October 2018 | Issue #24

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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Welcome to the
PERFORMANCE DIGEST

OWEN WALKER
Founder and Director of
Science for Sport

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

LATEST NEWS

1) Big things to come!

This month I just wanted to let you know that we (Science for Sport) have very big things to come which we're very excited about, so keep you eyes peeled :)

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

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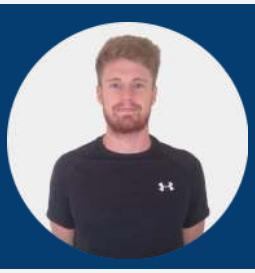
Research Reviewers



Owen Walker
MSc*D CSCS

Chief Editor

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

Francisco Tavares
PhD Candidate CSCS ASCA L2

Fatigue & Recovery

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

Dr. Will Vickery
PhD

The Science of Coaching

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

Tom Green
MSc UKAD Advisor

Youth Development

Tom is the Head of Athletic Development at St. Peter's R.C High School in Gloucester, England. He has an MSc in Applied Strength and Conditioning from Hartpury College. He has also worked with Gloucester Rugby Club as an Academy S&C Assistant and in professional boxing, semi-professional football, and GB Equine.

James de Lacey
MSc

Strength & Conditioning

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

James Morehen
PhD Candidate

Nutrition

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

Carl Valle
BSc

Technology & Monitoring

Carl is currently the lead sport technologist for SpikesOnly.com, and focuses his time on testing elite athletes and using technology to maximise human performance. Carl has coached Track and Field at every level, and also has significant expertise in performance data, including the practical application of equipment and software.

Dr. Stephanie Allen
PT, DPT, OCS, CFSC

Injury Prevention & Rehab

Stephanie is a Physical Therapist who graduated from Ithaca College and is working at Boston PT & Wellness. She is passionate about strength & conditioning and how it plays into rehab, and is also a member of the Strength Faction program.

Audio
REVIEW

Periodisation for Team Sports

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

with Matt Eyles

WHAT WE DICUSS

In this episode of the "Audio Review", Matt Eyles discusses how he periodises training for his Olympic female hockey players won have just the World Championships.

In this episode, you will learn:

- How Matt periodises training for Olympic team-sport athletes.
- The obstacles he faces working in a National team.
- The tasks which are necessary for a National team S&C coach.
- How he implements gym– and field-based S&C.
- How he individualises S&C for each athlete.
- How he periodises for the Olympic competition cycle.

A bit about **Matt**

Matt is a Strength and Conditioning Coach at Team NL (Dutch Olympic Team) with the women's field hockey who have just won the World Championships.

Episode length = 48 minutes

Listen Now

The Science of COACHING

Is communication quality between staff related to injuries?

It's not all about monitoring workloads.

[Abstract]

INTRODUCTION

The focus on injury prevention and workload management within the world of sport has never been more prevalent. You only have to turn to the back page of the newspaper (or the electronic equivalent these days) to notice how much time and resources are used by coaching and support staff to keep players in a state of availability to perform, come match day. Much of this focus is based on managing the workload of athletes through the use of numerous internal (e.g. perceived exertion) and/or external measures (e.g. GPS monitoring) (refer to any of the reviews **HERE**, **HERE**, or **HERE**). However, it may be that this is not the only way to ensure that players are injury-free (or as close to) and available to play. This study investigated whether the communication between the support staff of European football clubs had any influence on the injury rates and player availability.

WHAT THEY FOUND

The injury rate and status of 36 elite football teams was monitored across a four-year period, with the chief medical officer of each club also asked to complete a questionnaire at the end of each season - they were asked to describe their perception of the quality of communication within the club. The quality of the communication originating from the medical staff was initially examined with other support staff, including the coaches, before any links to player injury status and availability were determined. The results suggested that when a lower quality of communication between the medical and coaching staff was compared to both moderate and higher quality of communication there appeared to be a:

⇒ Higher injury burden;

⇒ Higher incidence of severe injury;

⇒ Lower attendance at training and;

⇒ Lower availability at matches.

Similar results were also reported when communication quality was examined between the medical staff and the fitness coaches. What is most interesting, though, is that when comparing the quality of communication between the medical team and each of the other factions of the support staff, the most significant in terms of quality was that between the medical and coaching staff.

WHAT THIS MEANS

Simply put, the quality of communication within the football teams was associated with both player injury rates and availability. Where low- or poor-quality communication existed, players were more likely to get injured more frequently and, therefore, less likely to be available for a match. The complete opposite was seen when high or good communication was reported. As stated by the authors, good and clear communication between the medical team and coaching and fitness staff when a player is injured or during the rehabilitation process might provide continual management of expectations. As such, this may lessen the probability of a premature return from injury and minimise the risk of a subsequent re-injury in the future.

Practical Takeaways

Regardless of the sport, the management of player workload, particularly within an elite sport environment, is one of the main priorities of the coaching and support staff. Although very rarely considered, the communication between these key stakeholders when discussing workload management plays a major role within the dynamic of sports teams and success. It is vital from a performance perspective that an effective channel of communication is present within any sport team. High-quality communication between these staff should take the form of both verbal (e.g. regular staff meetings and informal discussions between staff) and non-verbal (e.g. workload management databases).

Dr. Will Vickery

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

Strength & Conditioning

This month's top research in strength & conditioning.

VERTICALLY AND HORIZONTALLY DIRECTED POWER EXERCISES: WHAT'S THEIR RELATIONSHIP WITH SPRINT PERFORMANCE?
Loturco, I et al. (2018) PLOS One.

ACCENTUATED ECCENTRIC TRAINING TO ENHANCE PERFORMANCE?
Douglas et al. (2018) Journal of Strength and Conditioning Research.

CAN FLYWHEEL EXERCISE BE USED TO ENHANCE SPORTS PERFORMANCE?
Cuenca-Fernández, F et al. (2018) Journal of Sports Sciences.

[Abstract]

Vertically and horizontally directed power exercises: What's their relationship with sprint performance?

OBJECTIVE
It has been shown that the technical ability to apply force effectively against the ground is more important to elite sprint performance than the total magnitude of force produced (i.e. the amount of force an athlete can produce). It seems that the capability to orient the resultant force-vector horizontally while accelerating is a key determinant of speed. Therefore, the aim of this study was to examine the relationships between several mechanical measures assessed in hip thrusts and loaded jumps, unloaded vertical jumps, and performances obtained by professional sprinters and jumpers in different sprint distances varying from 10-150m.

WHAT THEY DID
16 top-level sprinters (Olympic & World Champ Level) participated in this cross-sectional descriptive study. On day 1, athletes performed a squat jump (SJ) and countermovement jump (CMJ) on a contact mat. They then followed this with a 60m sprint test using timing lights set up at 10, 20, 40, and and 60m on a track. Day 2 consisted of a 150m sprint, where timing lights were placed at 100m and 150m. Mean propulsive power outputs (MPP) were measured in the jump squat (JS) and half squat (HS), both of which were performed in the Smith Machine, while the hip thrust (HT) was performed with an Olympic bar. Three reps were performed with maximal intent at each load, starting at 40% body mass. After that, 10% body mass was added until a clear decrement in MPP was observed.

WHAT THEY FOUND
The main finding from this cohort was that independent of the movement axis (vertical or horizontal), all assessed exercises presented very large to near perfect correlations with all sprint distances (10, 20, 40, 60, 100, and 150m). The horizontally-based HT showed stronger associations with the initial phase of sprinting (0-10m), whereas the unloaded vertical jumps appeared to be more related with longer sprint distances (100m). Near perfect correlations (0.86-0.91) were found between HT MPP and all velocities assessed within the acceleration phase, up to 60m. The HS exercise (vertical orientation) MPP showed near perfect correlations with 10m velocity (0.82). The unloaded vertical SJ and CMJ showed the weakest (0.60) correlation to 10m velocity.

» Practical Takeaways

Based on this study, the use of the hip thrusts at MPP is a potential way of developing acceleration capacity in high-level sprinters. Interestingly, the half squat MPP showed near perfect correlations with 10m velocity, even though the exercise is vertically orientated. The authors put this down to the force-velocity relationship, where the load that maximises power output is categorised by heavy loading, low-velocity conditions during the half squat. As a result, it is rational to consider that sprinters who are able to produce higher levels of muscle power at lower velocities would be equally effective to overcome the inertia during the initial phases of sprinting.

Furthermore, the jump squat and hip thrusts presented similar correlations over the 150m course, suggesting that optimum power training might be effective for developing speed (check out my last month's review on optimal load training). While unloaded jumps showed the weakest correlations with 10m velocity, they presented very large to near perfect through the rest of the velocities measured throughout the 150m sprint. If during a vertical jump an athlete jumps higher than another athlete, they likely produce superior values of relative force and power than their weaker peer, which is of great importance for achieving high velocities during sprinting. In the article interview linked below, Matt Brughelli gives some interesting insight into horizontal vs. vertical force for sprinting. During an older interview, he states research has shown that runners apply sub-maximal vertical ground reaction forces during maximum velocity running. Thus, traditional S&C may improve performance through other variables. The use of complexes may, potentially, cover most athlete's needs in regards to gym work and speed. For example, complexing horizontal and vertical exercises with an optimal loading complex could look like this:

A1) Hip Thrust @MPP OPT Load 3x5
A2) Jump Squat @MPP OPT Load 3x4

OR

A1) Half Squat @MPP Opt Load 3x4
A2) 20m Sprint 3x1

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

James's Comments

"Generally, a sprint starts with a greater magnitude of horizontal force and, as the athlete accelerates, the magnitude of horizontal force decreases. Therefore, exercises that are categorised in the anteroposterior force-vector may provide a greater carry over to the initial phase of the sprint. This theory was supported by this study, where as the hip thrust showed greater correlations to 10m velocity compared to unloaded jumps. However, half squats performed at MPP also showed very large correlations with 10m velocity. As stated in the practical section, complexing both vertical and horizontal exercises may be a way to cover both your bases in horizontal and vertical force production. Having said that, that's not to say that it has to be done this way; there are many ways to cook an egg. Pairing two horizontal exercises together may give a better potentiation response due to the specificity of the force-vector. The video below gives an example of this by DeFranco."

[Abstract]

Accentuated eccentric training to enhance performance?

OBJECTIVE
Previous evidence indicates that accentuated eccentric loading (AEL) of traditional resistance training (TRT) exercises can induce greater enhancements in strength, power, and speed when compared to TRT alone. Superior adaptations in strength, power, and speed have been reported after chronic training with eccentric overload. Furthermore, there is evidence to suggest that fast eccentric contraction velocities with AEL training may elicit greater improvements in strength, power, and sprint performance compared to slower eccentric tempos. Thus, the purpose of this study was to investigate the effects of 4 weeks of slow eccentric tempo AEL training, followed by 4 weeks of fast eccentric tempo AEL training, in comparison with a TRT control group.

