March 2019 | Issue #29

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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Audio
REVIEW

Hot Topics in S&C

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

WHAT WE DICUSS

In this episode of the "Audio Review", James discusses hot topics in strength and conditioning.

In this episode, you will learn:

- General principles of a training week using a high/low training system.
- Specific sessions and specific days.
- Micro-dosing.
- The work of Fran Bosh.

Episode length = 32 minutes

A bit about **James**

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.

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The Science of COACHING

[Abstract]

How to positively influence athletes

Which practices or qualities of coaches are associated with more positive athlete responses?

INTRODUCTION

Positive responses of athletes are crucial to continued participation within sport and physical activity. Coaches are known to be key influencers in the development of such positive responses (**HERE**). However, monitoring and judging the level of influence that coaches have on athletes is incredibly difficult and complex. Consequently, there is a critical need to understand how coaches can play a role in shaping positive responses of athletes, and, specifically, which factors might contribute to this.

Understanding this further may help coaches to identify how, when and why they should act in particular ways to play an effective role in developing their players. This study therefore aimed to identify the qualities and practices of coaches that are associated with more positive responses in athletes.

WHAT THEY FOUND

Eighteen participants (9 male, 9 female, mean age = 42.6 yr) from a variety of sports and exercise programmes were interviewed to better understand their perceptions on the qualities and practices of coaches, which were more likely to result in a positive influence. Specifically, questions were focussed on the qualities, abilities, behaviours and actions that coaches possessed who were able to effectively develop positive responses in athletes.

After analysing the responses of the athletes, the authors developed a model which highlighted both general and specific competencies of coaches which were important in influencing positive responses, and how these factors were related to each other. The three general competencies of coaches were:

1. An ability to read the needs of the specific context and their athletes.
2. Managing relationships, showing empathy and self-management.
3. An ability to demonstrate skills effectively, and having relevant sport-specific knowledge.

This then linked to the specific-, or behaviour-related competencies of coaches:

⇒ Use of behaviours intended to increase motivation of athletes (e.g. praising effort levels).

⇒ The ability to be adaptable to both the ongoing needs of individual athletes and the context.

⇒ The ability to organise and coordinate (e.g. using clear instructions and planning well).

WHAT THIS MEANS

Athletes felt that they had more positive responses to participation when coaches correctly evaluated the needs of the context (e.g. understood the age, stage and development of participants). This was perceived to better support coaches in pitching demonstrations and sharing (or creating) knowledge and learning at the right level. Further, it also allowed coaches to develop more effective relationships (e.g. through appropriately communicating with athletes who had different needs), and show the right type of empathy (e.g. consulting athletes with mobility issues to better understand what they were, and were not capable of achieving).

Coaches who were able to effectively self-manage (e.g. manage their emotions and not overreact) were also perceived to be more effective at influencing positive responses. These general factors were then deemed to be related to the coach's ability to use specific behaviours which were more likely to foster positive responses.

In this sense, coaches who: were able to motivate (e.g. by creating a fun and positive environment); were adaptable (e.g. able to change their behaviour or the activity in the event that it was not working); and were organised (e.g. planned logical and clear activities), were perceived to be more likely to positively influence athletes.

Practical Takeaways

Coaches wishing to increase their ability to positively affect athletes could look to develop competencies in a number of related areas. Strength and Conditioning coaches, for example, could look for ways to more effectively evaluate the needs of the specific context (i.e. what are the limits, goals and needs of participants?). In doing so, they could look to develop more effective relationships (i.e. by asking how an athletes' wider life is, by thinking carefully about how they display emotions, and, as such, show relevant empathy). The strength and conditioning coach could also look to develop their own ability to give meaningful demonstrations (or get others to deliver these) and up-skill their sport-specific knowledge to use language that is familiar with athletes. Finally, coaches could ask themselves how they might effectively develop motivation within their athletes, how they could continue to adapt to emerging needs of their athletes and, how they could effectively organise their overall periodised training programmes.

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.

IS ISOMETRIC TRAINING THE MISSING LINK TO PERFORMANCE?
Oranchuk, D. et al (2019) Scandinavian Journal of Medicine and Science in Sports

BONDARCHUK, SIFF AND VERKHOSHANKSY VS. BOSCH: WHOSE APPROACH TRANSFERS BETTER?
Brearley, S. and Bishop, C. (2019) Strength and Conditioning Journal

IS CHANGE OF DIRECTION DEFICIT INFLUENCED BY PLAYER POSITION?
Freitas, T. et al. (2019) Sports

[Abstract]

Is isometric training the missing link to performance?

OBJECTIVE
According to Carl Valle (**HERE**), isometric contractions are simply neuromuscular contractions without movement. When included into a training program, isometric contractions have several potential advantages such as tendon morphology, force overload, weak point training, and pain-free force application in comparison to other muscle contractions. The purpose of this review was to evaluate the outcomes of various isometric training exercise and to provide training guidelines for a variety of desired outcomes.

WHAT THEY DID
During the sifting process, studies were included in the review if they compared two or more variations of isometric training (e.g. ramp or ballistic contractions, overcoming or yielding isometrics). Studies were excluded from the review if 1) it focused on small joints or muscles (e.g. fingers, toes), 2) the primary dependent variables were related to cardiovascular health, 3) the intervention period was less than three weeks, and 4) it included variables such as blood restriction, vibration or electrical stimulation. Following this process, twenty-six studies were selected which included:

⇒ Sixteen studies that recruited untrained subjects,
⇒ Eleven studies that recruited active or recreationally trained subjects, and
⇒ A mean intervention length of 8.4 weeks averaging 3.5 sessions/week.

WHAT THEY FOUND
The main results from the review were:

⇒ Muscular size increased significantly within nine studies (5-19.7%, ES = 0.19-1.23),
⇒ Isometric training when joint angles <70° improved muscle size 0.47 + 0.48%/week compared to 1.16 + 0.46%/week when training >70°,
⇒ Isometric training >70% maximum voluntary isometric contraction (MVIC) increased muscle size greater than intensities <70% MVIC,
⇒ Maximal isometric force increased significantly within fourteen studies (8-60.3%, ES = 0.34-3.26),

Practical Takeaways

The greatest improvements in neuromuscular function occurred at the trained joint angle, which would indicate that improvements in strength is likely specific to the joint angle being trained. Large neurological differences exist between isometric and dynamic contractions, suggesting that isometric training may not be an effective strategy for directly improving sports performance and should primarily be used to alter an athlete's morphology (e.g. to increase tendon thickness and stiffness).

As shown in the infographic below, isometric training may be better suited prior to an eccentric cycle, as isometric training potentially has a negative effect on the pre-stretch phase of the stretch-shortening cycle. This though may only be during a slow stretch-shortening cycle as this was assessed using a counter-movement jump. For example, a training cycle could start with isometric work to prepare the tendinous structures, followed by a slow eccentric emphasis before moving into a reactive training phase. The article below shows how specific isometric exercises can be used for speed development.

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

James's Comments

"After reading this review article it is clear that there is a lot of information to take in with regards to the topic of isometric training. The main take-home points though are that isometric training should be prescribed with the primary outcome in mind. For example, contractions greater than 70% MVIC are likely to improve tendon structure and function. Similarly, ballistic intent has been found to improve rapid force production compared to a gradual ramp in intensity.

Finally, isometric exercises should predominantly occur at those with a long muscle length due to the large advantage of improving muscle volume and strength throughout a range of motion, as well as increasing tendon stiffness. In my own experience, improvements in isometric strength happen very quickly. For example, where holding a Bulgarian Split Squat for 30sec is very difficult with just bodyweight first time round, but within a few weeks you can be loading the isometric much heavier."

[Abstract]

Bondarchuk, Siff and Verkhoshanksy vs. Bosch: whose approach transfers better?

OBJECTIVE
Training transfer refers to the degree of crossover from training to the desired outcome or task (e.g. how well does increasing the squat transfer to vertical jump performance). Various models of organising training into an effective performance outcome have been proposed through history. For example, Bondarchuk's exercise classification or Siff and Verkhoshanksy's dynamic correspondence (traditional overload approach). Recently, Bosch added a further layer underpinning his model on motor learning principles (coordinative overload approach). This review focuses on the concepts of a coordinative overload approach vs a traditional overload approach. The example task used throughout this review was accelerative sprint running due to its large importance in team sport.

WHAT THEY DID
The authors explored the coordinative overload approach, traditional overload approach, and a mixed model approach. The coordinative overload model was explained using Frans Bosch method of integrative strength training underpinned by motor learning principles. The traditional overload model was explained through specific and general strength transfer (Bondarchuk, Siff, Verkhoshanksy). Finally, a mixed model approach was proposed where a combination of each model highlighted a potential advantage over exclusively subscribing to an either or approach. In the links below you will find a table which puts the coordinative and traditional model applied to the same task together.

WHAT THEY FOUND
Coordinative Overload Approach:

⇒ The notion that human movement is a dynamical (non-linear) system which behaves in a self-organising manner.
⇒ Overload not just by kilogram on the bar, but by variation to the task, environment, or organism.

Traditional Overload Approach:

⇒ The notion that enhancing capacities through training is an effective way to enhance performance.
⇒ Specific strength transfer (to the task).
⇒ General strength transfer.

Mixed Model Approach:

⇒ Difficult to differentiate between approaches as most movement stems from both skills and capacities.
⇒ Provides the opportunity for the athlete to learn to apply new "gym strength" to relevant inter-muscular coordination of the desired movement.

Supported by the literature, transfer seems to be affected largely by athlete status, where general strength training may have less to offer an elite-level athlete who already possesses the requisite capacities. Hence, a mixed model approach may be of greater advantage.

Practical Takeaways

The emphasis which a coach places on the specificity of transfer of training varies between the coordinative-overload approach and a more traditional approach. A traditional school of thought is that the intent to move an object quickly is the important factor in transferring strength to fast actions like sprinting. However, increases in early phase neural drive (10-50 ms) are only associated with short-duration, high-force contractions, which somewhat nullifies this concept. Frans Bosch and Bas van Hooren have been leading the charge for the coordinative-overload approach. Van Hooren found (**HERE**) that rapid force development measures improved in unloaded jumps following heavy strength training only 38% in untrained and 43% in well trained individuals. Integration of coordinative-overload tasks should be discussed with a technical coach if they are deemed appropriate in your program. Practically, there is room for both approaches within an S&C program. For example, a typical training session will move from low-load, high-velocity to high-load, low-velocity exercises which may look like this:

1) General warm-up

2) Sprint drills emphasising stiffness

3) Sprint drills emphasising stiffness with variation (co-ordination overload e.g. arms overhead, aqua bag, stick on back)

4) Sprints + Sprints with some form of co-ordination overload or mechanical overload

5) Jumps/Throws

6) Main Strength Work (traditional and coordination overload approach)

A1) Various hip lock/foot from above exercises

B1) KB Swing

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

James's Comments

"When leading my athletes through a session, I use a blend of the coordinative-overload and traditional overload approaches. In my opinion, both are needed in order to develop structural and physiological changes within the body, as well as the intermuscular coordination needed to complete the task. The degree to which you use each approach will come down to your own coaching philosophy, and how you see your program fitting with your current group of athletes.

