, and reported over seven studies.

WHAT THEY FOUND

It was reported that SSG are an effective method of developing aerobic qualities in young male soccer players. After analysis, it was found that the differences between conventional, endurance -based training methods, and SSG were trivial to small between training types, suggesting that there were few differences.

Training programmes that were longer than 8 weeks had larger effect sizes (ES) in SSG's (ES=0.45) compared to conventional endurance training (ES=0.33), suggesting that the benefits are potentially greater. Programmes with more than 4 sets per session seemed to favour SSGs as a training modality over endurance training, with only a trivial difference between those with 4 or fewer sets.

» **Practical** Takeaways

The practical takeaways from this study are:

⇒ SSG can be used as an alternative to conventional endurance training (such as long distance running or repeated jogging).

⇒ SSG led to improved enjoyment, whilst simultaneously developing skills, motivation, and aerobic performance.

⇒ By altering pitch dimensions, numerical superiority, or increasing tactical load, players can experience high percentages of VO2max.

⇒ S&C coaches should work with sports coaches to train certain aspects of performance, where acceleration, as seen in the video below, can be incorporated into sports drills.

⇒ SSG should be performed twice a week, with 4 or more sets of 4 min of intense activity separated by 3 min of rest.

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

Tom's **Comments**

"From this research, it is clear that SSG can be a time-efficient method to develop aerobic qualities. Increased training volume is thought to be a contributor to increasing mitochondria levels. These, as the podcast below suggests, are directly related to aerobic performance, with increased mitochondria density supporting more efficient energy production to support repeated aerobic bouts. In addition, training at or around VO2max is known to trigger angiogenesis, more simply known as new blood vessel formation. These ensure that blood and oxygen can quickly get to the muscle, thus allowing for greater performance.

The benefits of SSG is that it offers a fun method for developing aerobic qualities, whilst simultaneously developing the skills specific to their sport. However, I am still a strong believer that traditional methods of aerobic training can serve a purpose in the athletic journey. To understand the aerobic contribution to sports, I think it is at times important to remove additional stimuli (e.g. balls, rules, constraints) and just allow children to understand what a "slower" pace of exercise feels like over time. Such drills, in my opinion, can also develop mental fortitude and focus."

[Abstract]

To move or not to move? Exploring active vs. passive recovery strategies in children

OBJECTIVE

Intermittent exercise is commonly used as a training method, as well as, within sport performance during a match. To have the ability to complete repeated maximal efforts is particularly valuable in team-sports, however, an individual requires a good anaerobic and aerobic system.

This study compared the effects of active (AR) and passive recovery (PR) following high-intensity intermittent exercises in children, where most other studies have focused on adults and adolescence.

WHAT THEY DID

Five boys and six girls (age 8-11 y) performed 3 field tests over a 3-week period. One of these was a maximal graded field test which required the children to run at an initial velocity of 6 $km.h^{-1}$. This was increased by 1.5 $km.h^{-1}$ every 3 min and continued to progress with time. This was used to monitor VO2 and maximal aerobic speed (MAS).

The other two tests were short, high-intensity exercise bouts with (15 sec at 120% of MAS) interspersed with either 15 sec of active recovery (50% of MAS), or 15 sec of passive recovery until exhaustion.

WHAT THEY FOUND

The main results of this study were:

⇒ Children performing high-intensity (120% of MAS), short duration exercises (15 sec) with AR travelled significantly less distance and had lower running times than those who undertook the PR protocol.

⇒ The time to reach peak VO2 was faster in the AR group compared to the PR group, who showed greater time to exhaustion (TTE) and distance to exhaustion (DTE).

⇒ Those who completed PR ran 3 times as long and covered double the distance.

⇒ With AR, peak VO2 can be attained to the same level, with a 3-fold shorter time on feet compared to the PR.

» **Practical** Takeaways

⇒ To sustain a higher percentage of peak VO2, AR is more suitable as children run less distance, but reach similar values of peak VO2 as PR.

⇒ Activities performed at a high-intensity (120% MAS) affords children a longer TTE and improved overall distances reached.

⇒ Such activities could lend themselves to periods of the season where high amounts of foot-ground contact (in-season), may not be desirable.

⇒ Children who used PR spent a longer time at 80-90% of their peak heart rate. Over time, this would lead to greater cardiorespiratory health and neuromuscular efficiency.

⇒ To calculate MAS, Jamie Bain has created a very short video to discuss what to do, why to do it, and what the disadvantages are (see video below).

⇒ Aerobic activity is not only important to develop cardiorespiratory system, but plays a key part in developing social, psychological, and coping strategies. More specifically, Dr Michael Trayford explains the benefits of aerobic activity in retrieval, memory, and cognitive processes which can support children in their academic pursuits (refer to podcast below). This could be a great way to support the inclusion of S&C in schools.