WHAT THEY DID
17 resistance trained academy rugby players were allocated into either AEL or TRT training groups. Subjects were in the preparatory phase of their respective programmes. The primary difference between the groups was the load used during the eccentric phase of the selected strength and power exercises. All other variables in the programme were matched. Both groups completed 2, 4-week training phases. The first phase emphasised a slow eccentric tempo (3-seconds) with a lower intensity and higher reps. The second phase emphasised a fast eccentric tempo (1-second) with a higher intensity and lower reps in the back squat. The eccentric load was 18-25% above the TRT load on a custom pneumatic Smith Machine. Testing was performed before, during and after the intervention over 2 days. The first day consisted of a 40m sprint measured using a radar system and concentric muscle power of the lower limbs through a custom built inertial load (IL) cycle ergometer. The cycle was performed maximally for 4-6 seconds and, from this, power-velocity and torque-velocity relationships were calculated. Day 2 consisted of an ultrasound scan for muscle architecture, a 0.50cm drop jump, and a 1RM back squat.

WHAT THEY FOUND
After the first 4 weeks, a small improvement was found in back squat strength in the slow AEL group, which was found to be likely superior to slow TRT (+0.12kg/BM; ES = 0.48). Slow AEL resulted in small improvements in 20m and 40m times. The improvement in 40m time was possibly superior compared to slow TRT (-0.07sec; ES = 0.28). Slow AEL training also elicited likely small improvements in Vmax (+0.2m/s; ES = 0.52), contact time (-0.01sec; ES = -0.45), step rate (+0.2Hz; ES = 0.83), and vertical stiffness (+0.05kN/m/kg; ES = 0.5), which were likely greater than slow TRT. In contrast, a moderate increase in IL optimal cadence with slow TRT was likely greater compared with slow AEL (+3.6RPM; ES = 0.52). No changes were seen in muscle architecture for either group. There was a possible small increase in drop jump flight time with slow TRT, but this had no effect on the reactive strength index (RSI; measured using the 50cm drop jump).

After the second phase, a likely reduction in drop jump contact time (-0.02sec; ES = -0.82) was observed in the fast AEL group which resulted in a small increase in RSI (+0.12; ES = 0.37) and likely moderate increase in leg stiffness (+0.05; ES = 0.77). The reduction in contact time was likely greater than fast TRT (-0.02sec; ES = =0.66). However, there was no clear difference in RSI. There were moderate increases in 10, 20, and 40m times with fast AEL, as well as small reductions in Vmax in both fast AEL and TRT. A small increase in IL peak power was observed for fast TRT which was likely greater than fast AEL (+0.72W/kg; ES = 0.4). Finally, there was a small increase in Vastus Lateralis muscle fiber pennation angle with fast TRT, however, there was no clear difference versus thes fast AEL.

Practical Takeaways

The main findings were that 4 weeks of slow AEL training was superior to slow TRT for improving strength and sprinting within a concurrent training programme. In contrast, a second 4-week phase of fast AEL did not seem to elicit any further improvements (other than a small increase in RSI) and may have even compromised sprint performance. This paper suggests that team-sport athletes may be less responsive to fast AEL training or chronic eccentric exercise in combination with concurrent training (technical, tactical, conditioning), and performance is possibly impaired with this periodised approach. Below I have linked a PDF that runs through a potential periodised approach you can use for eccentric training. A longer recovery period may, potentially, have been needed after 8 weeks of chronic eccentric training to see improvements in performance.

A pneumatic Smith Machine is very rare. However, weight releasers are a more realistic alternative for those wanting to perform accentuated eccentrics. Here are some guidelines for slow and fast eccentric training taken from the resource below:

Slow: 100-130% 1RM ECC: 70-85% 1RM CON
Fast: 120-150% 1RM ECC: 30-50% 1RM CON

Following slow and fast eccentrics, ballistic-style eccentrics can potentially be incorporated. Check out the video linked below for some examples.

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

James's Comments

"If you haven't read or own Triphasic Training by Cal Dietz, I recommend obtaining that resource if you are interested in eccentric training. In the book, Cal lays out some great tables and examples when using sub- and supra-maximal eccentric work that requires no other equipment. However, if accentuated eccentric training is something you want to implement and you don't have the special equipment, there are some low-cost ways to do this.

For example, a KB swing where a partner pushes down on the KB creating a faster eccentric phase. Another is the use of 2 legs up, 1 leg down during a leg press or leg curl which can replicate the slow accentuated eccentric training phase."

[Abstract]

Can flywheel exercise be used to enhance sports performance?

OBJECTIVE
Explosive actions from a stand still are an important component in many sports that involve accelerating a body mass quickly. A swim start is just one example and should include a fast reaction time, significant jump power, high take-off velocity, and low drag entry into the pool. In sprint events, a fast start is fundamental for competitive swimming success and it apparently contributes to 0.8-26.1% of the overall race time, depending on the event. Post-activation potentiation (PAP) has been shown to improve exercise performance when a previous conditioning exercise is performed. Hence, the aim of this study was to assess the effects of a PAP-inducing exercise based on eccentric flywheel maximal repetitions in the strength-related variables of a swim start.

WHAT THEY DID
13 (11 male, 2 female) competitive swimmers with <5 years of national-level competitive experience participated and two conditions were performed. First, 3 kick starts were performed with 6-mins rest between (USUAL). NOTE: A kick start technique involves a diving platform with a backboard for the foot to push off in a staggered stance. The second condition involved 5 repetitions on the eccentric flywheel 6-min before performing the kick start (PAP). The initial position on the flywheel consisted of the same position that was performed by swimmers on the starting block with staggered limbs. Repetitions were performed maximally in the vertical direction. The starting block for the kick start technique included 5 triaxial force plates to measure various strength measures. A new category for analysis was performed called "PEAK", where the best outcomes from each subject across trials were compared to the PAP condition to see if PAP may be faster than the quickest start a swimmer could do without the PAP-inducing activity.

WHAT THEY FOUND
No differences were found for reaction time, movement time, or block time in any of the comparisons between USUAL and PAP, nor when PEAK was considered. Peak horizontal force showed no differences between the USUAL and PAP conditions, while PAP values were lower than PEAK (624.39 + 58.60 N vs. 700.58 + 30.99 N, respectively). Peak vertical force was higher after PAP vs. USUAL (551.79 + 106.43 N vs. 509.55 + 105.26 N, respectively), but no differences were found between PAP and PEAK. Significant differences were found in vertical impulse between USUAL and PAP (18.25 + 29.54 N/s and 41.35 + 35.91 N/s, respectively). Velocity was higher for PAP (0.78 + 1.86 m/s) compared to USUAL (0.29 + 1.43 m/s), but not when comparing to PEAK. Vertical acceleration and peak power for PAP were greater than USUAL. RFD Rate of force development was also found to be higher in PAP the condition compared to the USUAL.

Practical Takeaways

As a result of the vertical force improvements, this study suggests that swimming start performance can be slightly improved after eccentric flywheel exercise as a result of vertical force improvements of the lower limbs. The PAP warm-up produced improvements in vertical forces which transferred to a higher resultant velocity at take-off. The results suggest that swimmers who possess greater maximum force and RFD rate of force development tend to achieve faster velocities at take-off. This improvement was seen in the vertical direction, where horizontal variables showed no improvements after PAP. It is conceivable that the lack of improvement in the horizontal direction might be a consequence of the PAP exercise being predominantly vertical. Based on this paper, the vertical force/impulse components, rather than horizontal vectors, may be crucial in improving swimming start performance.

It is unknown whether the full range, fast eccentric phase of the PAP exercise on the flywheel is what is needed to elicit these kinds of changes. Perhaps, simple jump exercises may elicit a similar response in improving force/impulse variables and, subsequently, take-off velocity if the jumps are loaded heavy enough to evoke high levels of force. This could be a reasonable alternative for those with smaller budgets. One example that would mimic the flywheel exercise used in this study would be a B stance or staggered stance trap bar jumps. If travelling, a short split stance DB jump may also serve as a similar PAP exercise for the kick start.

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

James's Comments

"I understand there may not be many swimmers or swim coaches as readers of the Performance Digest, however, I decided to include this study due to the use of the flywheel as a way to induce PAP for ballistic take-off performance (which is also important for sprint performance). In addition to this, and given the recent threads in the Science for Sport Members-Only Facebook group on different ways to perform a 'primer', I thought this would be of particular interest to you.

Based on the research (some of which has been reviewed in previous Performance Digest issues), PAP seems to be upper- and lower-body specific, force- and velocity-specific, as well as force-vector specific. When designing a PAP sequence to enhance a competitive movement, taking into account the direction of movement and whether force or velocity should have a greater emphasis may be an added key to improving performance. It may be an idea to identify an athlete's force-velocity profile prior to competition and prescribe the pre-conditioning exercise to address a force or velocity deficit to enhance take-off velocity."

Technology & Monitoring

This month's top research on technology and monitoring.

IS THERE A RELATIONSHIP BETWEEN SUBJECTIVE INDICATORS OF RECOVERY STATUS AND HEART RATE VARIABILITY?
Flatt A.A. et al. (2018) Sports.

CAN HORMONE TESTING BE USED TO HELP MONITOR YOUNG ATHLETES DURING THEIR DEVELOPMENT PHASE?
Hammami M, et al. (2018) Journal of Sports Science and Medicine.

TEAM-SPORT TRACKING TECHNOLOGY: ARE THEY VALID AND ACCURATE?
Linke D, et al. (2018) PLoS ONE.

[Abstract]

Is there a relationship between subjective indicators of recovery status and heart rate variability?

OBJECTIVE
Coaches need a balance between subjective and objective recovery measures to make better training decisions, and to discover what is holding back an athlete's recovery. A popular approach is to use a combination of physiological monitoring and wellness questionnaires to reduce overtraining and observe recovery, while practical ways to implement recovery modalities are usually cumbersome. A modern, quick, and convenient method that can tease out recovery based on load tracking would be very useful for coaches. Based on the aforementioned needs of coaches, this study aimed to help coaches monitor the athlete's recovery as a whole in relation to their training load with subjective and objective data.

WHAT THEY DID
Researchers monitored 17 elite sprint-swimmers for a period of one month, and monitored both subjective indicators and smartphone Heart Rate Variability (HRV) measures from an app and a finger sensor (Validation **HERE**). Training load was estimated based on duration of activities (hours of swimming and resistance training). Due to the similarities of the workouts, the training load was considered standardised among the group.

