July 2018 | Issue #21

THE PERFORMANCE DIGEST

A review of the latest sports performance research

Contents

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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

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

1. **Continuing Education Feature**

As readers of the Performance Digest, you can now earn continuing education points (i.e. CEU/CPD points) to all of the following organisations: NSCA, ASCA, ESSA, NASM, AFAA, Physical Activity Australia. To earn these points, simply visit the "Continuing Education (CEU/CPD)" area inside the "Members Zone" on our website and complete the associated 30-question quiz.

2. **Brett Bartholomew's Presentation**

Brett's presentation on building athlete buy-in is now available inside the "Member's Area" on the website. To watch it, simply navigate to the "Downloads" section inside the "Members Zone".

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

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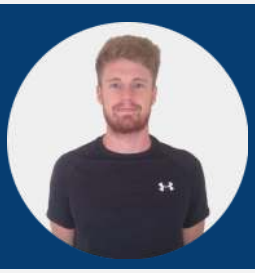
Research Reviewers



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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.

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The Science of Coaching

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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.

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Technology & Monitoring

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Dr. Stephanie Allen
PT, DPT, OCS, CFSC

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Audio
REVIEW

Practice Design

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

with Dr. William Vickery

WHAT WE DICUSS

In this episode of the "Audio Review", Will and Matt discuss practice design and how coaches can, and should, manipulate it to obtain the desired outcome, including what we currently know and don't know, from the research.

- In this episode, you will learn:
- What practice design is
- Why practice design is important
- What elements of practice design coaches can change in order to optimise their training
- A case study
- What research we hope to see in the near future

Episode length = 36 minutes

A bit about **Will**

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.

Listen Now

The Science of
COACHING

Coach-Athlete Conflict

How conflict between the coach and athlete impacts on performance

[Abstract]

INTRODUCTION

Both with the current coaching research and as many coaches can abide to, a high-quality coach-athlete relationship is linked with positive performance outcomes within athletes. Rarely reported within the research by comparison, but also known by many coaches, is the impact poor-quality coach-athlete relationships can also have on performance, particularly those characterised by conflict. Surprisingly, previous research (**HERE**) has shown that conflict which was caused by factors such as a breakdown in communication or power struggles between the coach and the athlete led to positive, neutral, as well as negative emotional, cognitive, and performance consequences. Unfortunately, there is little information which has highlighted the causes and outcomes of the conflict which exists between coaches and athletes. Therefore, the authors of this study investigated what characteristics were associated with conflict between the coach and the athlete, as well as the nature of this conflict (i.e. the processes experienced during conflict).

WHAT THEY FOUND

Using semi-structured interviews with 11 coaches and 11 athletes from a range of individual and team sports, the authors noted the following with regards to coach-athlete conflict:

⇒ There was no consistency with the intensity (mild to severe), duration (short-term to long-term), and the frequency (barely ever to nearly every day) with the conflict that occurred between coaches and athletes.

⇒ Both coaches and athletes suggested that conflict was likely to occur following a match or competition rather than before the event(s), but that conflict was still occurring at all times of a season within any environment.

⇒ There was a link between the topic of the conflict and the severity of the conflict. For example, sport related conflicts (lack of communication about team selection, feedback on performance) were linked with performance at training or in competition.

⇒ Both coaches and athletes were required to process the conflict that occurred and evaluate the situation which led to them either managing the conflict or escalating it. For example, an initial appraisal of a situation may have left an athlete uncertain about the implications of the conflict that occurred.

⇒ The emotions experienced both during and after the conflict between the coach and athlete were linked with the cognitive processes used to manage or escalate the conflict.

⇒ The development of conflict was more likely to result from how the other person responded to a situation, rather than the person who initiated it.

⇒ Coaches appeared to react in a more controlled manner in order to resolve the conflict, whereas athletes seemed more likely to use behaviours that are more negative in the same situation.

WHAT THIS MEANS

The results suggest that the topic or theme of the conflict led to the underlying process in which the conflict was managed by the coach or the athlete. This was linked to the characteristics of conflict such as how often it occurred and how long it lasted. In other words, conflict between the coach and the athlete can have significant consequences on performance, no matter how small or large the situation.

Coaches and athletes processed conflict in a number of different ways that manifested in a number of different behaviours. Initial appraisal was the first stage of this process and was characterised by the coach or athlete identifying whether the conflict was significant to them or not. This then led to one of three responses:

⇒ Escalation (e.g. blaming the conflict partner, yelling).