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

Tom's **Comments**

"Children show specific physiological responses to exercise, such as faster rest to exercise VO2, faster recovery, lower anaerobic capacity, and a higher ability to repeat supramaximal exercise when compared to adults. This may help to explain why children can run for so long and feel fine the next day. Boys between 12-17 y and girls between 10-15 y of age experience a sensitive period, where, aerobic capacity significantly improves.

In my opinion and by currently working with children aged 9-21 y, I have found that aerobic activities must be highly contextual for the children you are working with to maintain their behaviour and interest. For example, younger players may complete distance running through competition, games, or time trials such as "team treasure hunts". Older students (>16 y) value a more measured method of development, where MAS running would be pursued. This should change, and it's important that both younger and older children experience the benefits of a games-based approach and drill-based approach to develop associative physiological links and respect for the aerobic system."

Nutrition

This month's top research on nutrition.

DOES A CHERRY-BASED SUPPLEMENT HELP ALLEVIATE SORENESS AND IMPROVE MARKERS OF WELL-BEING?

Kupusarevic, J. et al. (2019) Journal Sports.

HOW DO IMMUNITY BIOMARKERS REACT FOLLOWING A 4-WEEK PERIOD OF INTERVAL TRAINING?

Hanstock, H. G. et al. (2019) Frontiers International Journal of Sports Physiology and Performance.

DOES "GOING KETO" REALLY BENEFIT METABOLISM AND FAT UTILISATION?

Durkalec-Michalski, K. et al. (2019) Sports.

[Abstract]

Does a cherry-based supplement help alleviate soreness and improve markers of well-being?

OBJECTIVE

The physical demands of rugby typically cause players to report increased soreness and attenuated recovery in the hours and days following a match. It is unsurprising then many professional players and nutritionists seek out food and supplements which may assist players during the recovery window.

This study aimed to find out if consumption of a popular cherry gel supplement had any benefit on reducing muscle soreness and alter wellbeing after a rugby union (RU) match.

WHAT THEY DID

Ten professional RU players were supplemented with either 2 x 30 mL of tart cherry juice (TC) or a calorie matched control (CON) gel two days prior, the day of and two days after a single 80-min competitive RU match. Players were asked to consume one gel in the morning and one gel in the evening, which follows previous cherry gel feeding strategy.

Subjective wellness (1 (poor) -5 (excellent)) and muscle soreness (visual analogue scale) were measured the day before the match and then for three consecutive days after the match, in the mornings upon waking, in an attempt to try and capture the typical soreness window of 72 hr after muscle damaging exercise

WHAT THEY FOUND

Both sets of players in the TC group and CON group reported similar total distance covered, high -speed distance covered, sprint distance, and player load.

Significant increases were reported in muscle soreness during the first and second day after the match, compared to the day before the match. Irrespective of whether in the TC or CON group, increases in muscle soreness scores were similar after one day and two days after the match. By the third day after the match, scores had reduced down to those similar to values before the match.

With regards to subjective wellness, a 15% reduction in wellness score was reported during the first day after the match, with all other time points being similar. As with muscle soreness, no differences were seen between the TC or CON groups at any time point following match-play.

» **Practical** Takeaways

This study builds on previous work which has shown cherry juice supplementation to exert beneficial effects on recovery following both marathon running and simulated laboratory-based soccer protocols. A video review regarding cherry gel supplementation can also be seen below. The key factor in this study, was the fact that supplementation in professional players occurred during an in-season RU match. It appears that when consumed alongside a normal habitual rugby player dietary intake, there are no beneficial effects of cherry gel supplementation versus a gel control.

Practitioners may therefore want to consider:

⇒ Focusing attention on increasing habitual intakes of foods rich in anti-oxidants, for example, mixed berries.

⇒ Consider switching the financial cost of purchasing supplements towards purchasing such foods rich in antioxidants, which typically tends to be cheaper for the club or player.

⇒ Encourage players to focus on recovery strategies which are supported with evidence, for example, increasing sleep, protein intake, and hydration following match-play.

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

James' **Comments**

"I enjoyed reviewing this article as during my final PhD study, I have also found similar results. It was evident that when supplementing cherry juice following a polyphenol depleted diet (a diet with no habitual intake of the active component of cherry juice), the beneficial effects of the anti -oxidant are far greater compared to consuming cherry juice alongside a normal habitual diet that may include anti-oxidants habitual. For example, an athlete that consumes high levels of fruit and vegetables in their normal day-to-day diet.