WHAT THEY FOUND
The findings were surprising but not shocking, a similar training load with a homogeneous group of male sprinters had considerable variation to the training with regards to subjective athlete self-report measures of recovery (ASRM). Perceived sleep quality was the strongest associated subjective indicator to cardiac-autonomic parameters, but the underlying reason was unknown. It is interesting to note that perceived muscle soreness and heart rate parameters were not found to have an association, thus questioning how coaches should interpret subjective data.

Practical Takeaways

The research study provided a few important takeaways, specifically the value of collecting both subjective and objective data to compare and contrast. Coaches should create a "checks and balance" with a combination of subjective indicators and objective physiological responses. Which, in other words, means to employee a combination of subjective and objective measures with no particular measures having more power over any of the others. In addition to the approach using simple applied methods of questionnaires and app-based technology, the study supports using a finger sensor for more practical measurements methods of HRV. The different responses to the standardised training load physiologically and subjectively do demonstrate the need to individualise training more based on lifestyle factors. Coaches may want to adjust training to sleep metrics (e.g. how long they slept) rather than encouraging the blind recommendation of getting more sleep.

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

Carl's Comments

"A common, but questionable, approach to recovery is to educate the athlete on the value of getting more and higher quality sleep, when sleep may be affected by training load (Interesting Rugby Study **HERE**).

Adding HRV monitoring and subjective indicators increases the spread of data that may be relevant to any sport outside of swimming, as soreness in swimming may not be representative of land-based sports where eccentric damage is more sensitive to performance and recovery (e.g. rugby). Due to the speed of data collection, I would recommend coaches in all sports rethink HRV monitoring regardless of sport they are involved with."

[Abstract]

Can hormone testing be used to help monitor young athletes during their development phase?

OBJECTIVE

The need to protect the long-term health and development of athletes requires a systematic way to monitor their physical and developmental growth. Blood analysis is a potential tool to safeguard chronic depletion of an athlete and, whilst it is interesting on paper, biomarkers are sometimes unable to reveal actual cause and effect, if performed at arbitrary time intervals. Measuring biomarkers periodically over the course of an athlete's developmental period could show if training load is interfering with physical growth, thus being a novel way to nurture athletes. The main purpose of the study on youth athletes was to explore how hormone testing could be used to help monitor them during their development phase.

WHAT THEY DID

Researchers measured jump performance, speed, conditioning, and anthropometric data of male youth soccer players under the age of 18 over a two-year span. Statistical analysis of all of the data points was calculated using ANOVA analysis, including estimates of physical maturation. Blood testing was done five times, from October 2008 to May 2010, by assessing IGF-1, IGFBP-3, and Growth Hormone. 36 total subjects were monitored, with half being the control (general population students) and the other half being the experimental group (soccer players).

WHAT THEY FOUND

The researchers did not find any indication of blood parameters showing a strong relationship, though the athletes had higher resting levels (basal) of hormonal concentrations compared to age-matched students. Since training load was not quantified and blood testing was arbitrarily assessed, the researchers didn't see a fatigue pattern of note. In summary, a two-year soccer period does not appear to impair the hormonal concentrations of GH, IGF-1, and IGFBP-3 (insulin-like growth factor binding protein) during the developmental years.

Practical Takeaways

At first glance, it looks like testing hormonal concentrations of growth hormones is not worth performing on young athletes, primarily because they don't reveal anything more than just the differences between active and sport participants, based on the data. What the researchers did note, however, was the limitations of their own study, since they only did resting data infrequently, unlike the studies done with German professionals (**HERE**) and the American collegiate player study reviewed last month (September 2018 issue of the Performance Digest).

The study does hint that if a team wants to monitor adaptation of athletes, the method used in this study is likely to be inappropriate, require more testing during the year, and, to add to this, better timing of the tests needs to be implemented. Another intriguing study on IGFBP-3 with overtraining was done with Rugby years ago (**HERE**), and while it's promising, it's still difficult to interpret. The strongest component of the study was the method of assessing soccer athleticism, as it used common tests that allow for easy comparison internally and externally.

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

Carl's Comments

"Blood testing is an expensive approach to monitoring athletes and the best practice requires the appropriate biomarkers and the right timing of the blood draw to be effective. General screening works for deficiencies or scores that are way out of normal reference ranges, but a shotgun approach without careful design is ineffective for analysis.

If coaches are going to use blood testing, especially with hormonal biomarkers, they should consider simple nutritional markers of health first. Due to the low value of using hormones in monitoring youth athletes, it's better to save those measures for advanced athletes who have fully grown and test them in a manner (quarterly after heavy phases) that can identify periods of excessive and unnecessary exhaustion."

[Abstract]

Team-sport tracking technology: Are they valid and accurate?

OBJECTIVE
Tracking athletes is essential in order to estimate the work rates and loading patterns on their bodies. Due to the array of different methods of collecting data, coaches need to know what can be used to accurately track athletes and know if the data presented can be used interchangeably with other systems. Along with different technologies, different sport activities are problematic in quantifying sports monitoring. Therefore, a thorough investigation to how accurate all of the main sports tracking options are to a research-grade motion captures system is especially useful; hence the purpose of this study.

WHAT THEY DID
The researchers observed players of a German soccer club with motion capture during practice activities and cross-referenced the data with three electronic athlete-tracking modalities. Video, GPS, and local positioning system recordings were all compared to motion capture (VICON) during a sport-specific circuit on a soccer pitch. After the data was collected, heavy statistical analysis was performed and comparisons were made on the congruency of the tracking systems.

WHAT THEY FOUND
The study concluded that the KPIs (Key Performance Indicators) of athlete tracking (**HERE** is a useful article on this topic) in a small area have notable deviations from each other. The authors concluded the measurements are not interchangable, and different systems require algorithms to correct for those errors and accuracy issues. Due to the fact athletes will compete and train with different tracking technologies, each system should be considered separate information and not be compared with one another.

Practical Takeaways

It's vital that coaches and sport scientists know the limitations to the accuracy and validity of their products compared to a gold standard (awesome video **HERE**) or similar. In addition to accuracy, the repeatability of the data is just as essential, because comparisons internally do provide value to professionals. Based on the research on each system used in this study, be it video, GPS, or local positioning system, all of them have strengths and weaknesses when collecting KPIs in athlete tracking. Since these systems are constantly refining and improving their data, legacy information from past years is difficult to compare with modern and different capture methods.

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

Carl's Comments

"Coaches should note that athlete tracking with every technology will always be an estimation of actual loads, rather than a very precise and exact measure. A fair question is how much accuracy is necessary to be useful, as interventions are usually very crude to be beginning with, such as fueling and rest options. Due to the limitations of the data, coaches should continue to use other measures of performance, such as field-testing and monitoring recovery to complement athlete tracking. In my opinion, the use of GPS systems are great for outdoor monitoring because of price, portability, and the data is useful."

Fatigue & Recovery

This month's top research on fatigue and recovery.

IS THERE A RELATIONSHIP BETWEEN WORKLOAD, THE ATHLETE'S STATE OF RECOVERY, AND INJURY?
Timoteo TF, et al. (2018) Journal of Strength and Conditioning Research.

WHEN IT COMES TO MEASURING RECOVERY STATUS, WHAT'S THE BEST MEASURE TO USE?
Noon M, et al. (2018) Sports.

CAN SELF-REPORTED WELLBEING MEASURES BE USED TO MONITOR FATIGUE, INDEPENDENT OF AGE AND PLAYING POSITION?
Hills S, and Rogerson D. (2018) Journal of Strength and Conditioning Research.

[Abstract]

Is there a relationship between workload, the athlete's state of recovery, and injury?

OBJECTIVE
In many sports, a strong association has been demonstrated to exist between training load and injury occurrence, however, no study has investigated if workloads and recovery state have an influence on injuries in volleyball. As a result, in this study, the authors investigated the relationship between workloads and the athlete's state of recovery with injuries during a 27-week elite volleyball season.

WHAT THEY DID
Training loads, perceived recovery, and injury occurrence were tracked in 14 elite male volleyball players during a 27-week season period. The following measures were obtained:

⇒ Game and training session rate of perceived exertion (RPE)
⇒ Week workload (sum of each week session RPE)
⇒ Weekly load monotony (average weekly workload / SD of weekly workload)
⇒ Weekly load strain (monotony / weekly workload)
⇒ Weekly acute:chronic workload (A:C; Week workload / 4-week rolling workload average)
⇒ Recovery status obtained from Total Quality Recovery (TQR; rating of recovery on a 6-10 scale [see the article link below])
⇒ Injury occurrence was categorised according to training/game time-loss: slight (no absence), minimal (1–3 days), mild (4–7 days), moderate (8–28 days), and severe (more than 28 days)

Three groups were created according to injury occurrence: 1) healthy, 2) traumatic injury, and 3) overuse injury. The analysis included the number of injuries per 1000 training/game hours and were compared to weekly workloads and A:C, differentiating pre-season and in-season periods.

WHAT THEY FOUND
64 injuries occurred during the 27-week period, with 53 of them being related to overuse. 46 of the injuries did not result in any time-loss. The amount of injuries resulted in an occurrence rate of 14 injures per 1000 hours of training/game.

Weekly training loads, A:C workloads, and injury occurrence during pre-season were significantly higher than loads during the in-season. Players who had injuries (overuse and/or traumatic) had significantly higher A:C workloads and lower TQR in comparison to uninjured players. A:C workloads and TQR were found to be both a risk and a protective factor towards injury occurrence. In addition to this, the odds of athletes getting injured appear to increase by more than 3 times for players who had higher A:C workloads.

Francisco's Comments

Given that the A:C workload (read more **HERE**) and TQR were found to be related to injury occurrence, monitoring these variables is highly recommended in order to reduce the likelihood of injury.

Practitioners should pay special attention during the pre-season phase when training loads and spikes in training loads are substantially increased. Although achieving "functional overreaching" is often seen as goal of pre-season periods, logical and well-structured periodisation of this phase of the season should be a focus for the coaching and medical staff. This includes not only the management of daily and weekly training loads, but also the progression in training loads from week to week. The design of the training schedule should also be carefully considered in order to allow players to optimally recover between training sessions and match days. Furthermore, strategies such as nutrition (e.g. have snacks available for athletes to refuel between training sessions) and recovery modalities (e.g. cold water immersion) should be implemented to speed-up recovery.

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

Francisco's Comments

A growing body of research has investigated the effects of training load spikes on injury occurrence. Typically, the load of a training session or a training week is compared to the mean of previous training weeks.