⇒ Uncertainty (e.g. self-doubt, worry).

⇒ Problem-orientated appraisal (e.g. prioritising goals, understanding partner's perspective).

Practical Takeaways

As the authors state, "Conflict is inevitable in any kind of relationship". It is unlikely that any coach will not experience some level of conflict between themselves and their athletes, but coaches need to be aware that this may not always be a negative situation. By understanding the characteristics of conflict (e.g. frequency or topic) between the coach and athlete, as well as some positive processes in how to resolve a situation when conflict has occurred, performance may actually be improved. Coaches would, therefore, be best served to try to approach conflict by applying an approach which encourages problem-orientated appraisal.

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.

RESISTED SPRINTING: CAN IT IMPROVE SHORT-TERM RATE OF FORCE DEVELOPMENT?
Mangine et al. (2018) Journal of Strength and Conditioning Research.

LIMB ASYMMETRIES: TRAIN YOUR WEAKER LEG TO GET FASTER AND JUMP HIGHER?
Bishop et al. (2018) Journal of Strength and Conditioning Research.

SQUAT MORE TO SPRINT FASTER? THE DIRECTION OF FORCE APPLICATION MATTERS
Williams et al. (2018) Journal of Strength and Conditioning Research.

[Abstract]

Resisted sprinting: Can it improve short-term rate of force development?

OBJECTIVE
Studies report that voluntary activation of skeletal muscle induces 2 reflexive periods: 1) an initial depression of motor neuron excitability followed by post-activation potentiation (PAP), and 2) improved excitability. It is theorised that PAP improves higher -threshold motor neurons on subsequent activity, which could potentially improve RFD and peak force production (see April 2018 issue for more on PAP). Traditionally, PAP is facilitated by slow, heavy resistance exercise. Though this may be useful for potentiating force, they may not be optimal for developing the power required for high-velocity sprinting. Therefore, the purpose of this study was to determine the effect of a resisted sprint using 5% of an athlete's body mass on sprinting kinetics.

WHAT THEY DID
10 male and 13 female Division 1 basketball players participated. Athletes performed 4 total 20m sprints on a basketball court. 1 free sprint and then 3 sprints while tethered to the 1080 Sprint were performed. A 1080 Sprint attaches to a belt around the waist with a tether that can be set to apply differing loads through a tablet device. The first and third sprint were performed against minimal resistance (1kg, the 1080 Sprint does not go below that), while the second sprint was performed against 5% of each individual athlete's body mass. The variables measured were sprint time (sec), step length (m), step rate (steps/sec), peak and average force (N), velocity (m/s), power (W), and RFD (N/sec) for each sprint and broken down into different distances (0-5m, 0-10m, 0-15m, and 0-20m).

WHAT THEY FOUND
Resisted sprinting produced significant reductions in step length at all distances analysed, while there was no effect on sprint time at 5m. However, resisted sprinting tended to reduce sprint time at 10m (-2.9 ± 6.2%) and significantly lowered times at 15m (-4.7 ± 5.2%) and 20m (-3.4% ± 4.9%). No significant changes in step rate were observed. No significant changes were observed in the final 1kg sprint. For all distances, greater peak and average force, peak and average power, and RFD were observed during the resisted sprinting compared to the first 1kg sprint. On the other hand, peak velocity (10 & 15m) and average velocity (15 & 20m) were slower. Following the 5% resisted sprint, a significant increase in RFD (5.2 ± 7.1%) was observed during the final 1kg sprint.

Practical Takeaways

The findings from this study suggest sprinting with 5% of an athlete's body mass does not improve sprint time or kinetics over the first 15m of a 20m sprint. However, an improvement in RFD was observed over the entire 20m sprint. Generally, PAP is facilitated by traditional, heavy resistance exercise, but this is not specific to the biomechanics or velocity of sprinting. Unlike traditional, heavy resistance exercise which recommends loads approximately 60-85% 1RM, an optimal resistance has not been established for resisted sprinting.

It has been generalised that the resisted sprinting load should not exceed 10% body mass or limit velocity by 10% (more on this in this in next month's Audio Review). In this study, the 1080 Sprint with a load of 5% of body mass reduced sprinting velocity by 6.6 ± 4.6% at 20m, fitting the arbitrary 10% velocity threshold. Interestingly, RFD improvements did not translate to improvements in any other kinetic or performance measure. Practitioners may use a resisted sprint prior to an athletic event to acutely improve RFD and, therefore, potentially enhance performance during the initial stages of a competition.