Beneficial effects of cherry juice were further exaggerated when previous studies were performed in laboratory environments or following long exercise durations (e.g. marathon running), which allowed either tight control of the exercise stimulus or simply a longer duration of damaging exercise. For example, an 80-min rugby game versus a 2-4 -hour marathon run.

A question that we raise in a paper I have in review, is regarding the beneficial effects of cherry juice on exercise-induced muscle damage versus impact induce muscle damage. Here we ask the question, can cherry juice exert the similar positive effects seen after exercise-induced damage to the same degree as damage caused from impact -induced muscle damage? Based on the current results, it would not suggest this is the case."

[Abstract]

How do immunity bio markers react following a 4-week period of interval training?

OBJECTIVE

With congested competitive windows and tight training schedules, many athletes now adopt the use of high-intensity training (HIT) in an attempt to elicit positive training adaptations and body composition manipulation, where possible, in a shorter time period. However, evidence suggests that during intensified periods of exercise training or competition, athlete health and immunity status suffers.

WHAT THEY DID

Twenty-five well-trained male cyclists and triathletes were allocated into three groups who each performed a 4-week cycling training intervention. This included three HIT sessions a week, totaling twelve HIT sessions overall:

⇒ Group 1 – 4 x 8 min intervals with 2 min recovery periods.

⇒ Group 2 – 4 x (12 x 40/20 sec) intervals with 2 min recovery periods

⇒ Group 3 – 4 x (8 x 40/20 sec) intervals with 2-min recovery periods

Resting blood and saliva samples, an incremental exercise test to assess fitness level, and diet and activity registration were all collected before and after the 4-week training block.

WHAT THEY FOUND

In total, fourteen athletes (56%) reported an episode of upper respiratory tract infections URTI's as a marker of lowered immunity, although, there were no differences in the amount, duration, or severity of URTI's between each training group. Episode of URTI's duration ranged from 3-22 days with eleven (79%) of the athletes reporting the illness within the first 8 days of training.

Athletes showed a moderate increase in VO2peak (performance measure), although, this was similar between each group. When controlling for pre-test measures, biomarker responses of testosterone, salivary IgA, cortisol, ferritin, and vitamin D were not different between HIT groups.

» **Practical** Takeaways

It is interesting that over half the cohort reported an episode of illness during the 4-week training period, with a large amount of these occurring in the first 8 days of training. This suggests that commencing a new training regime may have been a risk factor for URTI's. It is suggested that spikes in training loads, as seen in the first few days of the data collection period, may be identifiable risks for potential illness.

For the practitioner working with athletes, acute bouts of high-intensity training and exercise is certainly something to consider when commencing training camps, as well as, understanding the best strategies to best alleviate potential risks to illness. Professor Neil Walsh, a well published academic has some great practical advice as to how to best reduce such risks (see video link below).

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

James' **Comments**

"Picking up illness's during periods of heavy training is very common in the professional athlete world. In the team-sports environment, even little things like sweaty gym sessions with lots of handshakes and sharing of weights or drinks bottles can be big promotors of bacteria spread.

In the rugby clubs I use to work in, hand hygiene pumps were located in the gym in an attempt to keep players hands clean. Each player had their own labelled bottles and simple short educational talks were presented to just remind players of the risks of "If one gets it, its likely to spread!". A nice video from the English Institute of Sport summarises this below."

[Abstract]

Does "going keto" really benefit metabolism and fat utilisation?

OBJECTIVE

The effectiveness of ketogenic diets (KD) with the objective of manipulation of body composition and weight reduction, has resulted in it being a fairly popular choice amongst athletes who compete in weight-making sports (e.g. boxing) or those sports where aesthetic appearance is judged (e.g. body-building).

However, research is currently lacking on the relationship between exercise intensity and fat utilisation, in particular, within those athletes who compete at CrossFit.

Therefore, the authors 1) identified what shifts in substrate utilisation were possible following 4 weeks of training, and 2) determine if favourable shifts in fat utilisation were greater following a KD.

WHAT THEY DID

Following familiarisation testing, twenty-two CrossFit athletes (11 male, 11 female) began a 14-day run-in phase, where they ate habitual diets which were recorded by the researchers.

Following this, the first laboratory test included an incremental cycling test and the following day, the dietary intervention began where subjects followed either a controlled diet or a KD intervention period for 4 weeks. A second window of testing was implemented at the end of the 4 week intervention period, including the measurement of substrate utilisation and predicted energy expenditure.

The KD included 1.9 g.kg body weight (BW) from protein, 3.8 g.kg BW from fat, and 0.5 g.kg BW from carbohydrate, whereas the controlled diet consisted of 1.8 g.kg body weight (BW) from protein, 1.7 g.kg BW from fat, and 4.7 g.kg BW from carbohydrate.