In this study, the weekly training load was compared to the 4-week rolling workload average, with the authors reporting that a higher A:C workload increased the odds of injury by more than 3 times. Moreover, lower TQR scores were also associated to injury occurrence. These findings reinforce: 1) the need to monitor not only absolute training loads, but also A:C workloads; 2) to interpret training load data in combination with recovery (objective and/or subjective) measures.

As I mentioned in the practical takeaways, pre-season training loads are typically higher in comparison to the in-season. Due to the limited duration of pre-season periods, sharp progressions in training loads are often observed which results in higher A:C workloads and an increased likelihood of injury. These findings reinforce the importance of training periodisation in order to gain significant adaptations and injury prevention. In order to avoid spikes in training loads and injuries during the pre-season, practitioners can adopt some of the following strategies with their players. These include:

⇒ Educate the players to allocate some time to exercise during off-season;

⇒ Start the first week with a half-week followed by two recovery days;

⇒ On long pre-seasons (e.g. 10 weeks), allocate one unloading week (e.g. week 4) and a taper week (e.g. week 10). On shorter pre-seasons (e.g. 4-5 weeks), allocate a week of tapering prior to the competitive season;

⇒ Use individual/position-specific progressions on workloads. rather than generalising the same load volume for the entire squad.

[Abstract]

When it comes to measuring recovery status, what's the best measure to use?

OBJECTIVE
By monitoring the recovery of individual players, practitioners are able to manage training loads and make changes to training sessions in order to decrease the risk of injury. Although objective and subjective measures are frequently collected by many practitioners, until now, no study has investigated how these measures respond individually to different training loads. Therefore, the goal of this study was to compare the sensitivity of different subjective and objective measures to detect group and individual responses to a low and high training loads.

WHAT THEY DID
13 academy rugby union players performed a low (15min) and high load (90min) bout of high-intensity exercise. Each athlete performed both protocols with a one week interval between protocols.

Measures of subjective and objective recovery indices were obtained at baseline and 20 hours after each protocol. These measures included the Subjective Self-Report Wellbeing Questionnaire (**HERE**), resting heart-rate (HR), HR variability, and the countermovement jump (CMJ).

WHAT THEY FOUND
When analysed as a group, wellness scores (small to large effects), resting HR (very large effects), and HR variability (moderate ES) were sensitive to detect changes in training load. However, CMJ was not sensitive to changes in training load (trivial ES).

When subjective and objective measures were analysed individually, objective measures seem to be less sensitive and more individual to training loads in comparison to subjective measures. Although HR variables were sensitive to monitor acute increases in training load from a group perspective, the large day-to-day individual variation in these measures demonstrates that HR variables may not be sensitive enough to be used individually.

Francisco's Comments

Frequently, objective and subjective measures are collected on a daily to weekly basis in order for practitioners to detect "red flags" in their athletes and make changes in training, if necessary. This study has demonstrated that subjective measures are not only easier to implement, but they are also more sensitive than objective measures when it comes to tracking changes in training load.

It is, however, important to mention that the measures in this study were compared to a standard baseline score. This leaves room for error as it decreases the sensitivity to monitor individual changes. For example, a 1-point change in a subjective measure can be a severe change for one individual but not for another. In order to eliminate the variation in individual measures, practitioners can use Z-scores for both objective and subjective measures. A Z-score represents how many standard deviations from the individual mean the daily score is. Or, in simpler terms, how much of a change from the mean a certain daily score represents. It can be easily calculated using the following equation: Z-score = (measure score – mean) / standard deviation and by using this example worksheet (**HERE**). See the differences from obtaining changes from baseline using raw data and Z-scores on the attached image below.

From my experience, subjective markers of fatigue provide more meaningful information than objective markers. I have extensively used a 5-item (sleep quality, mood, muscle soreness, and stress) wellness questionnaire (see attached study #1) as a subjective tool. In addition, I have explored muscle soreness in greater detail by dividing the muscle soreness item into different muscle sites and differentiating from left and right sides (e.g. calves, hamstrings, gluteus, quadriceps, and groins). It has been found that monitoring the lower body at different muscle sites is more sensitive than a single question about muscle soreness (see study #3 attached).

Whatever tests practitioners chose to include as monitoring tools, these tests need to be valid, reliable, sensitive to detect small changes in training loads, and easy to apply. Ideally, for me, the daily monitoring test battery should be divided into two sections:

⇒ Objective tests that can inform us about readiness to train from an injury prevention perspective (e.g. groin squeeze test, knee-to-wall, etc.);

⇒ Subjective measures that provide information about the readiness of the player to train.

The testing battery should be implemented before the first training session of the day, and the data must also be analysed prior to the first training in order for the coaching staff to make changes in the training schedule for some players, if necessary.

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

Practical Takeaways

"Apart from CMJ, the remaining measures appeared to be sensitive enough to monitor acute changes in training load. When individual scores were analysed, subjective measures were more sensitive in comparison to the HR variables obtained.

Given the time-cost of collecting and analysing data, together with the lack of sensitivity to detect changes from different training loads, monitoring recovery using objective measures may not be entirely practical for the applied setting. On the other hand, subjective measures are more sensitive to detect changes in fatigue levels from different training loads and can be easily collected on a daily basis. Therefore, a perceived subjective assessment should most definitely be implemented instead of objective measures."

[Abstract]

Can self-reported wellbeing measures be used to monitor fatigue, independent of age and playing position?

OBJECTIVE
Together with objective measures, such as the countermovement jump (CMJ), wellness questionnaires are commonly used to monitor fatigue in team-sports. Until now, however, no study has analysed if changes in wellness and CMJ measures differ with age and between different rugby playing positions. Therefore, the aims of this study were twofold: 1) to understand the differences between self-reported wellbeing measures and CMJ; and 2) to identify if age and playing position interfere with this relationship.

WHAT THEY DID
A wellness questionnaire and a CMJs protocol was performed by 37 professional rugby players over a 12-week period. These measures were obtained on the first training day of the week. The wellness questionnaire was comprised of 5 questions: general fatigue/vigor, upper-body soreness, lower-body soreness, mood, and sleep quality/duration. A total wellness score was calculated from the sum of the 5 items.

The CMJ protocol consisted of 5 consecutive CMJ with a 20kg barbell. The barbell was attached to a linear position transducer and measures of peak velocity (m/s), dip of eccentric action (m), duration (s), and time to peak velocity (s) were collected. The average score across the 5 repetitions of the CMJ was used for further analysis. Further analysis included the division of the group into forwards and backs, and into under 25 and over 25 years old.

WHAT THEY FOUND

A significant decrease of the total wellness scores to baseline were observed throughout the 12-week period. A similar trend on changes in wellness questionnaire items was also observed over the period of the study, with the widest fluctuations being observed for upper- and lower-body muscle soreness and fatigue.

Peak velocity on the CMJ was lower than baseline throughout the study, with significant decreases being observed later in the study. A trend for lower CMJ peak velocity scores over time was also observed. Significant correlations were observed between total wellness and CMJ variables (positive for: velocity, dip, time; negative for: duration). Significant positive correlations were also observed for each wellness item and CMJ velocity. In general, these relationships were also observed for each subgroup of age and position.

Francisco's Comments

In general, I think this study provides very important practical applications to monitor fatigue in team-sport athletes. As I mentioned on my previous review of this Performance Digest issue, subjective measures can be a practical way to monitor our players fatigue and readiness to train. However, although wellness questionnaires are easy to implement, some important points need to be considered before using subjective measures. Those being:

⇒ Players need to be educated as to why they are required to complete the questionnaire every day/week. This includes some basic education around key training concepts such as individualisation and training stimulus adaptation (i.e. fatigue and recovery);

⇒ Questions should provide information to the coaching staff, rather than just collecting data for the sake of collecting data. This means that if there is a meaningful change in an athlete's wellness item score, there will need to be some action (e.g. a conversation with the player, a change in the gym programme, and/or a change in the team training);

⇒ The wellness questions scores should provide more information than just a number. The player's answers must be seen as a notice on how to approach the player on that training day. For example, "Good morning, I have seen that your lower-body soreness was considerable higher than usual for a training day 4. Do you feel sore in any particular area of your body? You feel the same in both sides? Have you changed anything on your recovery day routine?" you might ask.

Similarly to this study, I believe that players are not able to fully recover between training weeks in many team sports. This demonstrates the need for careful periodisation of training loads. Some examples of strategies to decrease training load are to:

⇒ Include some bye weeks (i.e. no match) every 8-12 weeks;

⇒ Rotate the squad to allow for some players to have a longer recovery period (e.g. 48-72 hours);

⇒ Decrease of training load (team-training running loads, gym, and/or meetings) in certain weeks (e.g. 1 week unload in each 4-week training block).

Even when dealing with amateur team-sport athletes where training loads are lower, practitioners should still understand that fatigue can also be accumulated as stress is a multifactorial concept (e.g. players can be going through a demanding study phase that disrupts recovery or be working over-time). Therefore, periodisation of training loads cannot be seen as something which is only applicable for professional teams – it's just as important for amateur teams.

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

Practical Takeaways

"The fact that incomplete recovery (i.e. re-establishment of wellness and CMJ scores to baseline) was observed throughout the study demonstrates that the typical 1-day off between the match and the beginning of subsequent training week may be insufficient to fully recovery.

The 5-item wellness questionnaire was demonstrated to be sensitive to changes in training load, meaning that this tool is useful for monitoring an athlete's fatigue.

Practitioners need to be aware that when using subjective markers of fatigue to adjust training load, players can misrepresent their scores to see their training load manipulated. Moreover, individual changes rather group changes must be used when interpreting measures of wellness (see my "editor's comments" on the previous study I just reviewed).

When possible, subjective markers of fatigue should be combined with more in-depth measures of fatigue and injury prevention tests (e.g. groin squeeze test). Ideally the testing battery should be individualised according to each athletes' injury history and a qualitative analysis should be done by medical and strength and conditioning staff members."

Youth Development

This month's top research on youth development.

CAN A TARGETED PROGRAMME REDUCE LOADING RATES IN ADOLESCENT FOOTBALL PLAYERS?
Lagas, I.F. et al. (2018) Journal of Science and Medicine in Sport.

SHOULD PRE-PUBERTAL CHILDREN TRAIN BOTH AEROBIC AND ANAEROBIC QUALITIES ALONE OR IN SYNCHRONY?
Alves, A.R. et al. (2018) Journal of Human Sport and Exercise.

INDIVIDUAL RESPONSES TO PLYOMETRIC TRAINING: DOES IT WORK FOR EVERYBODY?
Ramirez-Campillo, R. et al. (2018) Frontiers in Physiology.