"Master the basics"is a phrase quoted a lot when referencing strength training (e.g. squat, push, pull) and often refers to only performing these basic movement patterns with the sport taking care of the rest. However, running and sprinting should also be considered in this approach of mastering the basics. Perhaps overloading very specific positions or velocities with variation, not just load in a general movement, can be used to create a well thought out, mixed-model approach."

[Abstract]

Is change of direction deficit influenced by player position?

OBJECTIVE
Change of direction (COD) deficit has been suggested as an adequate method for assessing the COD ability amongst team-sports athletes. The COD deficit reports the difference in velocity between a linear sprint and a COD task of equal distance (e.g. a 10m sprint and 505 agility test). The aim of this study was to investigate the COD ability and deficits of National rugby union players, discriminating between forwards and backs, as well as between faster and slower players.

WHAT THEY DID
Twenty-four elite, male rugby union players completed all physical assessments on the same day: Squat jump (SJ), counter-movement jump (CMJ), 45cm drop jump (DJ45), standing long jump (SLJ), horizontal triple jump (HTJ), 40 m sprint and sprint momentum (body mass x velocity), pro-agility, "L"drill, zig-zag COD tests and 1RM back squat. Results were compared between positions as well as between faster and slower players. While not all tests are COD tests, linear speed and leg muscle qualities vary greatly between positions and may possibly influence COD.

WHAT THEY FOUND
Vertical Jump (SJ and CMJ) and Horizontal Jump

⇒ Very likely higher in faster vs slower players
⇒ Very likely higher (vertical jumps) in backs vs forwards
⇒ DJ45 RSI likely higher in backs vs. forwards and faster vs slower players
⇒ Very likely higher performances in SLJ and HTJ in faster vs slower players
⇒ Backs demonstrated possibly and likely better performances than forwards in SLJ and HTJ

Speed v COD
⇒ Sprint momentum between faster and slower players were unclear but almost certainly higher in forwards compared to backs
⇒ Faster players showed almost certainly higher sprint velocities compared to slower ones and backs very likely higher velocities than forwards
⇒ The COD velocities of backs was almost certainly higher than that of the forwards
⇒ No meaningful differences existed for COD deficits between the backs and forwards
⇒ The faster group reported almost certainly higher COD deficits compared to slower group

» **Practical** Takeaways

Faster players presented an inferior ability to change direction (i.e. greater COD deficits) independent of the angles of direction change. Separating players by positions (forwards vs backs) may not be sensitive enough to discriminate between players with varying ability to change direction. Therefore, measuring the COD deficit then splitting the group above and below a median score may be a more suitable approach to better identify specific player needs.

For example, ranking your athletes based on the difference between 10 m sprint time and 505 agility time, calculate the median score and those athletes above the median (greater deficit) could have a greater emphasis on COD/agility training while the athletes below the median (smaller deficit) could have a greater emphasis on improving linear speed.

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

James's Comments

"Faster players showed higher COD deficits in all COD tasks, suggesting that perhaps the use of only one test is enough to gain a picture of the athletes training needs. This presents a good opportunity to the time-poor coach where two short assessments can provide a wealth of information that can guide the training process with better accuracy. Once the two groups have been identified, two separate sessions can be performed during dedicated speed training times. With one coach this may be difficult, but if you have the speed group perform their sprint first and then the COD perform their task straight after you should be able to keep an eye on both groups, as well as keeping track of rest times. (e.g. the speed group performs a 30 m sprint, in the same area COD group performs a sprint-cut-sprint)."

Technology & Monitoring

This month's top research on technology and monitoring.

SCREENING ACL INJURY RISK USING SIMPLE VIDEO AND COACHING TOOLS
Weir, G. et al. (2019) International Journal of Sports Medicine

MONITORING THE SLEEP OF ATHLETES: WHAT ARE THE BEST PARAMETERS TO USE?
Claudino, J. et al. (2019) BMJ Open Sport and Exercise Medicine

THE UNILATERAL ISOMETRIC SQUAT: CAN IT HELP WITH ASYMMETRY DETECTION?
Bishop, C. et al. (2019) Journal of Strength and Conditioning Research

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[Abstract]

Screening ACL injury risk using simple video and coaching tools

OBJECTIVE
The female athlete is at a higher risk for anterior cruciate ligament (ACL) tears and any intervention that can reduce this risk or identify this risk would benefit coaches tremendously. The cutting manoeuvre, which is typical of many team-sports, places female athletes at a greater risk of an ACL injury due to the high eccentric forces during this manoeuvre, thus screening this movement pattern could be valuable. The objective of the study was to see if a simple video could be reliable enough to appraise injury risk within female sport athletes.

WHAT THEY DID
Thirty female athletes (15-24 yr) completed a customised change of direction test and were screened using two video cameras and a force plate. To help model the test to ensure it was reactive (choosing left or right cutting), a special video projection system was used to help with decision-making. Each athlete's movements were recorded from the side and front views and later analysed using the Silicon Coach software (see more **HERE**). Finally, 3D motion capture was used to estimate the movement strategy of the athletes cutting manoeuvre and was then compared to the video recording.

WHAT THEY FOUND
The key metrics (and their sub-metrics) of extension, valgus, and internal rotation appeared to have good to excellent repeatability, proving that measurements of injury risk can be utilised in real-world testing environments. In addition to sharing the limitations of accuracy with past research, the researchers cautioned readers regarding a possible type 2 error with the findings, specifically because of the sub-sample size being small.

Practical Takeaways

There are several important takeaways coaches should note regarding the differences between 3D motion capture and 2D video analysis. A set-up like the current study used 12 motion capture cameras and only 2 video cameras, demonstrating the practical nature of using video. Another takeaway message is the need for coaches to create a protocol that extracts a realistic movement response with change of direction.

Based on the findings of the study, coaches should place more effort on analysing high-speed cutting motions with change of direction reaction components integrated into their injury screening protocols. The authors of the current study made a point that the regression equations and the materials used to gain the results are enough for field-testing, provided that the projection arrow was involved. Thus, a coach with timing gates, modelling software, video analysis apps, and two tripods can turn their smartphones into a living laboratory.

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

Carl's Comments

"Creating an applied testing environment similar to that of a more sophisticated lab set-up using conventional timing gaits, two sport video cameras, and a digital projector appears to lead to reliable and specific results. Those three items are likely already available to coaching staff, making the analysis of the information gained the only possible cost. Kinovea, an open-source product, is free. Coaches can use Dartfish (see **HERE**) and other paid products if they have access to the software already or wish to invest into the technology. While the ability to truly predict injury with one or two metrics is unlikely, the combination of tests will enable teams to make progress is reducing the rate of injury.

[Abstract]

Monitoring the sleep of athletes: what are the best parameters to use?

OBJECTIVE
Sleep is a vital and powerful part of recovery in sport (see **HERE**), therefore, monitoring the sleep patterns of athletes using an effective monitoring tool is of high importance to coaches and athletes alike in the current era of elite sport. The goal of this meta-analysis was to discover what measurements of sleep quality were effective in assisting athletes monitor and track sleep performance. If coaches and support staff had access to this information and could more easily collect these measurements, coaching staff along with the athletes could monitor sleep more effectively using the available resources.

WHAT THEY DID
An exhaustive search of sleep-based criteria was performed. From which, the authors of the current study defined twelve parameters they believed to be valid and objective markers of sleep performance, outside five subjective ratings of sleep using questionnaire type methods. After all of the research was collected, studies were excluded based on how relevant and applicable to high-performance sport, such as:

⇒ Subjects were not actively competing
⇒ The research did include baseline measurements

WHAT THEY FOUND
The main finding from the study was the strong case for using actigraphy for assessing sleep performance which allowed for the monitoring of:

⇒ Sleep efficiency
⇒ Sleep latency
⇒ Wake episodes, and
⇒ The duration of total wake episodes

The PSQI (sleep efficiency), Likert Liverpool Jet-Lag Questionnaire, Liverpool Jet-Lag Questionnaire (sleep rating), and RESTQ (sleep quality) can also be used. However, these questionnaires provide subjective information form the athletes rather than specific, quantitative information as gained from actigraphy.

Practical Takeaways

Coaches should be aware of the best way to collect sleep data and measure sleep performance using both objective and subjective data. Based on the findings of this research, it makes sense to focus on using a Readiband from Fatigue Science (see **HERE**) or other products that have been validated. Metrics or parameters such as sleep efficiency, latency, and wakefulness duration are objective measurements that should be included in monitoring dashboards or other tracking tools used by athletes. Subjective reporting such as the perception of sleep quality and the level of sleepiness can be used in questionnaires, but these are not easily administered in an applied setting in a sustainable manner. Finally, the authors suggested looking at the logistics of monitoring sleep performance, as well as the statistical issues, such as the sensitivity and reliability of the measures taken from athlete sleep monitoring.

Want to learn more?
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Carl's Comments

"Monitoring sleep is popular amongst coaches, but compliance by athletes is an issue with elite sport since actigraphy requires a wearable device. Due to the privacy concerns and the legal constraints of collective bargaining agreements of professional sports, the focus of sport science departments should be on working with player's unions and ownership to have both parties understand the importance of sleep, and therefore the importance of these devices. If both sides are educated on the importance of this device and the information they can provide, then agreements can be made on how to support athletes while maintaining some sort of privacy and protection."

[Abstract]

The single-leg isometric squat: can it help with asymmetry detection?

OBJECTIVE
Sports teams care about the wellbeing of their athletes, as they want them to perform to the best of their ability for as long as possible. Over the years, coaches have used numerous monitoring protocols and assessments in an effort to reduce the prevalence of injuries, but most of the movement screening tools or athlete tracking methods are either too general (i.e. they are not specific to one sport) or are not reliable (i.e. they are not consistent in what they measure). One important part of the body which is paramount in the performance of many sporting activities are the Achilles tendons, which are at risk of injury within many athlete populations. Therefore, an objective way to evaluate the health (stiffness) of the Achilles tendon that is simple and quick would be beneficial for teams, especially if it was affordable.