WHAT THEY FOUND

Authors reported a high compliance with both diets, especially the KD, which was confirmed through blood analysis. Interestingly, shifts in macronutrient utilisation, in favour of fat oxidation, were different between the genders in the follow up testing, when considering exercise intensity and fat oxidation.

Males showed a tendency towards higher fat oxidation at exercise intensities less than 65% of maximum output, whereas, females showed increases in fat oxidation at intensities above 65% of maximum output.

In summary, it appears that CrossFit athletes can effectively adapt to training on a whole, however, this is gender dependent and the ranges in results may depend on the intensity that the athletes may be training at.

» **Practical** Takeaways

Considering the results of this study, coaches may want to consider how they individually apply these results to the population they are working with, for example, male or females, and how this may influence the programmed intensity of certain CrossFit sessions. Further, it has previously been reported that dietary interventions using a KD lasting less than 2 weeks seem to be insufficient to reveal the real effects of ketosis (see **HERE**). As such, this may have implications for how long you prescribed your athlete to follow a KD.

With this in mind, I think there is an element of being smart as to when to maybe use a KD to reduce unfavourable body mass, but then also identify key periods (i.e. a competition or critical performance), where the athletes may want to increase the carbohydrate intake to support intense exercise performance. With this in mind, the context surrounding KD is discussed nicely in the podcast below. Finally, at Liverpool John Moores University, the concept of fuel for the work required has been adopted in other sports such as cycling.

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

James' **Comments**

"The authors of this study attempted to identify if following a KD elicited favourable outcomes to fat oxidisation. Although they report greater changes in males over females, one should consider the possible limitations within the article. Large errors bars are reported following data analysis by the authors, which makes me think about individual differences outside the average of the responding group. For example, do we see significant differences between genders due to one of two individuals responding massively to the KD and, as such, draw conclusions that males respond better than females?

KD certainly have their place, however, implementation in a sport that requires intense, physical outputs may not be the best strategy to fuel such exercise sessions (see the video below for more information on this). If the goal is to reduce fat mass, then understanding energy balance and periodisation of nutritional intake may want to be explored. For those who may want to try KD, I have included a link below for a guide as to what to consume."

Injury Prevention & Rehab

This month's top research on injury prevention and rehabilitation.

THE EFFECT OF HIP AND GROIN PAIN ON THE HEALTH AND QUALITY OF LIFE IN RETIRED NBA PLAYERS

Ekhtiari, S. et al. (2019) Sports Health.

DO SPECIFIC, ISOLATED HIP OR KNEE BASED EXERCISES IMPROVE PATELLOFEMORAL PAIN?

Hott, A. et al. (2019) The American Journal of Sports Medicine.

TRUNK POSITION DURING LANDING MAY EFFECT THE KINETICS AND KINEMATICS OF THE LOWER EXTREMITIES

Critchley, M. L. et al. (2019) Sports Biomechanics.

[Abstract]

The effect of hip and groin pain on the health and quality of life in retired NBA players

OBJECTIVE

The majority of injuries occurring in the NBA are to the knee and ankle. Despite this increased injury incidence, there are few studies that assess the hip and groin injuries amongst players, during both their playing career and once retired.

The primary aims of this study were to:

1) Look at the rates of hip and groin injuries in the NBA, and

2) Determine the effects on long-term health, physical activity, and quality of life.

WHAT THEY DID

A survey was developed based on input from a focus group of orthopaedic and sports physicians, a statistician, and NBA athletic trainers. Face validity of the survey was achieved by asking former players and orthopedic surgeons for feedback on the survey questions. Content validity was achieved through the feedback from the orthopaedists who had experience working with NBA players. The survey consisted of 61 items within 4 categories:

1) Demographics

2) Pre-NBA injuries

3) Injuries that occurred while playing in the NBA, and

4) Health status in retirement.

The survey was distributed via SurveyMonkey to the National Basketball Players' Association, and members were given 3 months to complete it.

WHAT THEY FOUND

Out of 900 retired players to whom the survey was sent, 108 responded. The majority of the respondents (72.2%) were over the age of 55. A quarter of the respondents played in the NBA for up to 4 years, 31.5% for 5-9 years, 36.1% for 10-14 years, and 7.4% for 15-19 years.

While in the NBA, 39% of the respondents reported experiencing hip/groin injuries, the majority of which (85%) had been classified as a groin strain or sports hernia. Most of the respondents (88%) reported at least some hip/groin pain/discomfort. Those with current hip/groin pain (since retirement) reported significantly lower Tegner Activity Scale Scores and lower overall health ratings. The median Tegner score was a 3 (light labour work possible as well as such activities as walking in a forest).