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

James's Comments

"While sprint performance was not significantly improved following a resisted sprint, the improvements in RFD are promising and provide a rationale for using a resisted sprint prior to other activity. If you are after more information on this, we have previously discussed 'primers' and PAP in the Science for Sport members-only group on Facebook and most recently in the April 2018 issue of the Performance Digest.

Before competition or a match, a short resisted sprint can be a way to acutely improve RFD in a short time span with little to no equipment, making it practical in almost any setting. While gym-based primers are usually performed 6-48 hours before competition and require extra equipment, a resisted sprint can be done with something as simple as a resistance band a few minutes before competing. While you won't be able to apply exactly 5% of body mass resistance, using a thinner band or following the athlete closer with a thicker band will help reduce the resisted load from being too heavy and potentially inducing unwanted fatigue."

[Abstract]

Limb Asymmetries: Train your weaker leg to get faster and jump higher?

OBJECTIVE

Understanding whether inter-limb asymmetries have a detrimental impact on physical performance would provide practitioners with more tangible information relating to their athlete's performance. Jump testing is a viable method for quantifying inter-limb asymmetries (see May 2018 issue of Performance Digest for more on this topic) where it has been suggested that unilateral jump tests may be preferred for detecting differences between legs, as they appear to be the most sensitive of the tests. In addition, due to the multi-planar demands of most sports (e.g. soccer), more than one test should be used. Therefore, the aim of this study was to assess the relationship between jumping asymmetries and sprint and jump performance.

WHAT THEY DID

19 elite youth female soccer players were recruited from a Tier 1 regional talent center. Subjects were tested on 2 separate days, the first session being a familiarisation session and the second being the data collection. Each jump test consisted of 3 trials on each limb with 60-second rest between trials and 2-minutes of rest between tests. Tests were done in a randomised, counterbalanced order as to negate any potential learning effects. The tests used were: 1) single-leg countermovement jump (SLCMJ) performed with hands on hips, 2) single-leg hop for distance performed with hands on hips, 3) triple-hop for distance with hands on hips and required to stick the landing, 4) crossover hop, 5) 5, 10, and 20m sprints. SLCMJ was measured with the app MyJump, and the sprints measured by timing gates. The rest of the jumps were for distance so were measured using a measuring tape.

WHAT THEY FOUND

SLCMJ showed greater inter-limb differences (approximately twice as much) compared to all other jump tests. Other results indicated that larger vertical asymmetries were significantly associated with slower sprint times, with significant correlations ranging from 0.49 – 0.62. Asymmetries during the triple-hop test were significantly associated with reduced horizontal jump performance, and vertical asymmetries were significantly associated with reduced vertical jump performance.

Practical Takeaways

The only asymmetry that had a significant correlation with sprint times was the SLCMJ, with all correlations being positive. This indicates that larger asymmetries may be indicative of slower sprint performance.

Previous research has shown that decreasing lower-limb asymmetry can improve sprint performance after previous injury (see article #1 linked below). Given that the SLCMJ appears more sensitive for identifying inter-limb differences and shows stronger relationships to decrements in sprint speed compared with horizontal hops (as also seen in previous research in adult male team sport athletes), these results indicate that the SLCMJ may be the most appropriate lower-limb asymmetry test. However, an interesting finding showed that horizontal jumping appeared to be unaffected by vertical asymmetries and vice versa, indicating that inter-limb differences are direction specific when it comes to jumping tasks.

Furthermore, single effort jump tests showed the greatest individual variation in asymmetry scores. This potentially means that repeated efforts jump tests may "even out" the variation in asymmetry due to the momentum being built throughout the test.

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

James's Comments

"While the population in this study were youth females, there is some agreement with previous research on adult males, especially in regards to the SLCMJ and SL hop test. Therefore, these findings can potentially be extrapolated to male team-sport athletes.

Once inter-limb differences have been identified, there needs to be some thought before "correcting" them, as decreasing asymmetry may not always be the best idea. For example, because tennis is asymmetrical in nature, reducing a tennis player's inter-limb asymmetry a few weeks before a big tournament may, in fact, decrease their performance; though, at present, very little is known about this topic.

Having said that, in a paper by Brown et al. (**HERE**), the authors make an important statement - "In some cases, injury prevention and performance enhancement are pragmatically one in the same." What this basically means is that if an asymmetry is so large that the athlete is constantly injured, then reducing the asymmetry will likely lead to not only a healthier athlete, but one that will also perform better, thus "killing two birds with one stone". In the infographic linked below, there is a sample programme designed to reduce asymmetry between legs."