WHAT THEY DID
The single-leg strength of twenty-eight recreational level athletes a using a custom-built isometric rig and a single PASCO force plate. The subjects performed a maximal effort single-leg squat at 140°leg angle for 5 sec. Three trials were performed for each limb and the results were analysed using a customized and programmed excel file. Measures of peak force, impulse, and the rate of force (RFD) were calculated using a previously published study on the countermovement jump (see **HERE**).

WHAT THEY FOUND
The authors defined limb dominance based on the scores of each leg and determined that peak force could be used as a simple way to detect asymmetry. Measures such as RFD (see **HERE**) and impulse variables were not statistically strong enough to be confidently used for comparison purposes. One limitation of the study is, of course, the population and injury history, as the range of asymmetries were surprising since some subjects showed a high limb dominance in some cases. None of the athletes tested had an asymmetry <6.6%, a threshold known to influence countermovement jump performance.

Practical Takeaways

Due to the strong reliability that was reported, peak force, or the maximal vertical force reached during the isometric squat, should be used with confidence as a measure for testing limb dominance. The authors concluded that due to the high number of unilateral movements, screening athletes as early as possible could mitigate injury risk or poor performance. It was also recommended that prescribing specific training, such as exercises that decrease limb dominance like the step-up and split squat.

It should be noted that the authors recommended bilateral squatting as part of the general training solution. The authors do not make mention of bilateral facilitation or bilateral deficit as a way to determine the training history of the athletes beyond the reported one-year of resistance training experience. The authors included the company that created the customised squat rack (rig) so it appears that recreating the test is possible, but the information of the bar materials was not mentioned.

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

Carl's Comments

"Coaches will start wanting to experiment with mid-thigh pulls with single legs to determine limb dominance but should remember they are different movements. A major reason coaches appreciate isometric testing is that it's safe and easy to test, while conventional options may increase risk or unnecessary soreness. Thus, racks or rigs should be constructed to allow coaches to perform both the pulling and squatting movement. In addition to the rigs required (see more **HERE**), it may make sense to use bilateral force plates to save time assessing athletes in the real-world setting, as it could help with seeing if a difference between bilateral and unilateral lifting strategies exists, thus helping with exercise prescription. "

Fatigue & Recovery

This month's top research on fatigue and recovery.

SUBJECTIVE MARKERS PROVIDE MORE MEANINGFUL INFORMATION THAN OBJECTIVE MARKERS IN RUGBY PLAYERS

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

LOAD-VELOCITY-BASED 1RM PREDICTIONS ARE NOT ACCURATE TO MONITOR FATIGUE.

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

COLD-WATER IMMERSION AIDS RECOVERY FOLLOWING VOLLEYBALL TRAINING

de Freitas, V. et al. (2019) The Journal of Strength and Conditioning Research

[Abstract]

Subjective markers provide more meaningful information than objective markers in rugby players

OBJECTIVE
International rugby sevens tournaments typically occur during two simultaneous days, with teams playing five games of 14 min during those two days. In order to design an effective training and recovery program, practitioners need to understand the effect that these dense competitive days have on the fatigue levels of their athletes. This study aimed to understand how different markers of fatigue/readiness are affected during and after an elite International female rugby sevens tournament.

WHAT THEY DID
Over the duration of a Rugby Sevens World Series tournament, the fatigue levels of twelve elite, women rugby players were monitored. During each morning of the tournament (TD1 and TD2) and the two consecutive days after the tournament (TD+1 and TD+2) the following measures were collected:

⇒ Wellness questionnaire (fatigue, sleep quality, general muscle soreness, stress levels, mood)
⇒ Total quality of recovery (TQR)
⇒ Counter-movement jump flight time (CMJ)

Physical markers of fatigue (training load) were also collected using the following measures:

⇒ Total distance and total distance covered during different velocity thresholds measured with GPS
⇒ Number of physical contacts (PC) obtained from video analysis
⇒ Rating of perceived exertion (RPE)

WHAT THEY FOUND
A number of significant results were reported:

⇒ Following TD1, TQR and all wellness questionnaire items with the exception of sleep quality were significantly affected and did not return to baseline values until TD+2
⇒ Fatigue, muscle soreness, and TQR were the most affected measures following TD1
⇒ More high-intensity running (HIR; distance covered >3.5m·s^{-1}) was related to more fatigue, and a larger number of PC with more general muscle soreness

Practical Takeaways

This study reinforces the sensitivity of subjective markers (i.e. wellness questionnaire and TQR) to monitor fatigue/readiness amongst athletes. Within all items obtained, fatigue, general muscle soreness and TQR were the most impacted measures. Interestingly but not surprisingly, subjective fatigue seems to be more sensitive for monitoring HIR, and subjective muscle soreness for detecting contact frequency.

While subjective markers were affected by load, objective markers (i.e. distances covered during matches and CMJ) were not affected throughout the tournament. Although performance markers were not affected, subjective measures can be used by coaches to individualise recovery strategies (e.g. a more intense cold-water immersion protocol for the athletes who report higher muscle soreness) and training loads (e.g. players rotations between matches and tournament days).

Subjective markers of readiness/fatigue are easy to implement and are sensitive to training load. Practitioners involved with team-sport athletes are advised to use such measures to monitor readiness/ fatigue levels.

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

Francisco's Comments

"This is an interesting and well-designed study exploring different markers of fatigue during a congestive period of rugby sevens. As expected, PC frequency was related with increases in muscle soreness. In future research, it would be interesting if the authors investigated this relationship with different contact intensities.

While subjective markers were affected by TD1, no changes were observed in performance markers or CMJ. As mentioned by the authors, the CMJ obtained with contact platform may lack sensibility to detect changes. Moreover, the threshold used to detect HIR (i.e. >3.5m·s−1) is low. If the threshold was higher (e.g. >5.5m·s−1) one could probably observe differences throughout the tournament, and some relationships would have been observed with subjective markers.

As previously discussed in Performance Digest #24 (October 2018), it is important that fatigue measures are made relative to each athlete variation (e.g. using Z-scores). This study reinforces that subjective markers are easier to obtain and provide more meaningful information in comparison to in-field objective markers, which suggests that. coaches should implement these questionnaires into their practice."

[Abstract]

Load-velocity based 1RM predictions are not accurate to monitor fatigue

OBJECTIVE

Practitioners typically use a percentage of 1RM to prescribe resistance training lifting loads. However, this method does not account for daily variations in an individual's maximal 1RM which can be affected by fatigue and readiness to perform. Therefore, this study aimed to test whether different methods which are used to determine 1RM based on the displacement of the load, can indicate fatigue-related decrements in resistance training performance.

WHAT THEY DID

20 well-trained men (1RM squat 1.81 x body mass) completed five testing sessions. During Session 1 the individual 1RM (real 1RM) for the squat was determined. In Session 2, the individual back squat load-velocity profile was determined. During session 3 the subjects were exposed to a squat fatiguing protocol, and finally in sessions 4 and 5 (24 and 48 h after session 3) each subjects individual 1RM directly (DYN), isometrically (MVC) was calculated using 3 different load-velocity methods:

⇒ Minimum velocity threshold method (**MVT**),

⇒ Load at zero velocity method (**LD0**), and

⇒ Force-velocity method (**FV**).

WHAT THEY FOUND

The main findings of this study were:

⇒ Muscle soreness increased, and MVC and DYN decreased 24 h and 48 h following session 3

⇒ 1RM when calculated using MVT and LD0 were significantly related with the real 1RM during each session

⇒ The relationship between the 1RM determined by FV with the real 1RM was poor, and when calculated with this method it provided unrealistic estimations of maximal strength for some individuals

⇒ A large individual variability in maximal strength and velocity-based 1RM predictions was observed

» **Practical** Takeaways

The findings of this study are important as velocity-based training (and assessment) is a current trend in the applied world, however, practitioners need to be aware of the limitations of this method. For example, in this study some athletes increased their velocity-based predicted 1RM in the sessions following the fatigable session but the real 1RM decreased.

From my own experience with professional rugby players, one of the errors of estimating 1RM from velocity is the change in the lifting technique between lighter and heavier loads. Therefore, if the goal is to determine the readiness status of an athlete, practitioners can use changes in velocity from a heavy load (e.g. 2-3 reps with 75-80% 1RM). This method can be used to track an athlete's readiness prior to a heavy strength training session, and a lower load exercise, such as a countermovement jump and/or squat jump, can be used to track their readiness prior to the power sessions.

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

Francisco's Comments

"1RM can be easily estimated from velocity-based 1RM predictions by measuring velocity during 3-5 warm-up sets (see below this). Practitioners can use these methods in combination with other measures (e.g. neuromuscular tests and wellness questionnaires) to determine fatigue levels and adequate training loads or the training stimulus. However, due to the large inter-individual variations observed in the accuracy of velocity-based 1RM predictions, these methods can't be used to prescribe daily training loads.

How to estimate 1RM using velocity-based methods?

⇒ 4-6 different loads varying 30-85% of 1RM:

⇒ 2-3 light loads (30-50% 1RM)

⇒ 2 moderate loads (50-65% 1RM)

⇒ 1 heavy load (75-85% 1RM)

I suggest a variation of the mean concentric velocity of at least 0.5 $m.s^{-1}$ between the minimal and maximal load used. To estimate the 1RM from MVT and LD0, each athlete load-velocity regression line must be extrapolated to the previously determined MVT, or to the interception with a velocity of 0 $m.s^{-1}$."

[Abstract]

Cold-water immersion aids recovery following volleyball training

OBJECTIVE
By using cold-water immersion (CWI) as a form of recovery for their athletes, practitioners aim to accelerate recovery between training days. Previous conflicting results can be found within the literature, with the limitations and issues of this research including the ability level of the athletes, the training frequency, and the varying characteristics of specific sports. To provide a more specific answer relating to this topic, this study evaluated the effects of CWI on physical performance, muscle damage, and inflammatory, hormonal and oxidative stress markers in volleyball players.

WHAT THEY DID
Twelve professional volleyball athletes were exposed to CWI (~14°C for 15 min) or placebo (inactive light emitting diode) after each training session over 5 successive days. In the morning of each training day (and an additional day at the end of the intervention), the following measures of fatigue were obtained:

⇒ Days 1-6: Muscle soreness (DOMS), countermovement jump (CMJ);
⇒ Days 1, 3 and 6: Thigh circumference (TC), squat jump (SJ), agility test (AT);
⇒ Days 1- 6: Blood and saliva (muscle damage, inflammatory, oxidative stress, hormonal status markers).

The training load of each session was also monitored following each training session through the use of rating of perceived exertion (RPE).