[Abstract]

Can a targeted programme reduce loading rates in adolescent football players?

OBJECTIVE

Football requires a diverse range of movements such as cutting, stepping, drop-stepping, and pushing, all of which are assisted by the knee. The anatomy of the knee is complex, acting as a hinge that allows the lower leg to move relative to the thigh. Large forces can overwhelm both the passive and internal structures of the knee, making injury prevention programmes important considering that the knee accounts for roughly 17% of all injuries in football. The aim of this study was to assess whether targeted neuromuscular exercises can support players in reducing knee-load, with the overall objective of reducing knee injuries in adolescence football players.

WHAT THEY DID

Seventy-five players (14-21 years old) were recruited for this study in 2016. All participants were evaluated using a Drop Vertical Jump Test (DVJT; See attached video) to assess their pre-test knee-loading rates. Players (n = 39) with a high knee-load from one club performed regular training (control group), whilst players from another club (n = 36) with high knee-load participated in the FIFA +11 programme aimed to decree valgus and knee flexion range of motion (ROM). The difference in change of knee-load after 12 weeks was again measured using the DVJT and analysed using a paired sample t-test.

WHAT THEY FOUND

In this study, the authors found that knee loading decreased in both groups after 12 weeks of training. However, there was no significant difference between both groups (intervention vs. control) on knee-load. The study concluded that targeted neuromuscular exercises from the FIFA 11+ programme (see attached article) had no additional benefit for decreasing knee load than regular football training.

Practical Takeaways

From this study, it was established that those who performed the FIFA 11+ programme did not receive any additional benefit with regards to knee loading over their peers who trained normally. This study did not address what 'normal' training looked like for the control group, who may have had superior training to begin with. However, in the absence of this knowledge, it would be purely speculative to suggest this. What should be concluded from this study is that although 12-weeks of training did not cause any differences (control vs. intervention), both groups knee-loading did reduce over the study's duration, indicating that this time-frame can be significant when looking to reduce knee injury.

When performed properly, the FIFA 11+ programme can help the coach to identify risk factors that can contribute to some of the injuries mentioned in the attached podcast, and should, therefore, still be used as a holistic warm-up for grass-root and professional clubs; though professional clubs should adapt and advance this programme.

It is also important that when evaluating results through the use of algorithms, we tailor these to the athletes/cohort we are measuring. For example, this study used an algorithm used in a previous study on females, who are generally lighter than males. In light of this, some of the measurements may need to be changed in future studies if you are planning to use this with your own athletes.

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

Tom's Comments

"I was actually very surprised that the intervention group did not improve more after 12 weeks of training when compared to the control group, given that the FIFA 11+ programme is actually a thorough and well-thought-out plan with some commonly used S&C movements incorporated. According to the research team, previous studies have shown decreased knee loading after the implementation of the FIFA 11+ programme, however, these did not 'compete' against a control group in normal training, making this study the first of its kind.

The authors mention in the discussion that they suspected the algorithm is not adequate to detect a change in knee-loading rates, which, in my opinion, is poor scientific practice. The job of the author is to explain their results based on the methodology used, not to question its adequacy when it didn't show favourable results. Here, I had to ask myself if they would have said the same if the results were better for the intervention group. What I did agree with the authors on is that the selection of neuromuscular exercises could have 'trained' other effects, such as leg strength, knee stability, or power output that weren't related or measurable using a knee-loading test."

[Abstract]

Should pre-pubertal children train both aerobic and anaerobic qualities alone or in synchrony?

OBJECTIVE
This paper serves as an up-to-date literature review of the importance of physical fitness in children. More specifically, it discusses the benefits of engaging in resistance training, aerobic training, explosive strength training, and cardiorespiratory training both in isolation and concurrently in prepubertal children. This is important to understand in most academic and professional set-ups as time and contact with athletes can be limited, meaning sessions may need to touch on all components of physical fitness.

WHAT THEY DID
A literature review is when the research team search and evaluate all of the available literature on a given subject. It allows both the researchers and readers to appreciate the published landscape and 'state' of the research on a given area. This study undertook the task of understanding how a combination of training approaches could alter the physical fitness of prepubescent children. To do this, the vast amounts of research must be narrowed down to ensure that what they do read and analyse is relevant to the study's objectives. In light of this, the authors used a variety of keywords in the search bar (e.g. physical fitness, concurrent training, prepubescent children, resistance training, and aerobic training) and selected papers that were written in English and Brazilian which contained the desired keywords.

WHAT THEY FOUND
This is a relatively large review, covering a multitude of subjects which I could write about for days. I highly recommend you read the full paper to top-up/refresh your knowledge. The paper splits the findings into the following headings, which I will simplify to allow you to use as a reference point for your own use in either presentations, programme design, or continuing professional development:

Physical Fitness in Children (page 3): Physical fitness in children was found to decrease obesity, improve fitness levels, and to be an essential part of normal growth and development. Improved physical fitness is linked with a decrease in depression, better anxiety control, improvements in confidence, and higher academic performance. Unfortunately, physical activity levels have decreased in the last 10 years, making our roles much more relevant and important.

Resistance Training (page 4): Unfortunately, we are still fighting old myths despite the innumerable health benefits of resistance training, including decreases in cardiovascular disease risk, chronic disease risks, and improvements in bone health, body composition, motor skills, and muscular and explosive strength in children. According to a study reviewed in this literature review, just 2 months of resistance training can cause a 17.5% increase in isometric strength (see attached article).

Aerobic Training (page 5): Aerobic training provides all of the benefits mentioned above but, moreover, is also associated with a healthier cardiovascular profile later on in life. This suggests that pre-pubescence may provide a window of opportunity for life-long aerobic health.

Concurrent Resistance and Aerobic Training (page 6): Aerobic-based exercise before resistance training may be a great way to ensure that both modes of exercise are improved, where aerobic exercise can increase temperature and heart rate that will inadvertently improve performance. However, this is a delicate process, where too much aerobic work may create peripheral fatigue that can affect the quality of a strength session. To overcome these issues, the literature review revealed that training different qualities on different days (e.g. maximal strength on a Monday and aerobic-based activity on a Wednesday) was advantageous.

Practical Takeaways

This study firmly cements the concept that a mixture of exercise modalities is not only ethical for young children, but supports their physical and cognitive development. The relationship between getting the most out of both aerobic and anaerobic workouts during concurrent training still remains an interesting topic amongst researchers. This relationship is known as the 'interference effect' and has been documented in the attached video which can be watched at your leisure. The important thing to recognise is that muscular strength and power can be developed simultaneously to cardiovascular fitness, as long as the exercise frequency is generally low. For example, in this study, it is advised that concurrent training only had an impact on strength results, if performed for more than 3-sessions a week. As a result of this, you may want to periodise accordingly by taking into account the player's routines and habits both inside and outside of school.

When you are using a concurrent training method in practice, the period where you will see most of the adaptations will occur a bit later than just strength training used alone (6-8 weeks), occurring roughly on week's 8-16. This may need to be reconsidered for different sports where, for example, a single-event athlete may need either a strong anaerobic or aerobic base to compete, rather than a repetitive sport which requires both qualities trained together. Inevitably, this would shape your training focus and the context (athlete) in hand.

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

Tom's Comments

"Schools, as demonstrated in this study, can provide a fantastic canvas for growth and development in young children and adults. A culture of good habits and quality movement are only as strong as the foundation of the athlete's base. In this, I refer to their home life, where we have little say over the choices or behaviours they choose to adopt when they get home.

In the attached short podcast, Patti Neighmond expresses her concerns over the 'crunch time' between the child attending school and going home, and how this mainly contributes to excessive weight gain or low activity. The problem isn't usually a straight fix, with financial constraints, time constraints, or technological access becoming a barrier to sports participation. The answer isn't an easy one, but I certainly think that S&C in schools is a great way to forge strong habits that can hopefully last a lifetime,"

[Abstract]

Individual responses to plyometric training: Does it work for everybody?

OBJECTIVE
The ability to rapidly produce and absorb force is highly sort after in sports. To assists S&C coaches and physical therapists, plyometric training has long been used as a tool to enhance such properties. This study aimed to compare the inter-individual differences (between individuals) who performed a 7-week plyometric programme on change of direction speed, countermovement jump (CMJ), reactive strength index, five bound distance, maximal kicking distance, and a 2.4km time-trial, to peers who participated in regular training.

WHAT THEY DID
Seventy-six male soccer players aged between 10 and 16 volunteered to take part in this study. All participants had at least 2 years of systematic experience in a soccer setup. Participants were divided into two groups (Plyometric jump training [PJT], n = 38; or a control group [n = 38]). The control group completed regular training which consisted of 20-minutes of technical skills, 20-minutes of tactical skills, and a 20-minute small-sided game. The PJT group also completed this training, but replaced the technical skills block with 60 drop-jump repetitions, consisting of the following exercises:

20cm Height
40cm Height
60cm Height

Equating to roughly 840 ground contacts over a 7-week period. Sets and repetitions remained constant over the 7-week block due to the intensity (3 sets of 10 repetitions), however, the rest periods did increase from 15-seconds to 90-seconds as the weeks progressed.

WHAT THEY FOUND
The results indicated that the mean group improvement was greater in all physical fitness measures in the PJV group than those who had performed in regular technical training. The Mann-Whitney U test was used to compare sample means (PJV vs. control) to see if they were equal or not. This test indicated that the PJV sample responded better to this training stimulus (4-33 responders) when compared to the control group (0-9 responders). In summary, the PJV group performed greater in all tasks compared to the control group, with a higher number of participants demonstrating positive adaptations when compared to those participating in technical skills alone.

Practical Takeaways

This study suggests that plyometric training is a highly effective method at developing both anaerobic and aerobic properties in young soccer players. For practitioners, this does not simply mean that we should replace all technical work with a jump-based session. A great example of an injury prevention/ strength initiative has previously been shared in the Performance Digest with the inclusion of the FIFA 11+ programme explained in my first research review this month. Another example has recently been developed by England Rugby, known as the Activate programme (See attached article), where a series of cue-cards can be downloaded to be used pitch-side for U14's to adults.

These programmes are fantastic at incorporating jumping/ landing mechanics into a warm-up in an effortless manner, whilst allowing players to produce high levels of vertical, horizontal, and lateral forces. In the attached video, some ideas have been shared where the coach has used pitch-side equipment to assist their plyometric work. It may be a fantastic idea to replicate the jump heights used in this study (20, 40, and 60cm) with, of course, consideration of the context (the athlete's ability/previous training).