[Abstract]

Squat more to sprint faster? The direction of force application matters

OBJECTIVE
Strength exercises, such as the back squat, are often regarded as a fundamental component of strength programmes designed to increase lower-body strength and power. However, this movement does not always improve sprint speed. Having said that, when combined with horizontally-orientated exercises (e.g. barbell hip thrusts), improvements in sprint speed and peak power have been shown.

Therefore, the primary aim of this study was to determine the difference between muscle activation and force production during the bilateral squat, unilateral split squat, and barbell hip thrust. The secondary aim was to determine the association of mean and peak activation and ground reaction force (GRF) with speed, and horizontal and vertical forces during maximal sprinting.

WHAT THEY DID
12 male, team-sport athletes who had 4-years of strength training experience participated. The first part of this study, subjects performed 3-RMs of the barbell hip thrust, bilateral squat, and unilateral split squat on a force plate. Measurements of ground reaction force and EMG of the gluteus maximus were recorded. After their warm-ups for the 3RM testing, a standing maximal glute squeeze was used to measure the maximal voluntary isometric contraction (MVIC). After 10-mins of rest from the strength assessments, a maximal sprint on a Woodway Force non-motorised treadmill was performed.

WHAT THEY FOUND
3RM loads for the hip thrust (157 ± 29kg, 1.9 ± 0.3 x body mass) were higher than both the back squat (117 ± 39kg, 1.4 ± 0.3 x body mass) and split squat (68 ± 23kg, 0.8 ± 0.2 x body mass), with the back squat being higher than the split squat. The hip thrust displayed greater mean and peak gluteus maximus activation than both the squat and split squat. There was no difference observed in peak ground reaction force between the left and right legs in any of the 3 exercises. Peak horizontal force during sprinting significantly correlated with peak velocity (r = 0.72). There was no relationship between peak vertical force and peak velocity (r = 0.232). Peak force during the hip thrust significantly correlated with peak sprint velocity (r = 0.69). There was a weak relationship between maximal sprint velocity and peak force in both the squat and split squat, but did not reach significance. Peak glute activation for each exercise did not correlate with peak sprint speed.

Practical Takeaways

In this study (and previous research which has been summed up in the article linked below), given that maximal sprint speed correlated with horizontal force production, but not vertical production, using exercises that develop force in the horizontal plane may provide superior transfer to sprint-based performance. Further evidence of this is that maximal sprinting speed appears to be correlated with peak force during the hip thrust, which is a horizontally-orientated loaded exercise (see my Science for Sport article on Force-Vector Training for more on these terms - **HERE**). While the hip thrust was correlated with sprint speed, neither of the two vertical squat movements were.

A 2016 study by Contreras et al., found that the hip thrust transferred to horizontal-based movements, while the front squat transferred to vertical movements; further supporting the findings of the present study. Importantly, this does not suggest that the only way to improve sprint performance is to only use exercises which focus on force production in the horizontal direction. Instead, understanding how movement mechanics accentuate force development is an important factor when it comes to exercise selection. In other words, it's important to understand how different movements/exercises can enhance force development in various force vectors.

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

James's Comments

"There is mounting evidence to the efficacy of anteroposterior-based (i.e. horizontally-orientated) exercises for improving sprint and other horizontal-based exercise (e.g. forward jumps) performances. If you are interested in reading some of the older, but classic, papers on this topic, I have referenced a few in the article linked below. Furthermore, a pioneer in this area of research who is rarely mentioned is Dr. Matt Brughelli. You can find some of his older work from 2010/11 which looks at horizontal force production in running and see how the interest in this area first developed.

While horizontal force is important in maximal sprinting, it is important not to get lost in the "stronger is better" thought process that tends to be the narrative in some coaching circles. How quickly the force is applied, the orientation of force application, and the mechanics of the sprint are also very important variables that need to be addressed. Depending on the athlete, more velocity work may be needed instead of force, so assisted jumping and sprinting can also be used in this scenario. Furthermore, it's important to understand that speed isn't always linear during game/competition scenarios (although still very important) as technical skill movement (e.g. shuffle, stepping, etc.) and strength in the lateromedial force-vector are also vital to multi-directional movement."

Technology & Monitoring

This month's top research on technology and monitoring.