WHAT THEY FOUND
The main finding of this study was that those athletes who were exposed to CWI displayed no significant changes in any of the markers of fatigue throughout the data collection period. On the other hand, those in the control group displayed numerous changes in various fatigue markers following training. When compared to the CWI group, those not in the intervention group showed significant differences in DOMS, CMJ, muscle damage, inflammatory, oxidative stress, and hormonal status markers.

Practical Takeaways

Currently, the implementation of cold modalities is topical within scientific literature and the applied world. I appreciate the fact that the authors utilised CWI during pre-season, probably to avoid fatigue to be accumulated within the training week and from week-to-week, however, I was surprised by the fact that jumping frequency wasn't measured, as landing from jumps is one of the main reasons for muscle damage occurring in volleyball.

Interestingly, the authors do not seem to consider that small or moderate effect sizes are meaningful in such a well-trained population. I have to disagree as when training with such a well-trained population, we can't expect large changes. In other words, we implement different strategies (e.g. training strategies, recovery strategies) to promote small improvements in performance.

Overall though, I believe the findings of this study are very promising for the implementation of CWI when time to recovery is limited and athletes need to be fresh to perform.

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

Francisco's Comments

"The main finding of this study is that CWI can be used to enhance recovery when time to recovery is limited (e.g. <48 h between training sessions). Importantly, practitioners need to keep in mind the potential of CWI to blunt protein synthesis pathways and decide when and how to implement cold recovery modalities. Given this, some general guidelines for the implementation of cold recovery modalities should be considered:

⇒ Goals of the athlete (i.e. what are the long-term goals of this athlete?)

⇒ Goals of the subsequent training session (i.e. do athletes need to produce high power/ force outputs?)

⇒ Phase of the season (i.e. what are the goals of this training phase?)

⇒ Density of the weekly schedule (i.e. when will the following training session occur? Can the athlete recovery naturally?)

It is also important to remember that not all protocols will have the same intensity. For example, the potential to blunt adaptation when athletes are exposed to 5 min of CWI at 15°C is less than if the athletes are exposed to 10 min of CWI at 10°C. In a recent article, I have proposed a rationale for the implementation of CWI (see **HERE**)."

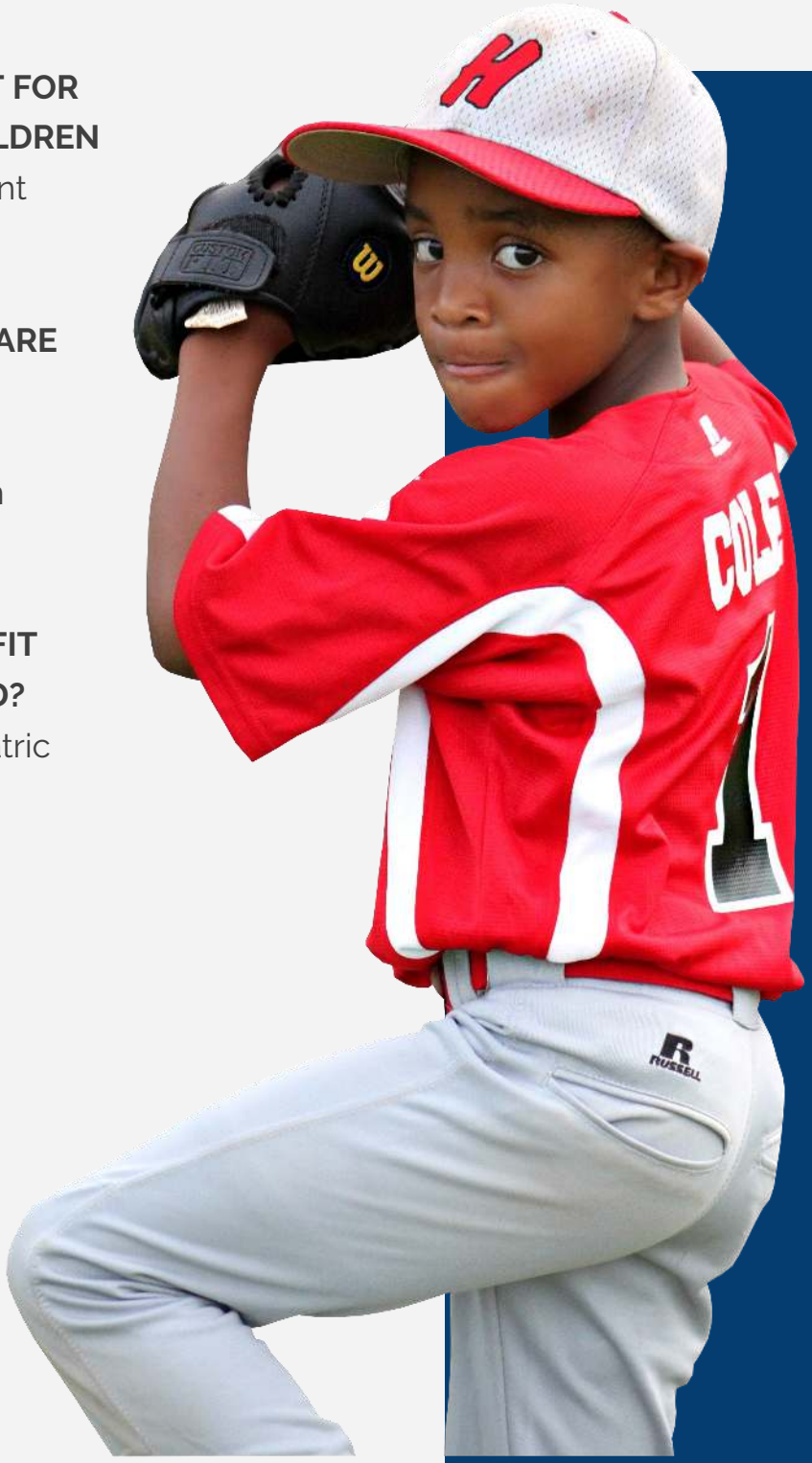
Youth Development

This month's top research on youth development.

THE DREAM MODEL: A CONCEPT FOR DEVELOPING STRENGTH IN CHILDREN
Faigenbaum, A. et al. (2019) Current Sports Medicine Reports

INCREASED LEVELS OF STRESS ARE LINKED TO TIME OF THE YEAR AMONGST STUDENT ATHLETES
Hamlin, M. et al. (2019) Frontiers in Physiology

CAN INTERVAL TRAINING BENEFIT THE SEDENTARY SCHOOL CHILD?
Martin-Smith, R. et al. (2019) Pediatric Exercise Science



[Abstract]

The DREAM model: a concept for developing strength in children

OBJECTIVE
When compared to previous information from a leading organisation as well as anecdotal evidence, children and adolescents are not as active as they were in the last 30 years. This decline in physical activity is thought to begin in early life and can have several consequences for both short- and long-term health. The authors of this study introduce a conceptual model known as the DREAM, with the aim of increasing child sport participation through strength development.

WHAT THEY DID
This study was an opinion piece, analysing the relationships between physical inactivity and life-long issues. In the review on strength, muscular strength deficits were found to be consistent in an individual throughout child and adulthood. This demonstrates that a child will not simply "outgrow" muscular weakness. This phenomenon was termed "paediatric dynapenia" and is characterised by muscle weakness and dysfunction in the absence of neurological or muscular disease. Prerequisite levels of muscular strength are needed to form the base of sports performance. Without these, children can never fully compete with their physically literate peers.

WHAT THEY FOUND
The DREAM model explores the relationship between varied levels of strength, and how over time with individual strength and conditioning support, subtle improvements can lead to improved athletic performance. The model and descriptions of each stage are listed below, which could be useful when categorising a child's strength levels:

Dynapenic – Abnormally low levels of body strength
Reduced – Weak children perform physical activity
Emerging – Remarkable gains in muscle strength and confidence
Adapting – **O**bservable improvements in power performance
Mighty – High muscular strength reserves, athleticism + low injury risk

The authors also suggested that the amount of time in each phase will strongly depend on their health, initial strength levels, and movement competency in a strength environment. As they learn more complex movements, they can perform more complex exercises and proceed up the model (i.e. from a standing press-up, to full press-up).

Practical Takeaways

In this review, the authors suggest that participating in youth sport alone does not develop a level of strength that can transfer to successful athletic performance and improved health. It's suggested that adequate levels of moderate to vigorous physical activity are not attained through participation alone, suggesting that more rigorous activities are required. In the attached article (see below), some user-friendly examples of activities that can be implemented are included.

The authors suggest that the gap between those who are classified as weaker or strong will gradually widen, leading to disparities in physical strength, confidence, and the likelihood of participation. The importance of managing your athletes through an individual approach is therefore paramount. To support this, Rob Gray has produced a mini-series on motor learning in practice which provides a fantastic tool for varying one exercise in a manner that will not "look" entirely different between two athletes (see podcast). A benefit of this is that both athletes feel that they are doing the same task and that one is not hugely out-performing the other. A practical example of this could be seen in two athletes performing a squat with varied competencies. Hypothetically one is fine, but the other individual is challenged in their squat with an excessive forward lean. With the second athlete, the coach could ask them to perform the squat against a wall to constrain the movement by pushing the hips back. Alternatively, if this athlete continues to lean forward, they will be met by the ground. Both athletes are moving in the same pattern, but the task has been changed to suit their individual needs. The same can be done with most exercises, once you understand the constraints-led approach.

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

Tom's Comments

"As a strength and conditioning coach, my opinion on youth strength development is ultimately biased. I am fortunate to work in the youth sector and see the merits of regular and engagement in sport. To explain this better, Paudie Roche who is the current strength and conditioning coach working with Arsenal Football club's academy provides a presentation on youth S&C (see the video below). Here, Paudie discusses how children are already strength training in their daily lives and how, with technical support, we can drive their performance and enjoyment in sport. With all things considered, this research is important to provide practitioners with a representation of where an athlete is with regards to their development. This can then support the use of initiatives and interventions that can support this athlete back into a healthier way of life with their peers."

[Abstract]

Increased levels of stress are linked to time of the year amongst student athletes

OBJECTIVE
In recent years, an increased level of sports professionalism has forced the hand of many sports scientists who must seek effective and innovative ways to support athletic recovery. Appropriate stress can motivate, sharpen, and ensure long-term development. However, too much stress can lead to overreaching, overtraining, injury, and illness. One population group in which stress can significantly impact on performance and recovery is the student-athlete, and as such, the aim of this research was to identify the impact of stress in University athletes to assess when this could be most harmful.

WHAT THEY DID
Subjective (mood state, energy levels, academic stress, sleep quality and quantity, muscle soreness, and training load) and objective (injury and illness) markers of stress amongst 182 elite University athletes were collected throughout the athletic year and analysed through a mixed modelling procedure which compared the means and standard deviations at the end of this period.