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

Tom's Comments

"Studies such as this really reinforce the importance of strength and conditioning programmes for youth. What this demonstrates is that in such a short period of time, a relatively simple-to-follow plyometric programme can improve many performance-related parameters. If coaches are considering incorporating plyometric activities into their warm-ups, it's important that jumping mechanics are developed beforehand by a qualified professional.

What is interesting to consider in studies such as this one, is the training age of the sample. For example, in this study, the participants have no practical experiences of a plyometric exercise regime. As children are often referred to as 'sponges' - a term used to explain the heightened learning period through increased neuroplasticity - naturally, they would perform better on these tests (CMJ, RSI, and five bound distance) due to their specificity to the protocol. Furthermore, the technical work that the control group performed may not have been as intense as the jump-based protocol, leading to less players responding to training."

Nutrition

This month's top research on nutrition.

CAN B-ALANINE SUPPLEMENTATION IMPROVE RUNNING PERFORMANCE?
Santan, J.O. et al. (2018) Frontiers.

EFFECTS OF PROBIOTIC SUPPLEMENTATION ON IMMUNE FUNCTION, HORMONAL STATUS, AND PHYSICAL PERFORMANCE
Townsend, J.R. et al. (2018) Sports.

DOES HMB SUPPLEMENTATION ELICIT SUPERIOR GAINS IN LEAN BODY MASS AND STRENGTH?
Jakubowski, J.D. et al. (2018) Medicine and Science in Sports and Exercise.

[Abstract]

Can β-alanine supplementation improve running performance?

OBJECTIVE

β -alanine supplementation can increase the intra-muscular stores of carnosine and has therefore been suggested to delay fatigue during high-intensity exercise via a buffering capacity of lactate. Considering lactate concentrations can be elevated during prolonged high-intensity exercise, this has been associated with lower running speeds. With this in mind, the authors hypothesised that β -alanine supplementation would improve running performance through buffering lactate accumulation during a 10km running time-trial.

WHAT THEY DID

In a randomised double-blind, crossover study design, sixteen healthy men were divided randomly into a β -alanine group (n = 8) and a placebo group (n = 8). The β-alanine group ingested 5g.day-1 plus 1g resistance starch, while the placebo group ingested 6g resistance starch, both for 23 days. 10km running time-trial and lactate concentrations were measured at baseline and following supplementation. Both groups received a standard training programme for a duration of 23 days. This included three running sessions per week on non-consecutive days, which were all supervised by the researchers to ensure a tighter study control.

WHAT THEY FOUND

The main finding of the study was that β-alanine supplementation over 23 days improved a 10km running time-trial and decreased blood lactate accumulation in physically active adults. This indicates that B-alanine supplementation has beneficial effects on prolonged running in recreational/amateur athletes. In particular, blood lactate decreased from 8.4 to 6.9 mmol/L in the supplement group.

Practical Takeaways

From a practical standpoint, these findings suggest that β -alanine supplementation (5g.day-1) for 23 days can be used as a nutritional strategy to enhance performance in 10-km running performance by attenuating the blood lactate concentrations in recreational athletes. These results can be applied by coaches and trainers to make informed decisions on supplement use during the pre-event phase.

It is worth highlighting that the study did not investigate other distance modalities which are also likely to be promoted at running events (e.g. 5km, half- and full-marathons), and often attractive to many first-time runners. However, these results support earlier research that has observed improved exercise capacity in 800m running when using ~6g.day-1 for 28 days in recreational club runners (**HERE**). However, the study in discussion only involved physically active men and, as such, this strategy may not be applicable or as effective to elite or highly-trained male runners. If elite athletes are unlikely to obtain any exercise benefits with β-alanine supplement on such distance, then these individuals can save resources and time.

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

James's Comments

"This study supports the ingestion of β -alanine supplementation to improve 10km time-trial performance. If you have consumed β-alanine personally, you will know it takes a little bit of time to get used to as it has many known side effects, including a tingling of the skin sensation. With this in mind, it would be recommended to trial the ingestion during a training block whilst out of competition, rather than trying it for the first time too close to competition day.

The fast or slow release manner of β-alanine has been one of discussion, whereby a slower release formula maybe better served to reduce side effects such as paraesthesia. A video link of the discussion by Trent Stellingwerf can be seen below and, in addition, a great podcast by Craig Sale is also included for those car journeys."

[Abstract]

Effects of probiotic supplementation on immune function, hormonal status, and physical performance

OBJECTIVE

College athletes undergo large amounts of physical and cognitive stress (e.g. from academic studies), resulting in more vulnerability to illness and injuries during periods of increased training. To attenuate the increase physiological stress associated with training, athletes often implement nutritional strategies to support their immune function. Probiotic supplementation, for example, is currently receiving considerable attention among athletes for training-induced stressors. However, only a limited amount of investigations has focused on the effects of probiotic supplementation on training outcomes in resistance-trained males.

Therefore, this study aimed to examine the effects of daily probiotic supplementation for 12 weeks on immune function and hormonal profiles in male college athletes during a period of increased academic and physical stress. Another aim of the study was to examine the effects of daily probiotic supplementation on physical performance adaptations in Division I collegiate baseball players following a 12-week off-season training period with a focus on resistance training.

WHAT THEY DID

In a double-blinded, placebo-controlled, randomised study, 25 Division I male baseball athletes were randomly assigned to a probiotic or placebo group. The probiotic group ingested one billion colony forming units (CFU) per day. Before and after training, all participants provided resting blood samples to examine circulating testosterone, cortisol, TNF-α, IL-10, zonulin, and saliva sample to examine immunoglobin (SIgA and SIgM). All athletes completed the same triphasic undulating periodised resistance training programme for 12 weeks (2-3 days per week) under supervision of a strength and conditioning specialist and athletic coach.

WHAT THEY FOUND

The authors reported that there was no beneficial effect on body composition, physical performance, hormonal status, or gut permeability from 12 weeks of probiotics supplementation. However, circulating TNF-α concentrations (a marker of inflammation) in male college athletes following off-season training were reduced.

Practical Takeaways

This study found that there were no performance or body composition benefits from using one billion CFU per day of probiotics in baseball athletes following an off-season training period with high physical and cognitive stress.

This is in contrast to previous work on endurance athletes (article link 1) and other team-sport athletes (article link 2). Protocol differences, including the dose of probiotic supplementation and the training stress, may account for these differences. For example, it is possible that due to prolonged repetitive nature of endurance exercise, these athletes may experience a larger volume of training-induced stress and are, therefore, more vulnerable to suppressed immune function than strength and team-sport athletes. This may be particularly true during the off-season, where 2-3 days per week is spent on resistance training. In addition, the current study used a small dose of probiotics in comparison to previous work (i.e. 1-billion versus 3-5 billion CFU per day) and, subsequently, beneficial outcomes may be dose-dependent.

Therefore, those who are either working with athletes or maybe training themselves during peak periods of the calendar (e,g. pre-season periods or an increase in training for an endurance event) may consider supplementation of probiotics in an attempt to reduce markers of inflammation (TNF-α).

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

James's Comments

"Certainly, this study shows that one billion CFU per day probiotics will not provide any benefits to body composition, hormonal status or gut permeability, however, it may attenuate circulating TNF-α in baseball athletes following an off-season training period.

From a practical perspective, probiotics may be more beneficial to an athlete during the in-season period, where training load is higher, and the dosage of probiotics is greater than 1 billion CFU. Decreased TNF-α levels as a result of probiotic supplementation may be promising, however, no other performance or body composition benefits were found. This leaves the practical relevance of lowered inflammation in team-sport athletes' following off-season unclear.

Although this study did collect biochemical markers, they failed to collect any self-reported measures of stress by method of questionnaires. As an example, self-reported measures of academic stress, social stress (number of working hours outside of studying), training stress (volume and load of training) would have provided a greater insight into other factors that can affect both immune function and performance output other than probiotic supplementation in college-level athletes

Moreover, as the effects of probiotics is suggested to be dose and strain dependent, more research needs to be performed to understand this further before conclusions can be made.

A nice video link is included below which discusses how scientists are now beginning to discover more and more functional bacteria in the gut and how we may be able to harness these in the future to positively affect performance outcomes. Additionally, a podcast link with Professor David Pyne from the University of Canberra outlines how the correct use of probiotics can help elite athletes with issues like leaky gut syndrome during exercise."

[Abstract]

Does HMB supplementation elicit superior gains in lean body mass and strength?

OBJECTIVE
β-Hydroxy-β-methylbutyrate (HMB), a leucine-derived metabolite, has been demonstrated to increase strength, and lean muscle mass when supplemented in conjunction with resistance training. Attraction to HMB supplementation is primarily because it has been promoted to increase muscle strength and size in conjunction with a structured resistance training regime. Having said that, there has been conflicting results from the research conducted on resistance-training-induced hypertrophy and strength gains.

Therefore, this study aimed to investigate whether HMB supplementation will elicit superior gains in lean body mass and strength in young, relatively-trained men performing a highly effective programme of undulating periodised resistance training (RT) when compared to leucine added to whey protein.

WHAT THEY DID
In a randomised, double-blinded, repeated measure study design, 26 resistance-trained men performed 12 weeks of RT with 3 phases:

1) 8 weeks of periodised resistance training (3 training sessions per week);
2) 2 weeks of overreaching period (5 sessions per week) and;
3) 2-week taper (3 sessions per week).

Participants were randomly assigned to twice daily consumption of whey protein (25g) plus HMB (1.5g) (n = 13) or whey protein (25g) plus leucine (1.5g) (n = 13).

Skeletal muscle biopsies were taken before and after the RT programme. Muscle thickness, cross-sectional area, and muscle fibre were all measured. In addition, body composition and maximal strength and power tests were also measured.

WHAT THEY FOUND
The ingestion of whey protein (50g) with HMB (3g daily) versus whey protein with the same amount of leucine (3g daily) provided no differences in fat- and bone-free mass, muscle size, strength, or power. In addition, no differences in blood hormones and serum creatine kinase (an often-used alternative marker of muscle damage) were detected. Therefore, the ingestion of HMB provided no benefits over that of whey protein with added leucine to maximise RT-induced gains and strength.

Practical Takeaways

The intention of the study was to mimic the nutritional practices of athletes and recreational exercisers who frequently supplement with high-quality proteins following a RT programme. The findings are particularly relevant to athletes or recreational active populations who attempt to maximise their lean body mass and strength through evidence-based nutritional and supplementation practices. The main take homes of this study by Stuart Philips and his group are:

⇒ Whey protein with added HMB or Leucine WILL support improvements in body composition changes and strength improvements.

⇒ However, no difference between whey + HMB or whey + Leucine appear to exist.