THE GYMAWARE POWERTOOL: IS IT VALID AND RELIABLE?
Dorrell H, et al. (2018) Journal of Sport Sciences

WHICH DAY OF THE WEEK SHOULD WE SCHEDULE LOWER -LIMB STRENGTH TRAINING?
Lovell R. et al. (2018) Scandinavian Journal of Medicine and Science in Sport

A NEW ERA FOR HEART RATE DATA: IS FITNESS TESTING DEAD?
Lacome M, et al. (2018) The International Journal of Sports Physiology and Performance.

[Abstract]

The GymAware PowerTool: Is it valid and reliable?

OBJECTIVE
Progressing strength and conditioning monitoring beyond repetitions and weight requires valid and reliable instruments for applied settings. Evaluating output of barbell training requires measurements of both the velocity of the bar and displacement of the repetition. If coaches can improve the precision and specificity of weight training with commercial barbell tracking sensors, the chance for more ideal workouts are possible. Therefore, the objective of this study was to investigate the validity and repeatability of the GymAware PowerTool device with regards to barbell velocity and indirect measures of force. In addition to barbell performance tracking with the GymAware PowerTool, the study also included vertical jump assessments compared to a gold standard.

WHAT THEY DID
The researchers validated the GymAware PowerTool with the use of a force plate and motion capture to see how close the readings were to gold standards. Thirteen experienced subjects performed all three powerlifts (i.e. Squat, Bench Press, and Deadlift) and a countermovement jump with the GymAware PowerTool and evaluated the readings with additional statistical analysis. After the analysis, the researchers obtained the typical error and smallest worthwhile change values for the GymAware unit.

WHAT THEY FOUND
After reviewing peak velocity, mean velocity, peak force, mean force, and displacement, the researchers discovered that the deadlift created some unique issues with velocity analysis. The rest of the measures with the bench press and squat reported to be robust enough for use in the field, but the findings looked to be problematic with the velocity readings of the deadlift. The countermovement jump was reported to be a viable test using the linear positional transducer (LPT) technology of the GymAware PowerTool, as the error % was not significant.

Practical Takeaways

Velocity Based Training (see attached article) is a growing approach to strength training, and it appears that the accuracy of the GymAware PowerTool is strong enough to have confidence in the readings during training. Coaches should know due to the idiosyncrasies of the deadlift, that readings might be inaccurate due to barbell technique issues. This article also brings up the important point of the metrics themselves, such as knowing that mean velocity is likely to have both pros and cons due to the sampling strategy of exercise movements. Coaches should look at standardising the technique more, as the research is speculating that differences in technique are the cause of reading errors. Finally, due to the challenges with the deadlift, coaches may want to consider experimenting using a hexagonal bar to improve the readings of their lifts.

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

Carl's Comments

"Scientifically valid barbell tracking delivers a major benefit to the strength coach, as the technology is practical and adds more precision to the training. This study demonstrated that the GymAware is a useful tool to not only produce valid and reliable readings in bar speed, but also displacement—often an underrated measure. In addition to the benefits of tracking barbell performance, the data shows that basic jump monitoring, albeit crude and limited, is worth adding to battery of tests a coach can use in the field."

[Abstract]

Which day of the week should we schedule lower-limb strength training?

OBJECTIVE
Coaches are always searching for the best way to sequence training methods during a competitive season in order to reduce unnecessary fatigue and improve performance. After games, coaches are looking to manage the need to get in training while facilitating recovery after intense loading. If sport science can discover how the body responds to the timing of common load prescriptions, coaches can design better workouts that are in harmony with the recovery cycles after games and before the next match. The goal of this article was to find out what sequence of lower-limb injury prevention training facilitated the best recovery profile between matches.

WHAT THEY DID
The researchers staggered workouts with semi-professional soccer players so they could see how different timing strategies after games influenced fatigue patterns before the next match. The scientists ensured that the workouts and practices were similar enough to properly compare, and they also evaluated fatigue using jump analysis as well as creatine kinase (i.e. a muscle damage biomarker). The athletes were divided into three groups and each of them experienced all three timing experiments, including a rest day control. Isometric strength and perceptual recovery were also tested. The exercise protocol consisted of 4 exercises; lunges, single stiff-legged deadlift with 6 kg kettle-bell, single-leg eccentric squats (all 4 x 5 repetitions on each limb), and Nordic hamstring exercises performed on a Bosu-ball (4 x 5 repetitions).

WHAT THEY FOUND
The investigators found that placing training earlier in the week resulted in a superior recovery rate if they are only employing injury reduction exercises. Specifically, the inclusion of the Nordic hamstring exercise, an eccentric overload option in training, wasn't taxing enough to interfere with both training and competition.