WHAT THEY FOUND
The results showed that at the beginning of each University semester, students experienced their highest levels of energy which coincided with a long break from typical University life (i.e. during teaching weeks vs. out of teaching weeks). However, both energy levels and sleep quality were negatively affected during examination periods. Both energy levels and sleep quality, along with perceived mood, and increased academic stress were found to be a reliable predictor of subsequent injury. A strong link was also found between high training workloads (typically seen during the athletic pre-season) and an elevated risk of injury and illness, along with high academic stress a leading contributor to illness.

Practical Takeaways

An increase from pre-university training load (931 ± 710 AU) to 1916 ± 1229 (an increase of 106%) in the first 8-9 weeks of pre-season was reported. Training loads reduced during holiday time when the athletes could rest but remained at this increased level throughout the rest of the athletic season. This sudden increase in workload was strongly associated with injury and illness. As a result of this, strength and conditioning coaches may wish to reduce the training volume and/or intensity which is placed upon their athletes to avoid such a drastic increase and increase the chance of injury. Further still, the coach should assess whether this increase in load is necessary.

With regards to mood quality, mood scores were at their lowest during the two examination periods at the end of the semester. Sleep quality mirrored these scores, where students reported that their sleep was significantly better when away from University. Subjective measures (mood, sleep duration, and academic stress) were also associated with an increased injury likelihood. As a takeaway, this study found that for every unit decrease in mood (i.e. 4 being good and 5 being very good), injury risk increased by 10.8%. This was also similar in sleep duration and academic pressure, with a 5.9 and 9.0% increase in the odds of getting injured when either was affected.

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

Tom's Comments

"When working with young athletes, we have a duty of care to support them through their athletic endeavours and provide them with the safest ways to progress and recover during the season. As coaches, we should look at not only an individual's athletic schedule, but their academic schedule and periodise around phases of high stress (i.e. an exam period). In the attached podcast (see below), Rob Walsh (Head of Strength and Conditioning at Netherlands Ski and Snowboard) discusses how to alter training around periods of stress, which may prove useful moving forward.

To support our athletes, regularly recording information such as mood or sleep quality is vital to see if there are any deviations from the "norm" which could be concerning. The attached stress questionnaire (see article below) could be a useful attachment, giving the athlete a written task to perform on a regular basis to surmise how their week has been. Regular low scores or sudden alterations may require strength and conditioning initiatives (e.g. improved recovery time, reduced intensity/volume, altered conditioning strategies) that combat an already stressed system. Overall, this was an interesting read and really reinforced the importance of getting the basics right both in and outside of training."

[Abstract]

Can interval training benefit the sedentary school child?

OBJECTIVE

Participation in regular moderate to vigorous physical activity is known to support physical and mental health. However, recent data has found that physical activity levels decline by 10% each year during adolescence, with only 1 in 5 children and adolescents (<18%) participating in enough physical activity. To combat this, interventions that are short and effective have been suggested, with sprint interval training (SIT) being explored. The aim of this study was to examine the impact SIT training has on the cardiorespiratory fitness and physical activity levels of adolescents.

WHAT THEY DID

Fifty-six adolescent athletes (age: 16.5 ± 0.5 yr) were recruited from two higher physical education (PE) classes and were randomly allocated to either the intervention group or control group. To examine the impact of SIT training, the intervention group performed 5-6"all-out" sprints (30 sec on, 30 sec off) 3 times per week over 4 weeks. The control group performed 3, 1-hour PE classes per week over 4 consecutive weeks which did not include any specific SIT training. Prior to and following the testing period, all participants were assessed on maturation stage (self-reported questionnaire for pubic hair development), cardiorespiratory fitness (20 m multistage fitness test), physical activity levels (accelerometer), heart rate (beats per minute), blood pressure, and blood samples.

WHAT THEY FOUND

The results showed that a 4-week school-based SIT intervention improved the cardiorespiratory fitness and habitual physical activity levels of adolescent school children. In addition to this, fasting blood samples obtained after the intervention revealed that SIT training prevented a decline in cardiometabolic risk, which is a risk factor for stroke, diabetes, and risk of heart disease. In contrast, the control group showed no significant differences in their results, which may suggest that a typical PE lessons may not be vigorous enough to improve cardiorespiratory fitness.

Practical Takeaways

This study has revealed some impressive results from a relatively short intervention period which can be replicated in 5 min of a session following a thorough and progressive warm-up. Disappointingly, though, this study did not measure if speed over a set distance (i.e. 20-30 m) improved after this intervention which could have been useful to see if unstructured speed drills improve speed over time. However, in the context of a secondary school, this may not have been of interest to a PE teacher. To progress these sessions, PE teachers and coaches may wish to improve technical aspects of sprinting, to prevent the overuse/overload of muscular-tendon structures. The article below does a great job of providing some external cues (cues that direct attention away from the body) which can lead to impressive results over time and are child-friendly. In addition, these will ideally lead to improved sprinting mechanics which decreases the risk of injuries.

It is worth noting, however, that the sample size in this study was fairly small (n=56), with only a single school and the highest ability individual's representing this data. This may not adequately reflect the majority school children, so it is important that sessions can differentiate between those of varied abilities, as demonstrated in the video (see below). Differentiation is the act of altering or running a parallel task to appeal to the varied abilities of the class. In this example, some children may be able to handle competitive sprinting (i.e. chasing a ball against a partner), whereas others may need to run in a lane with little pressure being applied. This must be considered when working with children to foster a positive attitude and association to sport for their health and performance longevity.

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

Tom's Comments

"Although measured informally, participants in this study reported that the SIT intervention was more enjoyable than their normal PE class due to the competitive and fast-paced nature of the task.

Whilst this may seem obvious, it is important to reinforce that it is within human nature to be competitive and to seek progression without the fear of "specialising" a child to constantly chase the win. In the attached podcast (see below), Doug Orchard and Ron Jones discuss the forgotten PE lessons of old, designed to breed strength, diversity, and character. At times, I have found PE to be too slow and inactive, which is partly due to a curriculum which assumes a linear learning process and could be criticised for being slightly outdated. In this podcast, however, the presenters do a great job of reminding teachers and coaches alike what our job is and why now more than ever it is of growing importance to produce strong and physically literate children to combat high levels of obesity, disease, and financial burden."

Nutrition

This month's top research on nutrition.

THE POTENTIAL BENEFIT OF FRUIT INTAKE ON IMPROVING RECOVERY AFTER EXERCISE

Bowtell, J. et al. (2019) Sports Medicine

ORAL HEALTH AND NUTRITION: THE IMPORTANCE OF LOOKING AFTER YOUR MOUTH

Needleman, I. et al. (2019) British Journal of Sport Medicine

DON'T FORGET YOUR BREAKFAST! EAT TO AVOID FAILURE.

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

[Abstract]

The potential benefit of fruit intake on improving recovery after exercise

OBJECTIVE

Consuming polyphenols from fruit-based food sources has received a lot of attention in recent times. It is suggested that polyphenols (the active compound found in food) possess anti-inflammatory properties and have also been shown to enhance vascular function within blood vessels. To this end, there is a rationale for supplementation with fruit-derived polyphenols to enhance recovery from muscle damage sustained after exercise. The authors provide a concise review on the many unanswered questions within the field of polyphenol research.

WHAT THEY DID

In this review paper, the authors introduce why many athletes and practitioners are turning towards polyphenols as a way to help reduce markers of damage and inflammation following strenuous exercise. The key areas for discussion throughout the review include:

⇒ Polyphenols (also see the video below)
⇒ Effects of polyphenol supplementation
⇒ The rationale for fruit-derived polyphenols and exercise performance
⇒ Evidence of enhance performance from acute and chronic polyphenol supplementation
⇒ Mechanisms of Action
⇒ The rationale for fruit-derived polyphenols and recovery after intensive exercise (also see the article
⇒ below). Evidence for enhance functional recovery
⇒ Mechanisms of action

WHAT THEY FOUND

Polyphenols can be found in many dietary sources including grapes, green tea, cherries, berries and mango, which all belong to different families and sub-families. Depending on the bio-availability of each food type (how well it is absorbed), this will dictate the variation seen of active compounds that actually exerts its effects on both performance and recovery. The main mechanism of action for performance benefits relates to antioxidant and vascular effects, however, the authors agree that more work is required to optimise doping strategies and to determine the specific modes, intensities, and durations of exercise for which ergogenic effects may be achieved. Concerning recovery, there is a larger body of evidence suggesting chronic supplementation of polyphenols benefits recovery from intensive exercise, however, similar to performance, more research is required to identify the optimal dose and blend of polyphenols.

» **Practical** Takeaways

From a practical perspective, the results from several studies (Table 2 in this study) suggest that acute and chronic supplementation improves performance and assists in the recovery process following intensive exercise. From a coaching or practitioner point of view, the below outlines some key strategies to achieve improvements in both singular (cycling, running) and team-sport athletes (field-based and court-based):

1) An acute dose of 300 mg polyphenols 1-2 hours before competition or,
2) Supplementing polyphenols chronically 1-6 weeks prior to competition
3) 1000 mg polyphenols per day for three days will enhance recovery following events that induce muscle damage

In food terms, this looks like:

1) 450 g blueberries or,
2) 120 g blackcurrants or,
3) 300 g Montmorency cherries

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

James's Comments

"Polyphenol supplementation is a rapidly growing area of both research and consumption with recreational and professional athletes. This review paper provides great up-to- date information on where we currently stand with what has been shown to work and where the research still needs to be completed. Personally, I utilise the consumption of various polyphenol-rich foods in the diet of the athletes I work with, for example, mixed berries and dark chocolate combined with a low-fat Greek yoghurt after exercise. One thing to remember, like with all supplements, if you are working with professional athletes, you will need to obtain the batch certification for the supplement before administration. Not all polyphenol-rich supplements on the market follow the stringent testing procedures so be careful as to the chosen product."

[Abstract]

Oral health and nutrition: the importance of looking after your mouth

OBJECTIVE

Poor oral health is common in elite athletes . Reports from the London 2012 Olympic games show 55% of athletes with dental caries, 45% with dental erosion and 28% were bothered by their oral health (see article below). One key determinant of oral health particularly amongst athletes, is nutrition and the frequent consumption of carbohydrate -containing, acidic sports drinks and supplements as well as their eating behaviours. Poor oral health negatively affects training and performance of athletes by inducing pain, reducing well-being and quality of life, and increasing whole-body inflammation. This call to action is to recommend strategies to improve oral health in athletes.