As such, the effects of HMB added to whey proteins may not be more effective than adhering to the normal current recommendations on protein intake in resistance-trained males. In support of protein supplementation for resistance training adaptations, I have included a nice review article below which would be a good supplementary read to this article.

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

James's Comments

"It is important to acknowledge that the study is not without limitations. Firstly, the authors did not include a control group which would have improved the robustness of the findings. Moreover, when assessing HMB supplementation in athletes, the type of HMB should also be considered. The authors utilised HMB in its calcium form (HMB-Ca), with the explanation that HMB-Ca and HMB-FA are equivalent in their stimulation of muscle protein synthesis (the process of building muscle proteins). This topic is nicely explained in the YouTube video link below and the supplementary article below which included a 12-week study of HMB ingestion.

Despite these limitations, I give credit to the authors who conducted a well supervised RT programme which included a fairly invasive muscle biopsy assessment that has been previously demonstrated to induce muscle damage. This was the first study to compare HMB to its parent metabolite (Leucine) during a RT programme in young men, rather than just comparing to a carbohydrate placebo.

A related podcast by Sigma Nutrition and Arthur Lynch is included below for a more in-depth discussion around lean mass adaptations following HMB versus Leucine."

Injury Prevention & Rehab

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

CONFIDENTLY RETURN ATHLETES TO SPORT AFTER ACL SURGERY WITH THIS PROTOCOL
Blakeney WG, et al. (2018) Sports Health.

HOW TO MANAGE PERSISTENT PAIN IN ATHLETES: AN EVIDENCE-BASED APPROACH
Moseley GL, et al. (2018) Clin J Sport Med.

CONCUSSION IN COMBAT SPORTS: ARE WE STILL IN THE DARK AGES?
Neidecker J, et al. (2018) Br J Sports Med.

[Abstract]

Confidently return athletes to sport after ACL surgery with this protocol

OBJECTIVE
Many of the questionnaire style outcome measures that assess return to sport (RTS) readiness following ACL surgery have not been validated. What is more concerning, is that recent research confirms that many surgeons admit to using a time-based criterion of 6 months to clear athletes for RTS. This study, therefore, aimed to validate the Knee Santy Athletic Return to Sport (K-STARTS) test by comparing a group of patients who underwent ACL reconstruction (G6M) and a control group (CG).

WHAT THEY DID
The K-STARTS is a composite test designed to assess fitness for RTS, and the score is calculated as the sum of 8 components from 7 tests (max of 21 total points). The 8 components, scored in a manner appropriate to the construct they were testing, were as follows: ACL Return to Sports Injury scale (ACL-RSI), dynamic valgus with single-leg landing, side-to-side difference for single-leg hop, triple hop, side hop, and for triple crossover hop, as well as the modified Illinois Change of Direction (MICODT) test (See video link below). From final K-STARTS scores, the authors analysed the data for construct validity, internal consistency, discriminant validity, and reproducibility and response to change.

WHAT THEY FOUND
Overall, the K-STARTS scores in the CG group were significantly higher than in the G6M group. The K-STARTS score has a low correlation with the single-leg landing and its dynamic valgus component, though had moderate correlation with the ACL-RSI, hop tests, and modified Illinois test. There was little internal consistency among the 8 components of the K-STARTS, though this was not deemed necessary considering the goal of this test was to analyse different aspects of a "complex phenomenon." Finally, there was a significant difference in scores at 6 months and at 8 months, indicating that the test is sensitive to change over time.

Practical Takeaways

This test meets the criteria for validation as an objective measure for RTS after ACL surgery. In other words, a coach or clinician can use this test for RTS after ACL surgery with confidence. Knowing that the K-STARTS is well correlated with the ACL-RSI, hop tests, and the modified Illinois test, a coach or clinician could potentially utilise only those components of the test (if time and resources are lacking) and be fairly confident of the athlete's readiness for RTS (or perhaps their risk of re-injury if they return too soon).

For the test to be totally valid, of course, it would need to be administered in its entirety. This test also lends itself well to being used for follow-up and repeated testing in order to measure progress, as it shows good response to change. There was a high completion rate and a high degree of reproducibility due to the minimal need for equipment, which is helpful for coaches with large groups and/or with limited time for testing. .

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

Steph's Comments

"It can be overwhelming trying to make sense of all of the proposed ways to accurately determine RTS following ACL surgery. We are still largely depending on time-based criteria over criterion-based (i.e. having to pass physical tests, for example), which is certainly not in the best interest of the athlete. This test battery is diverse and includes a psychological measure of readiness which, research has shown, plays a significantly greater role in RTS readiness than we previously thought.

The K-STARTS does not include formal strength testing and does not require much, if any, equipment. This lowers any barriers to implementation and makes it a realistic tool for coaches and clinicians. The authors state that there was no "ceiling effect" found, which means it is not too easy for athletes to "pass", which would also decrease its credibility."

[Abstract]

How to manage persistent pain in athletes: An evidence-based approach

OBJECTIVE
Many elite athletes are able to accomplish incredible physical and psychological feats and are able to do so because of an acclaimed "high pain tolerance". Latest research and a growing knowledge base in pain science appears to place this assertion into question. This review was born from an International Olympic Committee initiative to develop a more standardised and evidence-based approach to pain management with elite athletes.

WHAT THEY DID
The authors provide an updated definition of pain, a conceptual framework to guide its management, special considerations for the impact that pain has on performance, and guidelines for the non-pharmacological management of persistent pain in elite athletes. Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or, at least, described in terms of such. The authors state that pain in elite athletes is best managed with a biopsychosocial approach and that this approach needs to consider the adaptability of the body/brain (we learn pain), that perspectives on and expectations about recovery are important, and that pain impacts both performance and other aspects of life.

WHAT THEY FOUND
Based on recent research, the following conclusions have been made:

⇒ There are 3 types of pain (nociceptive, neuropathic, and centrally mediated) and it is important for the clinician to assess and determine which is predominating for the athlete so as to best inform treatment.
⇒ Coach-related problems, cultural issues, and team cohesion are all potential modulators of pain and need to be investigated via private discussion. The coach/clinician and athlete relationship is crucial.
⇒ "There is no role for opioids or cannabinoids in managing persistent pain in elite athletes."

Coaches and clinicians engaging in explaining pain need to have a deep understanding of the biology behind it, but also need to be able to effectively convey "target concepts".

Practical Takeaways

Explaining pain is now supported by level 1 research, and it is absolutely a tool coaches and clinicians can utilise to better treat the subpopulation of elite athletes who struggle with persistent pain. In addition to targeted education, effective tools include removing potential contributors to pain, psychological therapies, and altering loading strategies. Removing pain contributors is essentially done via activity modification, training volume or motor pattern adjustments, or even inflammation management. Though not a direct psychological intervention, addressing sleep disturbances can also have a positive effect on many psychological and physical contributors. Load management is where coaches and physios play a greater role, and this is accomplished through reducing provocative loads and increasing analgesic loading.

The authors use the example of chronic tendon pain, where either compressive loading (of the tendon over a bony prominence) or aggressive stretching of the muscle-tendon are provocative loads that can be modified via a change in position or that can be reduced in general. Adding in analgesic loading via heavy isometrics and/or slow, heavy isotonics can also have a pain reducing effect without having to cease training or suffer a decrease in strength.

On the subject of passive modalities for pain (e.g therapies such as heat, cold, electrical stimulation, and ultrasound), the authors conclude that they are of little utility for long-term benefit and resolution of symptoms, stating that their continued use tends to feed into a "culture of dependency, fragility, and vulnerability".

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

Steph's Comments

"What I enjoy most about this article, is its ability to simplify a notoriously nebulous topic and demonstrate how it can be applied to an athlete outside of a doctor's office. Aside from psychological treatment, to which physios and coaches can refer out appropriately, there are a number of things within each discipline's scope of practice that can be used to help these athletes.

Perhaps the most powerful thing to have an athlete or patient grasp first, is that pain is protective and adaptive, it is NOT inherently bad, and pain does not equate to tissue damage.

It is extremely important for coaches and clinicians to have even a basic understanding of pain neuroscience, as research has shown that simply educating someone on the concepts of how pain is processed in the brain/body can have a positive impact on their symptoms (See article link below). Though this review does not go in depth into the biology of pain, there are a number of great resources to begin learning; some of which have been included in the related links below."

[Abstract]

Concussion in combat sports: Are we still in the dark ages?

OBJECTIVE
There is little standardisation and implementation of return to sport (RTS) guidelines or protocols in combat sports following a concussion. Most of the literature on the subject is retrospective and does not clearly define concussion. This review is the result of a collaborative effort among the Association of Ringside Physicians (ARP), in which they consider current practices and best supporting research and, ultimately, propose guidelines for concussion and RTS for the combat sports athlete.

WHAT THEY DID
A thorough literature search including, but not limited to, MEDLINE, Cochrane Reviews, and non-indexed peer-reviewed articles was performed regarding combat sports and concussion. The current RTS practices in combat sports were then reviewed and compared to those of non-combat sports. After weighing the latest research and comparing the two current methodologies of management, the authors put together proposed guidelines to follow for treatment of concussion and decision making for RTS in combat sports.

WHAT THEY FOUND
In non-combat sports, an athlete is immediately removed and is not allowed to RTS the same day if concussion is suspected. He or she is evaluated off-field in a quiet environment, and then is required to progress through a specific, step-wise protocol. To then be cleared for return to play, the athlete must be cleared by a licensed healthcare provider.

In combat sports, however, only some have written policies regarding concussion management and RTS after technical knockout (TKO) or knock out (KO). Suspensions are based on loss of consciousness (LOC) and are arbitrarily enforced as 30 days for a TKO, 60 days for a KO without LOC, and 90 days for a KO with LOC. There is inconsistency in who may stop a fight (referee or ringside physician). These procedures are only applicable to competitions and are not carried over into practice or sparring. Lastly, most jurisdictions rarely require medical clearance for RTS and generally default to the 30/60/90 day "rules".

Practical Takeaways

Considering all of these variabilities within practice, the authors propose the following guidelines (further detail in body of the article):

- ⇒ A fight should be stopped if the athlete exhibits signs of concussion.
- ⇒ If the athlete sustains a TKO due to blows to the head, he or she should be suspended from competition and sparring for a minimum of 30 days (symptoms can have delayed onset - see infographic link below).
- ⇒ If the athlete sustains a KO without LOC secondary to blows to the head, he or she be should be suspended from competition and sparring for a minimum of 60 days.
- ⇒ If the athlete sustains a KO with LOC secondary to blows to the head, he or she be should be suspended from competition and sparring for a minimum of 90 days.
- ⇒ Both athletes (winner and loser) should be evaluated for concussion after a bout at ringside as well as later in a quiet, controlled environment (e.g. locker room).
- ⇒ Athletes may participate in non-contact training and conditioning 1-week after sustaining a concussion or loss via TKO/KO secondary to head strikes, followed by gradual activity progressions.
- ⇒ Under no circumstances should the athlete compete or engage in sparring if they are symptomatic.