Practical Takeaways

If you are tapering a team for playoffs/ championship play or follow a programme that uses very low volume and intensity, then it's a good idea to place the lower-limb strength training closer to the last match played. Another idea is to consider the use of creatine kinase testing in conjunction with force plates, as the pairing may create a repeatable micro-cycle set-up that is useful for in-season training. Also, working with a team coach is recommended to ensure the sequence and loading is similar, otherwise the responses may not be the same as the study.

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

Carl's Comments

"What is important, is that coaches should revise the workouts used in this study and decide if they are similar enough to your own and that the conclusions are relevant to your programme. I feel that this workout structure is not appropriate for team-sports such as Rugby and American Football, but it might suffice for programmes that conform to minimal weight training (e.g. semi -professional football [soccer]). It would be nice to repeat the study with programmes that are successful using higher intensities and volumes to see if the same conclusions are found."

[Abstract]

A new era for heart rate data: Is fitness testing dead?

OBJECTIVE
Internal load monitoring is a common practice within sport science and amongst performance coaches. In addition to heart rate monitoring, the modelling of training and readiness to perform is also important to advance the practice of sport. If coaches and staff can create better models using heart rate data for football (soccer) preparation, athletes can be supported with better methods of training to improve fitness and decrease the risk of injury. Therefore, the aims of this study were twofold: 1) to examine the ability of multivariate models to predict the heart rate responses to some specific training drills from various GPS variables, and 2) to examine the usefulness of the difference in predicted vs actual heart rate responses as an index of fitness or readiness to perform.

WHAT THEY DID
The sport scientists reviewed an entire season of heart rate data, as well as GPS/Accelerometer measurements, from the 2016-2017 football season and performed heavy statistical analysis. In addition to the very strict statistical evaluation, the researchers also recorded environmental data (e.g. temperature). After the data was collected, a custom model was created from the variables that were available.

WHAT THEY FOUND
After comparing it to actual external monitoring, the researchers agreed that modelling with heart rate is valid for evaluation of fitness and preparedness. The researchers found that if GPS and HR data is used in combination, they could help prescribe better general and specific workouts. Another interesting relationship was found between accelerometry and heart rate, indicating that mechanical work, not just speed, is important to monitor. Finally, confidence in changes in maximal aerobic speed can be found when the changes in heart rate drop by approximately 5%.

Practical Takeaways

Coaches should be excited about this seemingly typical heart rate monitoring article for two reasons. The first is that early seasonal changes can be seen from using heart rate data with confidence, and this means over time coaches can see if fitness is changing without having to perform conventional testing (e.g. Yo -Yo tests). Conversely, if you are not using team heart rate monitoring consistently, you must perform field-testing to estimate maximal aerobic speed and other fitness metrics. The second is that this study may provide us with a glimpse of what is to come in the near future with regards to using heart rate and GPS data for fitness assessment purposes.

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

Carl's Comments

"Perhaps this study is a great example of getting more out of simple data, since heart rate telemetry is easily collected in team environments with commercial products. From a budgeting standpoint, coaches should think about heart rate again and focus on creating a model with Athlete Management Systems (**HERE**) or use open source products like those from the R-Project (**HERE**)."

Fatigue & Recovery

This month's top research on fatigue and recovery.

FOREARM COMPRESSION GARMENTS: DO THEY AID RECOVERY?

Engel, F. A. et al. (2018) Frontiers in Physiology.

DOES THE IPAD NIGHT SHIFT MODE AFFECT SLEEP?

Nagare, R. et al. (2018). Lighting Research and Technology.

WHICH ARE THE MOST EFFECTIVE RECOVERY MODALITIES?

Dupuy, O. et al. (2018). Frontiers in Physiology.

[Abstract]

Forearm compression garments: Do they aid recovery?

OBJECTIVE
Climbing is highly demanding on the forearm muscles. Muscle contraction-induced ischemia (i.e. inadequate blood supply) in these muscles leads to high levels of localised fatigue and, consequently, a decrease in performance (e.g. grip strength). By using a forearm compression garment, climbers may benefit from changes in hemodynamics (e.g. increased venous return). Therefore, the aim of this study was to measure the effects of forearm compression during climbing.

WHAT THEY DID
This study had a single blinded, placebo-controlled, cross-over design. Seven elite climbers performed 3 sets of 3 climbing bouts wearing either forearm sleeves with compression (CG) or placebo forearm sleeves with no compression (CON). Heart rate (HR) was obtained during each climbing and blood lactate concentration (La), perceived exertion (RPE), and forearm muscle pain (PAIN) were also obtained after climbing.