» Practical Takeaways

Over a third of the respondents reported hip/groin pain since retirement, with nearly 15% undergoing a total hip arthroplasty (THA). In comparison, only about 2% of adults over the age of 50 yr undergo THA in the United States. In the normal adult population, a total knee arthroplasty (TKA) is nearly twice as common as a THA. In this population of retired NBA players, however, 9% had undergone a TKA while 15% had a THA.

When working with basketball players, we should be aware of the long-term health and injury risks to begin educating these athletes. Although hip and groin injuries are not very common amongst current players, we should still be addressing hip mobility and strength to potentially decrease the risk of issues down the road after their playing days are over. Basketball players tend to be very knee and quad dominant in their sport movements and training. Perhaps adding some more hip-focused work as a supplement can help with their long-term hip health and quality of life.

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

Nicole's **Comments**

"I was personally surprised by the rates of hip and groin problems amongst retired NBA players. It is important to note that many of the respondents of this survey played professional basketball more than 30 years ago, when there was not as much of an emphasis on injury risk reduction and strength and conditioning.

There has also historically been a high-degree of variance in the diagnostic terms given to different hip and groin pathologies and dysfunctions, which has been addressed only as recently as 2015 with the Doha Agreement paper reaching a consensus on terminology for hip and groin problems in athletes (see **HERE**). I would be interested to see the rates of hip and groin issues in current players when they retire. In the meantime, I do think it is important to develop resilient and robust athletes and address hip mobility, strength, and loading within their comprehensive program."

[Abstract]

Do specific, isolated hip-, or knee-based exercises improve patellofemoral pain?

OBJECTIVE

Patellofemoral Pain Syndrome (PFPS) is anterior knee pain that is aggravated by loading the patellofemoral joint (PFJ). Current methods of treatment involve exercise-based rehabilitation focusing on biomechanics of the PFJ, but, it is still unclear whether hip- or knee-dominant exercises provide a better relief of symptoms.

It has also been shown that kinesiophobia, anxiety, depression, and catastrophising are correlated with PFJ pain (see **HERE**). The purpose of this study was, therefore, to find whether hip-dominant, knee-dominant, or free physical activity had the best short-term effect on patients with PFPS, in combination with patient education.

WHAT THEY DID

Enrolled patients were randomly assigned to one of three groups (Hip-based, knee-based, or free physical activity). The research team was blinded to the treatment groups, and the treating physios were blinded to baseline measures in the patients. Patients in all groups received education aimed at reducing kinesiophobia and promoting self-efficacy. Both the hip- and knee-based groups were prescribed a 6-week program with sessions 3 times per week. Two of those were to be performed at home and one was with a physio. They were to have at least one day of rest between sessions. Exercises were prescribed for 3 sets of 10 which progressed to 3 sets of 20, all with 30 sec between sets.

The primary outcome measure was the Anterior Knee Pain Scale (AKPS), which measures pain and disability at 3 months. The secondary outcome measures were visual analog scale (VAS), Tampa Scale for Kinesiophobia, Knee Self-Efficacy Scale, EuroQol (a tool to assess quality of life), step downs, and isometric hip abduction, external rotation, and knee extension strength using a force sensor.

WHAT THEY FOUND

At 3 months, there was no difference between groups for the AKPS. All groups improved from an average of 65.9 to 73.5 (out of 100), which does not meet the minimal clinically important difference of a 10-point change. There was also no difference in VAS, step downs, EuroQol, self-efficacy, or kinesiophobia.

There were some differences in strength, but they were not specific to the exercise groups assigned as the hip-based group showed, on average, improved knee extension strength. The knee-based group showed improved hip abduction and external rotation strength, but not knee extension strength improvement.

» **Practical** Takeaways

Nearly every outcome measure improved at the 3-month mark for all groups, except for strength measurements, which showed non-specific improvements. The free physical activity group did not improve any of their strength measurements, but still had improvements in all other outcome measures. The one consistent factor across all groups, was the patient education intervention. This might mean that aiming our interventions at reducing kinesiophobia and patient self-efficacy may have a greater effect than specific strengthening exercises.

The results of non-specific strength improvements in this study shows us that we can prescribe exercises based on that individual's presentation and personal goals, and not have to focus on one specific body part. This study can guide our treatment plans for PFPS by stressing the importance of patient education, specifically in reducing kinesiophobia and promoting self-efficacy, as well as, guiding the patient through a gradual progression of activities that are meaningful and specific to them and their unique goals. If that individual wants to improve their strength, then we can prescribe a more well-rounded program that is not necessarily specific or isolated to either the hip or the knee, but based more upon that person's needs and goals.