WHAT THEY DID

The authors declared a call to action regarding the oral health of athletes, targeting both athletes and health professionals (nutritionists and dietitians, sport and exercise medicine practitioners, dental professionals, scientists in related field, sport policy organisations and industry) in their statement piece. This involved developing strategies to reduce the risk of possible adverse oral effects, whilst maintaining the performance benefits.

WHAT THEY FOUND

A consistent finding in previous published studies is that oral health is poor amongst athletes, especially considering younger participants (both selected samples attending dental clinics or more representative evaluations of teams) (see **HERE**). The proportion of athletes affected by dental caries were 15-75%, moderate-to-severe infections around wisdom teeth were 15%, tooth wear was 36-85%, and gum diseases were 5–39%. In addition, dental trauma was reported by 14-57% of athletes in at-risk sports. This statement concludes with recommendations to guide the improvement of oral health in elite athletes (see practical applications and infographic below).

Practical Takeaways

It is important to establish strategies to reduce the risk of possible adverse effects of poor oral health, whilst also maintaining performance benefits. Take home messages to support a good oral health among recreational exercisers and athletes include:

⇒ Avoid the use of beverages and supplements containing sugars (which are linked to poor oral health) outside of a specific training regimen or competition when prescribed by a qualified nutritionist and identify suitable alternatives. For instance, milk could be substituted for a proprietary sports drink in post-competition.

⇒ Where carbohydrate or acidic supplements are used regularly, high-concentration fluoride toothpastes (minimum 1350 parts per million) should be substituted for standard toothpastes twice a day. It is advised that athletes spit but do not rinse after toothbrushing to maximise the benefit of the fluoride availability.

⇒ Use of interdental brushes and floss before tooth brushing to reduce dental plaque.

⇒ Routine periodic oral health assessment (twice-yearly) and personalised coaching/instructions by a dental professional.

⇒ Where possible, use a two-bottle strategy. For example, if you are having a sport supplement followed by drinking water. For more information about athlete's practices on oral health (see video below).

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

James's Comments

"It is important to highlight that some of these practical applications are more feasible depending on behavioural changes and adherence to care, which are particularly difficult to change. As such, in order to improve and sustain good oral care, oral health should be an integral area within aspects of health promotions and inter-relationships within their sport and peer networks. The authors reported that literature on oral health is limited and studies are needed to identify the best approaches for the implementation of these practical applications in different sport environments. Indeed, regular assessments by a dental professional will allow personalisation of prevention plans and early treatment of any disease. Ultimately, if the bacteria in your mouth is not functioning to the best of its ability then an individual will struggle to absorb all the nutrients we require."

[Abstract]

Don't forget your breakfast! Eat to avoid failure

OBJECTIVE

Morning training sessions are often the choice of many athletes and recreational exercisers, and many report that they skip breakfast prior to their training sessions. Whilst previous research suggests breakfast omission may influence energy expenditure stronger than energy intake, these studies were performed following endurance training (see the first article below). Therefore, the effects of morning carbohydrate intake before resistance exercise has not been well studied. Thus, the aim of the study was to examine the influence of high-carbohydrate intake in the morning on a resistance training protocol.

WHAT THEY DID

Sixteen resistance-trained males who habitually consumed breakfast, completed 4 sets of resistance exercise at an intensity of 90% of 10RM) to failure. Following the assessment of 10RM and a familiarisation trial, the participants performed two randomised trials. Participants consumed either a typical breakfast meal (containing 1.5 g carbohydrate per kg) or a water-only breakfast. Two hours after, participants performed 4 sets to failure of a back squat and bench press at 90% of their 10RM.

WHAT THEY FOUND

Participants completed ~15% less repetitions of the back squat, (reduction of 10 repetitions over the 4 sets) and ~6% less repetitions, (reduction of 3 repetitions over the 4 sets) of the bench press when they neglected breakfast, compared to the consumption of a high-carbohydrate breakfast meal. Sensations of hunger, desire to eat, and prospective food consumption were lower, whereas fullness was greater after a meal for high-carbohydrate breakfast group compared to the water-only group.

» **Practical** Takeaways

The findings suggest that a high-carbohydrate meal (containing 1.5 g carbohydrate per kg) might be a beneficial pre-exercise strategy to enhance training volume if exercising to failure whilst completing compound exercises, particularly if the training session is undertaken in the morning. This finding is applicable to habitual breakfast consumers, and not necessarily non-breakfast consumers. It is important to highlight that there are potential benefits of exercising aerobically before breakfast (see the video and article below for further information for more on this).

Nevertheless, the key is to understand the individual you are going to work with, taking into consideration the following;

⇒ Their daily routine/time commitments and training goals (e.g. weight loss over time, metabolic health, performance goals)

⇒ Their level of knowledge for nutritional intake

⇒ Their training status, and

⇒ Their personal preferences (e.g. appetite sensations, stomach upset)

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

James's Comments

"The study is not without limitations. First and foremost, the results could be influenced by the fact participants were aware of consuming/ omitting a pre-exercise meal/breakfast (i.e. the study was not blinded). For example, considering participants were habitual breakfast consumers, the breakfast omission trial may have represented a deviation from their normal practices, limiting their performance. Therefore, the reduction in performance could also have been due to psychological factors. Clearly, there is a need for more carefully controlled studies of resistance training exercise assessing the optimal amounts and timings of pre-exercise meals to maximise resistance-type exercise performance.

Further, in addition to carbohydrate, it would be advisable to consume a protein source before and after any resistance training session to support muscle growth and repair. Practically, a blend of the two in a smoothie would be a great option especially for those athletes who are short on time and have to travel in the mornings.

For example:

1 banana, half a cup of oats, 1 scoop of whey protein, spoonful of peanut butter, and 300ml of milk. Blend and enjoy!"

Injury Prevention & Rehab

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

EXPECTATIONS VS. REALITY FOR ACL RECONSTRUCTION
Webster, K. et al. (2019)
The American Journal of Sports Medicine

UNDERSTANDING THE RETURN TO SPORT TIMELINE FOR ATHLETES AFTER ANKLE SYNDESMOSIS INJURY
Vancolen, S. et al. (2019) Sports Health

HOW WORKLOAD INFLUENCES INJURY RATES IN PROFESSIONAL FOOTBALL
Bowen, L. et al. (2019) British Journal of Sports Medicine

[Abstract]

Expectations vs. reality for ACL reconstruction

OBJECTIVE

Whilst previous studies have looked at the rates of return to pre-injury activity after ACL Reconstruction (ACLR), it has generally been assumed that patients expect to be able to return to pre-injury level of sport. It may also be the case that the patients' expectations change once they have undergone surgery. This study aimed to see if patents' expectations regarding return-to-sport (RTS) changed from pre- to post-surgery as well as whether age, sex, previous ACLRs, pre-injury level of activity, and sport participation frequency were associated with any changes in expectations.

WHAT THEY DID

Prior to undergoing ACLR, 675 patients (437 male and 238 female) were asked four "yes" or "no" questions regarding their RTS expectations:

⇒ Do you expect to return to your main sport?
⇒ Do you expect to return to the same level of sport?
⇒ Do you intend to return to or take up a different sport?
⇒ Do you intend to give up sport?

Additionally, patients provided information on their-pre-injury status and the frequency of these existing injuries. At 12 months post-surgery, patients reported whether they had returned to sport or not, and in what capacity. Those who had not were then asked whether they still planned to.

WHAT THEY FOUND

Some of the key findings of this study included:

⇒ 91% initially expected to RTS, and 84% expected to return to the same level of sport
⇒ Patients who were about to undergo their second ACLR or a revision surgery had lower expectations for RTS than did those about to undergo a primary ACLR.
⇒ Patients under the age of 20 had higher expectations than those who were older than 20 (92% vs 86%, respectively). At the 12-month follow up, 24% of the patients who had expected to return to pre-injury level of sport actually had, and 15% of the entire cohort ended up giving up sport entirely
⇒ Of the patients who initially expected to RTS, 9% ended up giving up sport entirely, and 71% of those cited fear of re-injury as their primary reason

Practical Takeaways

This study shows us that far more athletes who are about to undergo ACLR expect to return to pre-injury level of sport than those who actually do. For patients who are about to undergo their first ACLR, it might be beneficial to help them set realistic goals and timelines so that they do not have unrealistic expectations. It is also beneficial to note that female patients, and patients who are about to undergo their second ACLR or a revision surgery are more likely to give up sport entirely after an ACLR. For these patients, it may be beneficial to focus more on short-term goals and celebrate small successes in the clinic. We may also need to shift the timeline of achieving certain goals and milestones in the ACLR rehab program back slightly for these patients. The primary driver for not returning to sport in this cohort was fear of re-injury. Perhaps addressing the psychosocial aspects of recovery can help patients feel more confident in returning to pre-injury level of sport after an ACLR.

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

Nicole's Comments

"Although most patients expect to return to pre-injury level of sport after an ACLR, not all of them will. It is worth noting, however, that this study's follow-up period was 12 months, and it is likely that some patients returned to sport later on. What most struck me was that 88% of patients undergoing their first primary ACLR expected to return to pre-injury activity, 80% of patients undergoing their second primary ACLR (on the contralateral side) expected to, while only 63% of those who were about to undergo revision surgery had that same expectation. This might be associated with fear of re- injury and lack of confidence in that knee.

The finding that only 24% of the athletes who expected to return to pre-injury level of sport actually did begs the question of whether or not those patients needed to undergo ACLR in the first place. If we could somehow prospectively determine whether or not an athlete will have a successful RTS after an ACLR, maybe some of these athletes could avoid surgery altogether."

[Abstract]

Understanding the return-to-sport timeline for athletes after ankle syndesmosis injury

OBJECTIVE
The ankle syndesmosis which helps to provide structural stability to the ankle joint, is typically injured due to forced dorsiflexion or external rotation in many contact sports. Much of the research on treatment and return-to-sport (RTS) following ankle injuries has predominantly examined lateral ankle sprains despite the comparatively longer RTS time following ankle syndesmosis injuries. Therefore, this study evaluated RTS rates and the associated performance of athletes after ankle syndesmotic injuries.