WHAT THEY FOUND
HR, La, RPE, or PAIN increased from pre- to post-climbing, however, no differences were observed between groups. Also, no condition (CG vs. CON) × time was observed for any of the obtained measures. This study demonstrates that a forearm compression garment has no effect on blood lactate concentration, heart rate, perceived exertion, and/or local forearm muscle pain.

Practical Takeaways

From a practical perspective, I found this study very interesting as lately we have been seeing a growing body of research around climbing; primarily because it will be an Olympic sport in the 2020 games. In fact, in the April 2018 issue of the Performance Digest, I reviewed the effects of cold water immersion on climbing performance.

I particularly appreciate the fact that the sample was very homogenous (i.e. elite-level rock climbers) and the climbing protocol was well-designed by considering the demands of competition climbing. As pointed out by the authors, a key limitation to this study was the small sample size. In an attempt to overcome this limitation, the authors calculated effect sizes during their analysis. Interestingly, the authors did not valorize the moderate effects that observed on the between-groups differences for blood lactate, heart rate, and pain perception as they conclude that there were no benefits of wearing a forearm compression garment.

Although the results from this study only partially support the usage of forearm compression garment, as I mentioned previously, research seems to support the usage of long-sleeve compression garment shirts during rock climbing. Therefore, coaches should consider the usage of these compression garments as a method for enhancing performance. I would encourage you to listen to the podcast from Dr. Halson (see attached podcast) where she reviews the concepts of recovery and goes through different recovery modalities, including compression garments.

In previous issues of the Performance Digest where I have reviewed some articles regarding lower-limb compression garments, I have always mentioned the fact that compression garments should be customised in order to fit properly (e.g. provide an adequate compression). Interestingly, I have recently received an email from a company (iso-bar compression – see attached video) that provide custom-sized compression garments. With the increase in research surrounding rock climbing, I have no doubts that these services will extend to upper-body compression garments.

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

Francisco's Comments

"The findings from this study suggest that climbers do not benefit from the usage of a forearm compression garment. Nevertheless, it is important to mention that the sleeves used in this study only covered the forearm. Previous research observed that long-sleeve compression shirts had a beneficial effect on blood lactate concentration after exercise. The differences on the covered area may justify the lack of effects observed in this study.

Given long-sleeved shirts have been shown to have positive effects, I believe elite-level rock climbers could benefit from using compression garments. Nevertheless, future studies should aim to measure the effects of long-sleeved compression shirts on athletes of a similar competition-level in order to determine if the effects are similar to previous research."

[Abstract]

Does the iPad Night Shift mode affect sleep?

OBJECTIVE
The usage of gadgets such as mobile phones, tablets, and/or laptops are associated with melatonin suppression and consequently a disturbance in sleep (e.g. delayed sleep). In order to reduce short-wavelength light emissions, gadget manufacturers have now developed apps that reduce these emissions of the display in an attempt to reduce the effects on sleep and circadian health. As a result, the goal of this study was to test the efficacy of the "Night Shift" app (see App link below) on melatonin responses.

WHAT THEY DID
Twelve participants were exposed to 4 different conditions: 1) a dim light control [orange goggles]; 2) a high-circadian stimulus true positive [blue light goggles] intervention; 3) a low-correlated colour temperature "Night Shift" intervention from the device (iPad, Apple Inc.); and 4) a high-correlated colour temperature "Night Shift" light from the device (iPad, Apple Inc.). The two iPad lighting interventions were generated by adjusting the color temperature of the "Night Shift" application to one of the two extremes of the app (i.e. the warmer or less-warm option).

WHAT THEY FOUND
Melatonin suppression was significantly greater after two hours of exposure compared to just one hour. Furthermore, over the 2-hour exposure, melatonin suppression from exposure to the blue light goggles intervention was significantly higher in comparison to the two "Night Shift" interventions. Nevertheless, melatonin suppression between the two "Night Shifts" (both high- and low-correlated color temperature) was not different.

Practical Takeaways

The results from this study demonstrate that the three interventions resulted in melatonin suppression. Interestingly, while the blue light googles resulted in an increase of melatonin suppression during the first and second hour, the "Night Shift" interventions only increased melatonin suppression during the first hour. These findings demonstrate that the "Night Shift" interventions were effective for decreasing the harmful effect of the devices from the first to second hour.