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

Nicole's **Comments**

"Since it does not seem to be specific strength improvements that reduce the symptoms associated with PFPS, we can act more as coaches or guides for our patients with PFPS. We should be educating them, helping them find meaningful activities and tasks, and helping them to gradually increase their activity levels. Because of this, it may be possible to see these patients only once a week or every couple weeks. Doing this can help the patient save time and money on less sessions, and can help promote greater self-efficacy.

My biggest takeaway from this article is that there is no one "best way" to treat PFPS. We really need to tailor the program to the individual and guide them along the process, providing ample support and education along the way."

[Abstract]

Trunk position during landing may effect the kinetics and kinematics of the lower extremities

OBJECTIVE

The typical mechanism of injury for an anterior cruciate ligament (ACL) injury includes hip adduction and internal rotation with an extended or very slightly flexed knee. A more upright trunk position, as well as, a more posteriorly shifted centre of mass and increased trunk lateral flexion has also been observed in some studies.

This study aimed to find the effects of both whole body and trunk only rotation during a landing task on knee kinetics and kinematics.

WHAT THEY DID

During five different conditions of a drop jump, the participant jumped from a 30-cm box to a landing area that was half of their body length in distance away from the box. Upon landing, during each of the five conditions, they had to reach for a basketball placed on a tripod, grab the ball, and hold it during a subsequent maximal vertical jump. The conditions were:

⇒ No rotation (NR):

⇒ Whole body rotation ipsilateral (WBRI)

⇒ Whole body rotation contralateral (WBRC):

⇒ Trunk rotation ipsilateral (TRI)

⇒ Trunk rotation contralateral (TRC):

Kinematic and ground reaction force (GRF) data were collected during each of the five conditions, the order of which were randomised. Measurements were taken at initial contact (IC) and in the first 100 ms of landing.

WHAT THEY FOUND

NR: Greatest maximal vertical jump height.

WBRI: Greater knee adduction and external rotation at IC compared to knee abduction and internal rotation, respectively. Less peak knee flexion than NR and TRC conditions, but greater than WBRC condition. Least peak knee extension and external rotation moments.

WBRC: Decreased knee flexion angles at IC and increased knee abduction and internal rotation angles at IC. Less peak knee flexion during the first 100 ms after landing than the other conditions.

TRI: Greater knee internal rotation at IC. Greatest peak knee abduction and internal rotation in first 100 ms of landing. Greatest peak vertical GRFs and knee moments of all conditions.

TRC: Least peak vertical GRF and least peak knee adduction moments. Decreased knee flexion angles and increased knee abduction at IC.

» Practical Takeaways

This study shows us that trunk positions during sports activities can impact the kinetics and kinematics of landing which can, in turn, affect the amount of load through the ACL. The TRI condition most resembled the kinematics of an ACL mechanism of injury. The WBRC and TRI conditions in this study had the potential to cause the most load on the ACL. These results would suggest that we should be training athletes to maintain a neutral trunk position while landing and decelerating.

It may, therefore, be helpful to train athletes in multi-planar tasks and with asymmetrical loading in order to prepare for the increased loads put through one limb over the other in various multi-planar tasks performed during sport. It may also be beneficial to train proprioceptive awareness so that athletes can have better control over their limb and trunk positions in space while mid-flight, prior to landing.

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

Nicole's **Comments**

"This study only looked at the dominant limb in relation to the five different conditions. I would be interested to see if there were any side-to-side differences by testing the non-dominant limb as well. They also only tested athletes with no previous injury history. Since there are known inter- and intra-limb compensations (see **HERE**) in patients post-ACLR, it is likely that they would have different loading patterns in these tasks.

In each of the five conditions in this study, the athlete was told exactly what they would be performing and were able to pre-plan their movements. In a game situation, movements are much more reactive. When rehabilitating or training athletes, it would be important to progress the task performed in this study to be reactive, with varying degrees of rotation, and even to progress to single leg landing tasks."

Infographics

A round-up of our monthly research infographics.

ELEVATION TRAINING MASKS

Solomon, M. (2019) Science for Sport.

NEEDS ANALYSIS

Solomon, M. (2019) Science for Sport.

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ELEVATION TRAINING MASKS

SCIENCE for SPORT

What are they?

Elevation training masks (ETMs) claim to simulate altitude training and the subsequent benefits associated with this training modality.

Performance

We will dissect the claims made about ETMs and whether or not they can actually improve athletic performance.

Altitude simulation

Wearing ETMs does not produce a hypoxic stimulus great enough to elicit the necessary physiological responses experienced at true elevation. More research is needed to identify the specific physiological mechanisms that are elicited by this device.

Respiratory muscles

It appears that the ETMs function more like a respiratory muscle training tool than a tool which simulates high-altitude training. There is currently ambiguous data supporting respiratory muscle training as a potential method to enhance performance.