WHAT THEY DID
An electronic literature search was performed. Ten studies were included in the final analysis and were assessed for bias using the Methodological Index for Non-Randomised Studies (MINORS) scoring system. Data including demographics, descriptive statistics, and outcomes (e.g. time to return to sport, proportion of those who returned to sport, the Olerud-Molander Ankle Score) were extracted.
Inclusion criteria:

⇒ All levels of evidence
⇒ Athletes with ankle syndesmotic injury
⇒ Reported rate/time of RTS
⇒ Published in English in a peer-reviewed journal
⇒ Studies on humans

Exclusion criteria:
⇒ Lateral ankle sprains
⇒ Reviews, conference proceedings, opinion pieces, letters to the editor
⇒ Case reports
⇒ Not in English

WHAT THEY FOUND
From the ten studies included in this review, the average RTS rate to pre-injury level was 93.8% (range: 77.8-100%), The average time to RTS was found to be 55.2 +/- 15.8 days in a group of patients managed with medical assistance, and 41.7 +/- 9.8 days in a group of patients received not assistance with their rehabilitation. In one specific study, it was reported that patients had minimal to no pain and excellent foot specific function following surgical interventions (as measured by the Visual Analog Scale for pain, the American Orthopaedic Foot and Ankle Society score, and The Olerud-Molander Ankle Score), whilst another found that 2 out of 36 athletes had recurrent sprains which did not affect their RTS status.

» **Practical** Takeaways

The main point to take from this review is that most athletes with an ankle syndesmosis injury will be able to return to sport, although the time it takes to return will be longer than with a lateral ankle sprain. There is also evidence that suggests that the newer surgical technique of a button suture fixation may be superior to the trans-syndesmotic screw as it does not rigidly fix the joint in place and does not require a subsequent hardware removal procedure.

This study also identified that patients who have an injury to both the Anterior Inferior Tibio-Fibular Ligament (AITFL) and the deltoid ligament may take longer to RTS than those who have an AITFL injury in isolation. There are some differences in grading ankle syndesmosis injuries, particularly those identified radiographically as a grade II injury. It is also possible for radiographic images to show a grade II injury that we would expect to be unstable, but when tested clinically, it is a stable joint. This means that we cannot solely rely on the imaging for information on how stable or unstable the joint is.

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

Nicole's Comments

"This study is limited by the heterogeneity of the included studies. The 10 included studies were not consistent in how they defined RTS, and in how they cleared athletes to RTS. There were also differences across the studies in the grade of injury studied, the sport played, and the treatment applied. Therefore, there is still no way for us to identify superiority of one treatment over another for ankle syndesmosis injuries. Since it is not the most common injury seen, it can be difficult to perform systematic reviews and meta-analyses. This is where case series might be helpful in guiding the rehab process (see **HERE**)."

[Abstract]

How workload influences injury rates in professional football

OBJECTIVE

The acute-to-chronic workload ratio (ACWR) has been very topical amongst researchers and practitioners alike recently. However, minimal research has examined the relationship between injury and workloads of professional football players. Keeping players healthy and available for competition is crucial to club success and having a better understanding of how workloads influence injury rates can help clubs maximise player availability. Therefore, this study examined the relationships of accumulated workloads, the ACWR, and injury risk within Premier League football across three seasons.

WHAT THEY DID

The workloads of professional football players were quantified using GPS during all on-pitch training sessions and friendly matches whilst A semi-automated video system was used to capture workload data from competitive matches. Throughout the data collection period the following was calculated/reported:

⇒ Cumulative (1-weekly, 2-weekly, 3-weekly, and 4-weekly) loads
⇒ ACWR
⇒ Relative risk (RR) (the magnitude of injury risk above and below given workloads or ratios)
⇒ The workloads between injured and uninjured players was compared for all workload variables independently (e.g. total distance, low-intensity distance, high-speed running distance, sprint distance, accelerations, and decelerations)

WHAT THEY FOUND

The main findings of the study included:

⇒ The greatest overall injury risk was when there were low chronic workloads for accelerations, decelerations, and low-intensity distance combined with a very high ACWR (> 2.0)
⇒ With regards to non-contact injury risk, there was a 5-7 times greater risk of injury when there were low chronic workloads combined with very high ACWR for total distance, low-intensity distance, accelerations, and decelerations than there were when ACWR was <2.0
⇒ For contact injury risk, the largest risk was found when there were moderate to high ACWR for total distance, decelerations, and low-intensity distance

Practical Takeaways

Being exposed to very high ACWR with low chronic workload led to the greatest injury risk in this cohort, and regardless of the chronic workload, high ACWR was associated with increased injury risk. Although, this risk decreased with higher chronic workloads. Based on this evidence, it seems as though excessive and rapid increases in the acute workload may be primarily responsible for a large portion of non-contact injuries rather than high chronic workloads (i.e. overtraining).

In this cohort, 80% of the contact injuries occurred during competitive matches which may imply that players who were regularly in the starting team had a more consistent workload due to constant match load. These players, although they had a lack of variation in workloads, were at an increased risk of contact injuries, simply because most of the contact injuries occurred in competitive matches. This is an important point that emphasises the need to systematically and gradually increase a player's chronic workload prior to clearing them for return to competitive matches.

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

Nicole's Comments

"To calculate ACWR, you are meant to multiply the external load by the internal load to get Arbitrary Units (AUs). Those AUs are utilized to come up with weekly workloads and average workloads. This study, however, only took external workloads into consideration. The internal workload is the athlete's response to the external load and is typically measured with heart rate or rate of perceived exertion (RPE). The internal load is an important aspect to consider because it can alter the overall workload of an athlete if they are stressed, sleep deprived, nutritionally deficient, ill, or any other factor that may make a given external load seem more or less difficult than usual. For example, a 5km run at a given pace may normally be a 5/10 on the RPE for you. However, if you haven't slept well, are dehydrated, and stressed and then run that same 5km, you might rate it as being an 8/10 that day. When tracking training load with athletes, it is important to look at both the external and internal loads."

Infographics

A round-up of our monthly research infographics.

COLD WATER IMMERSION

Solomon, M. (2019) Science for Sport

DYNAMIC STRENGTH INDEX

Solomon, M. (2019) Science for Sport

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Cold Water Immersion

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What is it?

Cold water immersion (CWI) is a recovery process involving the immersion of the body into cold water immediately after exercise.

Does it work?

Research supports the use of CWI for reducing the effects of subjective measures post-exercise (i.e. DOMS and RPE), its effects on objective measures are far less apparent. This raises questions about the physiological mechanisms underpinning these findings.

Physiology

The primary mechanisms for CWI's ability to enhance recovery are still not fully understood. However, the following theories have been suggested:

- Vasoconstriction (blood vessel constriction)
- Analgesic (pain relieving) effect of the cold water
- Reducing inflammatory pathways
- Placebo effect
- Hydrostatic pressure

Blunted adaptation

Uncertainty within current research means that it is still unclear whether continuous CWI use reduces long-term adaptations or not.

Application

Though research is varied, the following advice is possible:

Temperature

Temperatures of approximately 11˚C are advised

Duration

Current research suggests that the optimal immersion duration is between 11-15 minutes.

Depth

Deeper immersion could lead to a greater improvement in recovery.

Our summary

CWI has been proven to improve recovery for subjective measures, but its effects on objective measures are far less apparent. The underpinning psycho-physiological responses of this recovery method are still not fully understood.

For the full article check out the Science for Sport website

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DYNAMIC STRENGTH INDEX

What is it?

The dynamic strength index (DSI) is simply a ratio between an athlete's ballistic peak force and their dynamic or isometric peak force.

Importance

The DSI provides information regarding how forceful the athlete is, and how much of that strength they can use during fast movements. The DSI can therefore be used to design individual training programs.

Measurements

The isometric mid thigh pull (IMTP) or 1RM dynamic back squat is used to measure an athlete's maximal force capabilities, whilst the countermovement jump (CMJ), which is a ballistic movement, is used to determine how much of their total force capability can they produce in a very short timeframe.

Calculation

The equation below is used to calculate an athlete's DSI:

Dynamic Strength Index (DSI) = Ballistic Peak Force / Dynamic or Isometric Peak Force

Table 1: Test scores and DSI calculation.

Exercise	CMJ Peak Force (N)	IMTP Peak Force (N)	DSI
Athlete A	1,450	3,178	0.46 (46%)
Athlete B	2,500	3,000	0.83 (83%)
Athlete C	2,600	2,600	1 (100%)

Application

A higher DSI means more time should be spent on developing maximal strength. A smaller DSI means more time should be spent developing the rate of force development, using ballistic strength training.

Table 2: DSI scores and training recommendation.

Score	DSI Score	Training Emphasis Recommendation
Low	<0.60	Ballistic Strength Training
Moderate	0.60-0.80	Concurrent Training
High	>0.80	Maximal Strength Training

Our summary

The DSI can be used to identify whether the athlete may require maximal strength training, ballistic strength training, or concurrent training as a stimulus in their programme. It can also be used to reliably measure the performance capabilities in both the lower- and upper-body and in recreational, university, and elite athletes.

For the full article check out the Science for Sport website

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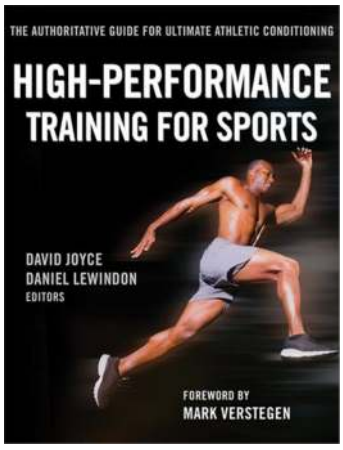