The authors also suggest that the athlete not return to competition until cleared by a clinician that specialises in concussion management (including neuropsychological testing) and, more importantly, that athletes, coaches, and trainers are all educated and trained to recognise signs and symptoms of concussion. Whether you are a coach, athlete, or clinician, these guidelines are very helpful to follow if you happen to be in a system that is very unorganised.

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

Steph's Comments

"This review was incredibly eye-opening, as it highlights the scarcity of systems and procedures for combat sport athletes following concussion, and the unfortunate tendency to default to "the way its always been done" (See blog link below). It seems almost counterintuitive that non-combat sports can have more stringent guidelines and protocols in place for RTS after concussion, while combat sports, in which blows to the head are an accepted part of the sport, have variable and inconsistent policies on the matter.

I feel as though the variability among states and commissions is an effective place to start, as some standardisation and proper setting of expectations can go a long way in ensuring proper care for these athletes. The return to fighting protocol proposed in this review, with phases 1-3, is an extremely helpful place to start. Future research with long-term follow-up would be interesting to track trends in fatal or serious head injuries with the implementation of more stringent guidelines."

Infographics

A round-up of our monthly research infographics.

COMPRESSION GARMENTS

Solomon, M. (2018) Science for Sport.

POST-EXERCISE STRETCHING

Solomon, M. (2018) Science for Sport.

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COMPRESSION GARMENTS

SCIENCE for SPORT

Key information

The current body of research into compression garments (CGs) is of low-quality and riddled with inconsistencies and therefore should be accepted with caution.

What are they?

Tight, compressive forms of clothing, often made out of elastin and nylon, which are designed to enhance recovery

Do they work?

Many theories as to how CGs may work have been suggested.

Inflammation

Applying external pressure is thought to reduce inflammatory response and the experience of pain. A lack of evidence means this theory remains uncertain.

Creatine Kinase (CK)

Large inconsistencies exist in the literature, some studies suggest CGs can lower CK concentrations, others do not.

Exercise perception

Studies show that CGs have little effect on ratings of RPE, suggesting that they may only have a limited placebo effect on recovery.

Cardiovascular

Evidence suggests that compression garments have no benefit on the delivery and utilisation of oxygen during exercise, however evidence does suggest they may improve sub-maximal running economy.

Proprioception

Compression bandages may improve proprioception by the external pressure acting upon receptors within the skin, however this theory has not been directly tested on compression garments.

Strength & Power

A 2013 meta-analysis concluded that they can improve chronic recovery of muscle strength and power between training sessions.

Our summary

CGs can have a positive effect on recovery and performance, with no evidence to suggest any negative side effects. There is currently no research on how to optimise CG,

For the full article check out the Science for Sport website

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POST-EXERCISE STRETCHING

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Stretching

"The application of force to musculotendinous structures in order to achieve a change in their length, usually for the purposes of improving joint range of motion, reducing stiffness or soreness, or preparing for an activity."

Stretching types

Stretching has been used for centuries, and can be split into various categories; static, dynamic, and pre-contraction.

Recovery

Recovery from exercise is typically seen as a 2-stage model: returning what was lost (e.g. reducing fatigue and re-establishing range of motion), and adapting (i.e. supercompensation) to the imposed training demands.

Our Summary

Post exercise stretching is a popular recovery modality used by high performance practitioners. Due to the specific effects of stretching on flexibility, it's use is likely to continue. Post exercise stretching is likely best used in combination with other modalities in order to optimise athlete recovery.

Static stretching

Static stretching may influence recovery though a range of mechanisms.

Blood Flow

Despite being reduced during static stretching, blood flow increases significantly post-stretch.

Muscle Soreness

Post-exercise stretching appears to have a little effect on reducing muscle soreness 1-7 days after exercise.

Parasympathetic modulation

Static stretching increases parasympathetic nervous system activity, and therefore may improve relaxation.

Range of movement

Static stretching appears to be an effective means for improving flexibility.

For the full article check out the Science for Sport website

SCIENCE for SPORT

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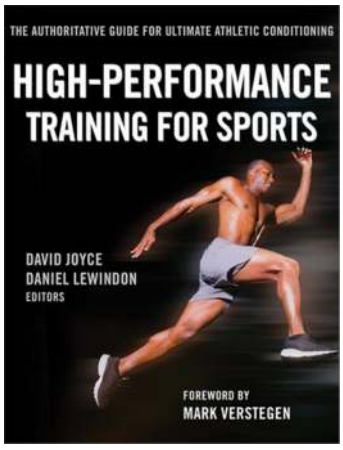

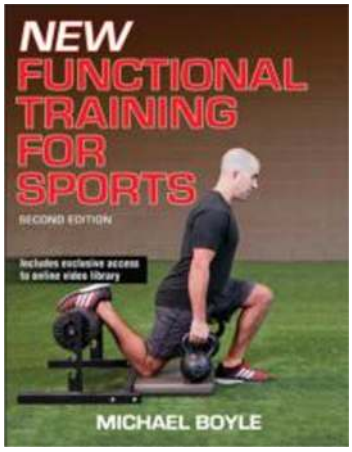

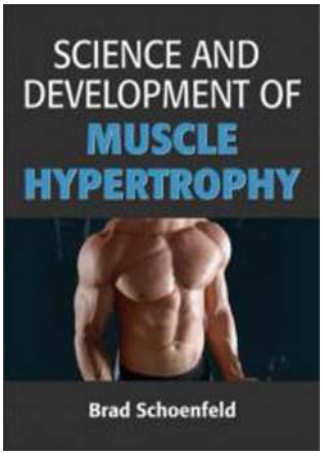

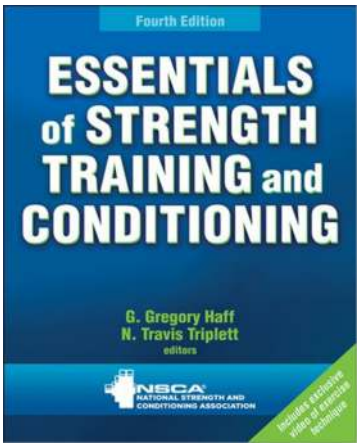

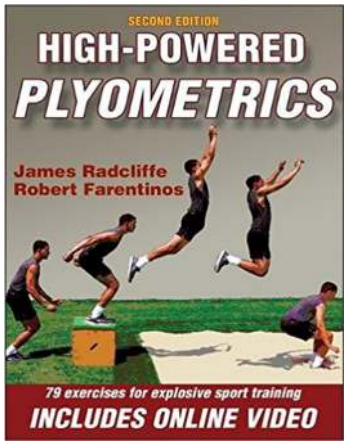

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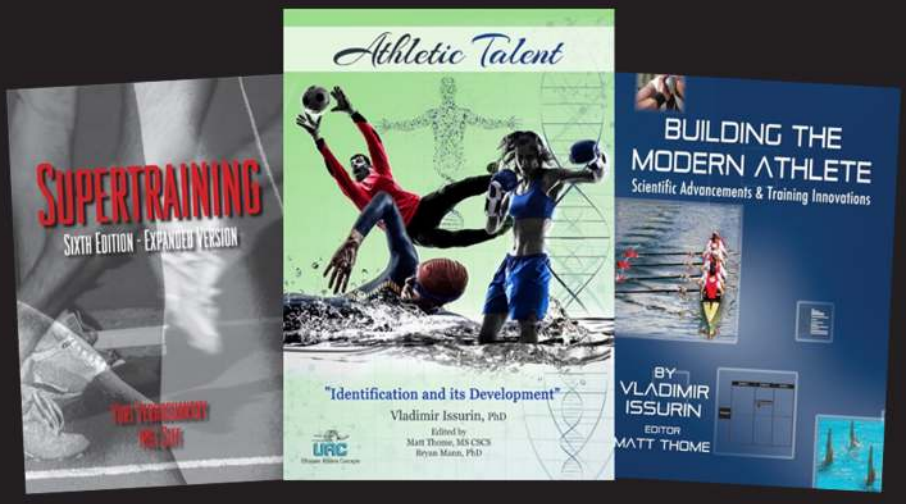

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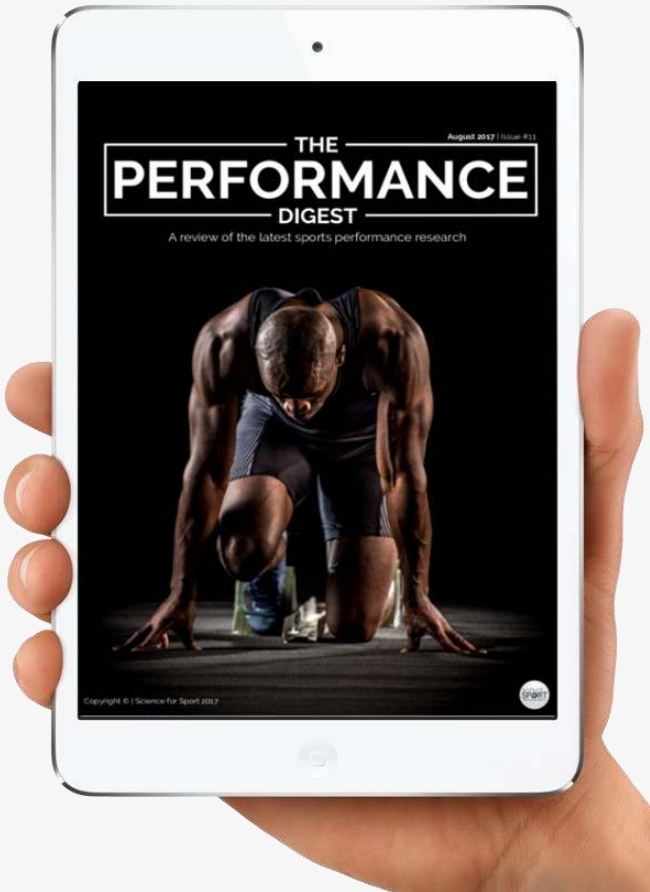

Thanks for Reading!

The next issue will be published on
1st November, 2018.

Did you like all the great content in this issue?

If so, then make sure you spread the knowledge with your friends and colleagues!

Warm Regards
Science for Sport