Aerobic Performance

ETMs do not simulate an altitude environment, therefore the desired effects of high-altitude training (e.g. increase in red blood cells) will not exist. As a result, wearing the ETM in training settings with the purpose of increasing stamina and improving endurance is not supported with conclusive evidence.

Strength and power

Although resistance training during hypoxic exposure has been shown to contribute to advanced fibre-type recruitment that may contribute to greater increases in maximal strength, ETMs appear to negatively influence peak velocity during both the back squat and the bench press exercises, which may attenuate training outcomes over time.

Our summary

It seems that ETMs work more like a respiratory muscle training device than as an altitude simulator. There is still limited research concerning the aerobic and anaerobic benefits of altitude training at sea-level with the use of ETMs. Despite the claims made by manufactures the effectiveness of ETMs has been intensively debated and recent studies have shown inconclusive results.

For the full article check out the Science for Sport website

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Needs Analysis

What is it?

A needs analysis is a detailed breakdown of the physical demands of a sport and physical profile of the athlete.

Importance

A needs analysis is essential as it provides vital information on the demands of the sport, the current profile of the athlete, and what the athlete needs to be successful in their sport.

Application

The needs analysis is used to design individualised strength and conditioning programs which can prevent injury and enhance performance.

Sport analysis

The sport analysis can be broken down into; sport factors (e.g. competition schedule, game duration), injury analysis (e.g. common injuries, predisposing factors), biomechanical analysis (e.g. sprinting, rate of force development), aerobic analysis (e.g. average heart rate), and anaerobic analysis (e.g. lactate threshold).

Athlete analysis

Profiling the athlete will include performance testing to identify their strengths and weaknesses. For example; position, competitive level, date of birth, gender, height, weight, height-weight ratio, BMI, body fat, biological age. technical training age, athlete's injury history, and the athlete's strengths and weaknesses.

Comparative analysis

After the sport and athlete analyses are complete, the two can be compared to identify where the athlete matches the sporting requirements, and any areas for improvement.

Our summary

To design an effective physical training programme, it is essential that the fitness coach researches and designs an in-depth sports-specific needs analysis for their athletes. This is an essential process required to maximise the effect of the physical training programme and reduce the likelihood of injury.

For the full article check out the Science for Sport website

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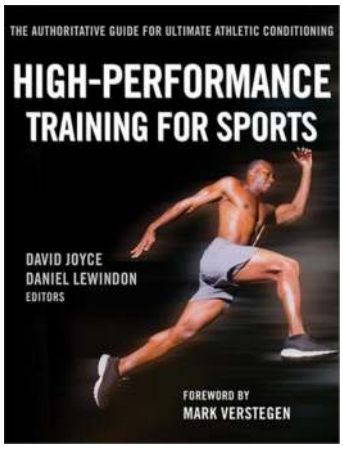