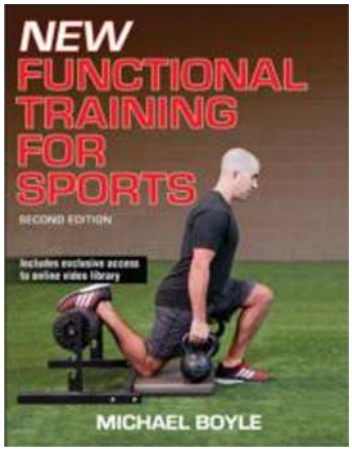

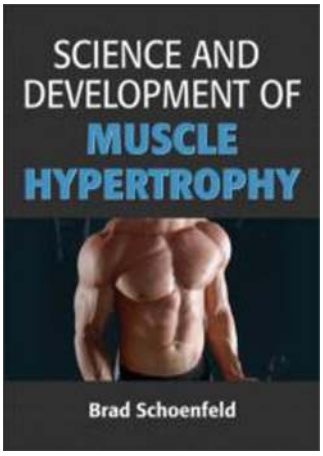

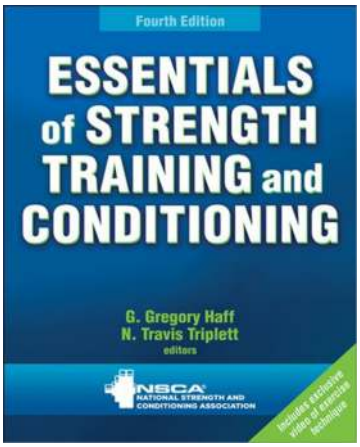

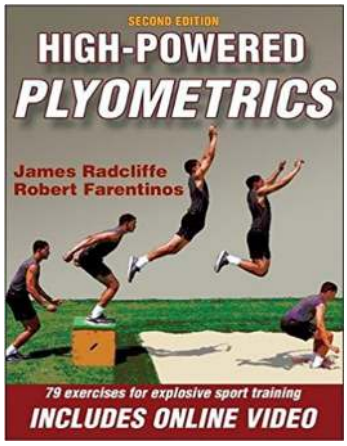

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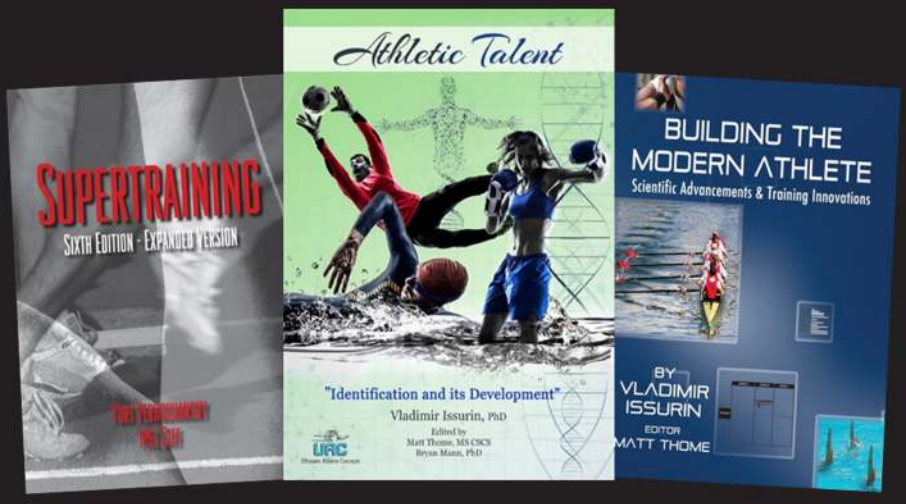

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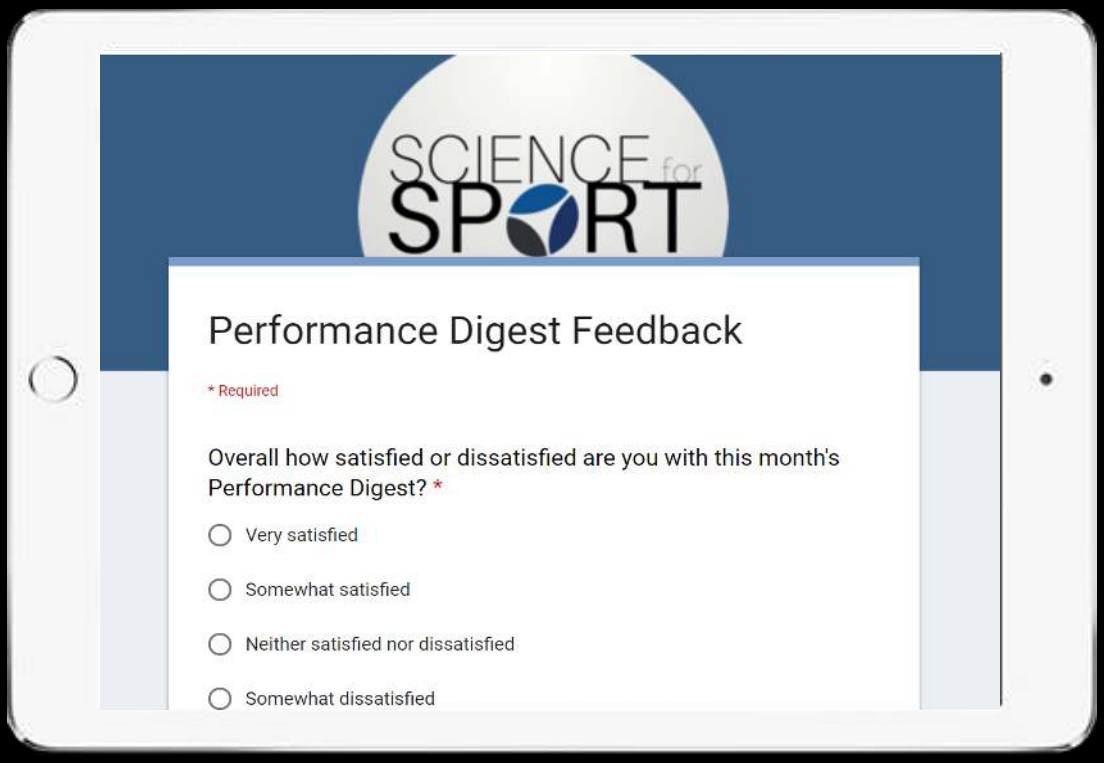

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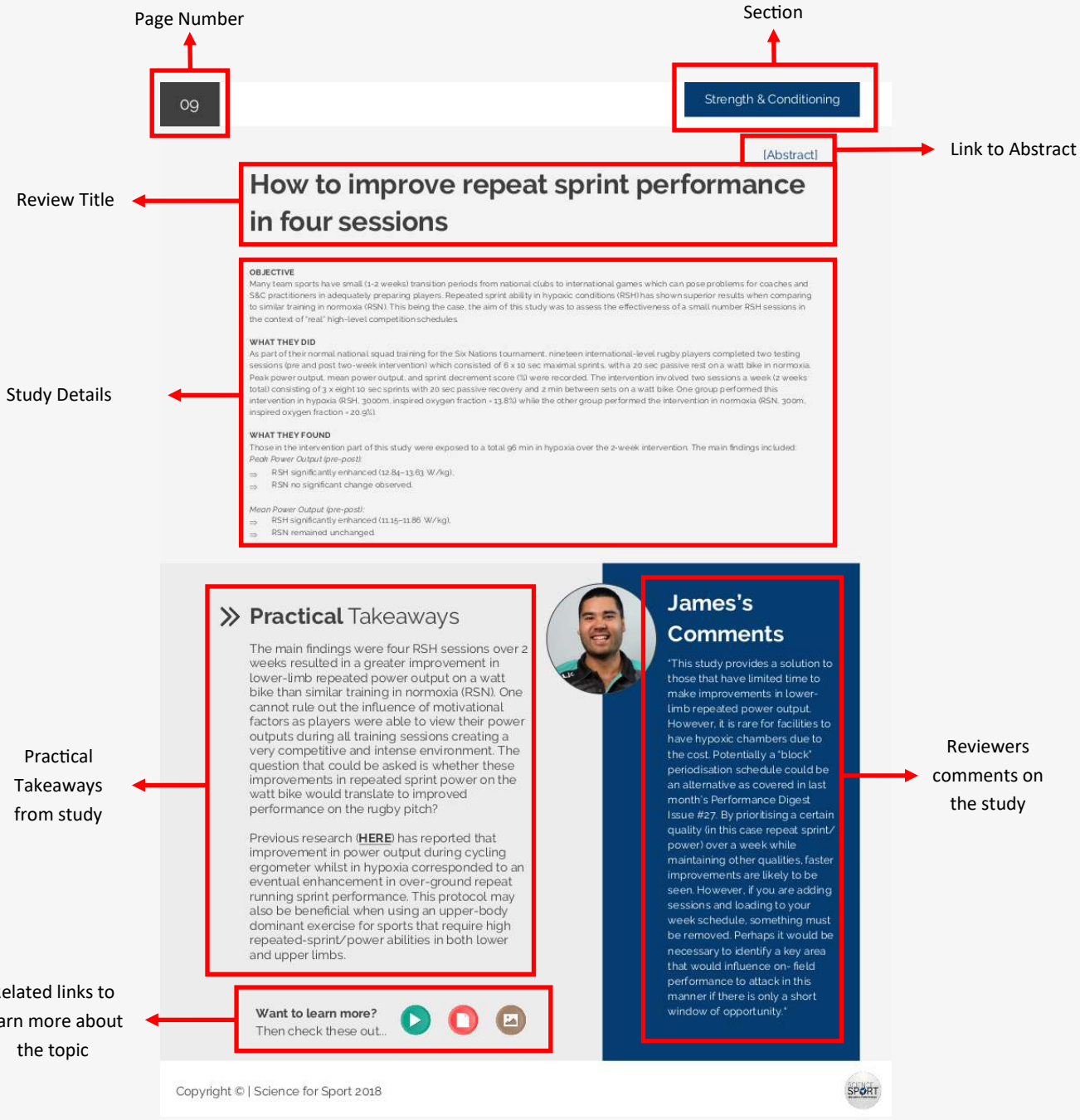

Thanks for Reading!

The next issue will be published on
1st April, 2019.

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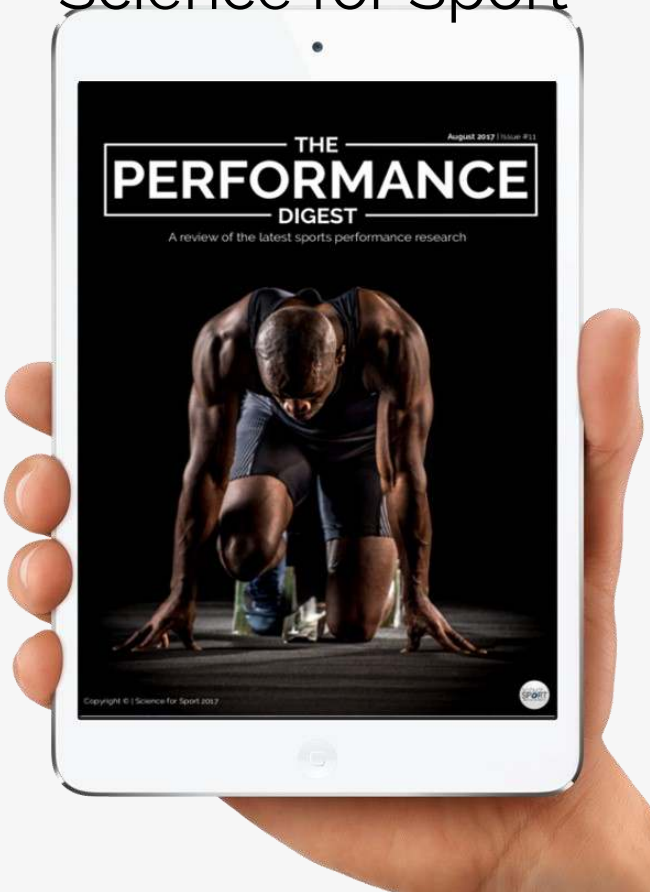
Warm Regards
Science for Sport



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