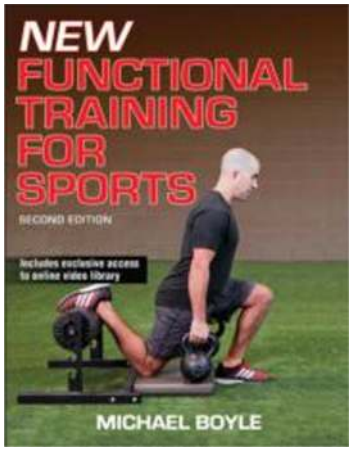

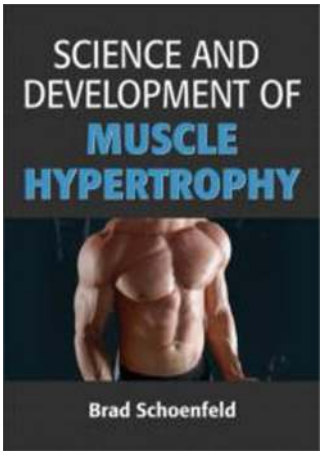

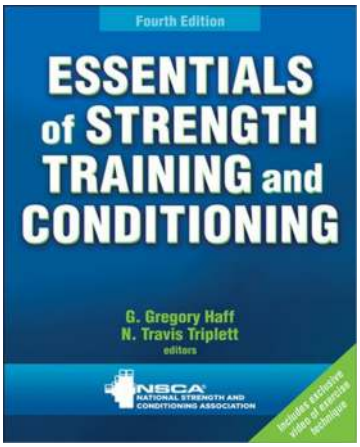

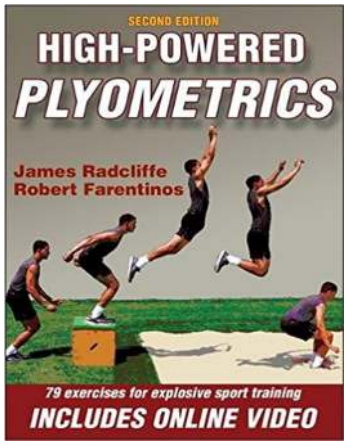

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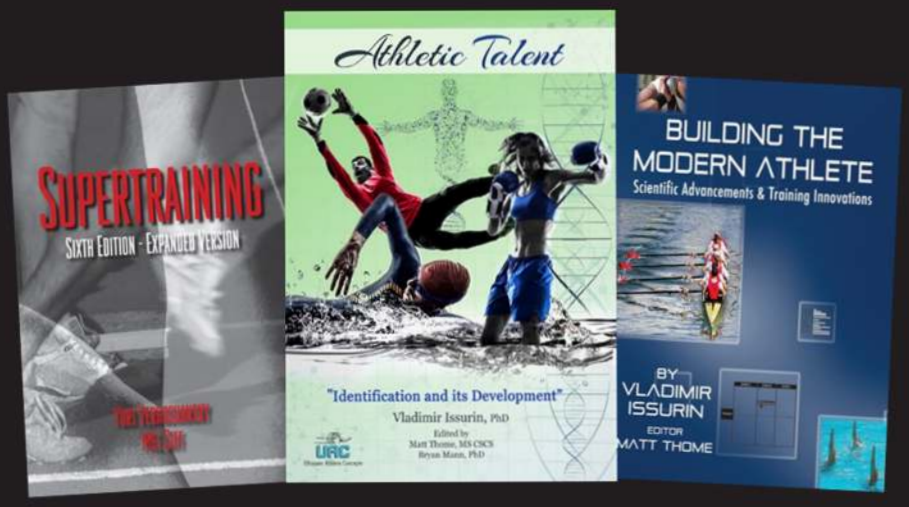

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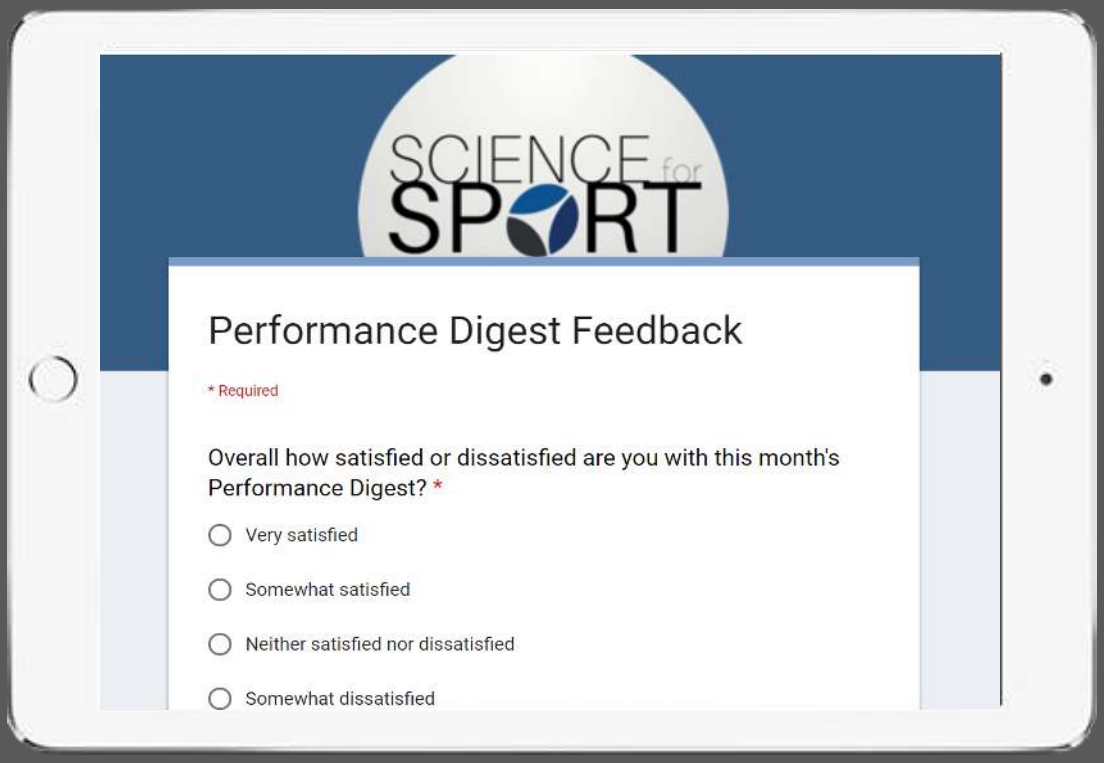

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