Importantly, the melatonin suppression observed did not differ between the two "Night Shift" interventions. As a result, athletes are advised to adjust both the display's spectral composition and the display brightness when using the devices in the evening (i.e. when it's dark).

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

Francisco's Comments

"I think this is a very interesting study which demonstrates that sleep disturbances cannot be totally solved by simply using a "light-adjusting" application on a device. Nevertheless, a combination of "Night Shift" and a reduction in the brightness of the device screen can limit the harmful effects of artificial light on sleep disturbances. As I have reinforced in previous issues of the Performance Digest where sleep studies were reviewed, adequate athlete education regarding sleep hygiene should be a major focus for coaches. Athletes need to be fully aware of the role that sleep plays in wellbeing, recovery, and performance. To reinforce, athlete education regarding sleep education strategies should be provided.

Furthermore, because sleep is affected by training (see **HERE**) perceived sleep duration and quality should also be monitored on a regular basis (e.g. daily or monthly). This is an important topic to which I eluded to in last month's issue of the Performance Digest (June 2018); the Drillers et al. questionnaire (ASBQ; see attached article), which is a valid tool to detect sleep disturbances. I would recommend that you use the ASBQ in the early stages of the season (i.e. pre-season) and keep tracking the sleep duration and perceived quality daily from there onwards. Athletes who score lower on the ASBQ, or with chronic decreases in sleep duration and/or quality, should be "flagged" and should attend group and/or 1-to-1 sleep hygiene education sessions."

[Abstract]

Which are the most effective recovery modalities?

OBJECTIVE
Sport scientists and coaches implement different recovery modalities in order to speed-up their athletes' recovery. Although these recovery modalities have been previously analysed independently for their effects on recovery, there is a lack of systematic reviews and meta-analyses comparing different recovery modalities. Therefore, the goal of this systematic review and meta-analysis was to compare the effects of various recovery modalities against each other.

WHAT THEY DID
The authors compared the effects of different recovery modalities on delayed onset muscle soreness (DOMS), perceived fatigue, and muscle damage markers (C-Reactive protein [CRP], Interleukin-6 [IL 6], Creatine kinase [CK]). The following recovery modalities were included for analysis: Active recovery, stretching, massage, massage + stretching, electrostimulation, compression garment, cold water immersion (CWI), contrast water therapy, cryotherapy, and hyperbaric therapy.

WHAT THEY FOUND
The effects of different recovery modalities on DOMS, perceived fatigue, and different muscle damage markers can be observed in the table below. Significant positive changes for DOMS and perceived fatigue are represented with an asterisk (*). Moreover, when different characteristics of CWI were compared, temperatures <15°C were associated with moderate effects, >15°C to <38°C with small effects, and >36°C with harmful moderate effects on DOMS. For the effects of CWI on perceived fatigue, temperatures <15°C were associated with large effects and no beneficial or harmful effects were observed on temperatures between 15°C and 38°C.

» **Effects sizes** of the protocols

Recovery modalities	DOMS	Perceived fatigue	CK	IL 6	CRP
Active recovery	*Large**	*Moderate* (harmful)	*Small* (harmful)	*Small*	NA
Stretching	*Small* (harmful)	*Small*	*Large (harmful)*	NA	NA
Massage	***Large****	***Large****	***Large***	***Large***	**NA**
Massage + Stretching	NA	*Large**	NA	NA	NA
Electrostimulation	*Small*	*Small*	NA	NA	NA
Compression garment	***Large****	***Large****	***Small***	***Small***	***Small***
Cold water immersion	***Small****	***Large****	***Moderate***	***Small***	***Large***
Contrast water therapy	*Small**	*No change*	*Large*	*Small*	NA
Cryotherapy	*Moderate**	NA	*Small*	*Large*	*Large*
Hyperbaric therapy	*Moderate (harmful)*	NA	NA	NA	NA

Go to the next page to continue reading this review...

[Abstract]

CONTINUED: **Which are the most effective recovery modalities?**

PRACTICAL TAKEAWAYS

According to the findings of this study, massage, compression garments, and CWI appear to speed-up recovery the most and, are thus, the most effective recovery modalities. Massage appeared to have the most beneficial effect on DOMS and perceived fatigue. Although to a smaller extent, compression garments and CWI also have a beneficial effect on both DOMS and perceived fatigue. Cold modalities (e.g. cryotherapy and CWI) and massage elicit the greatest effects on reducing muscle damage markers. Active recovery, hyperbaric therapy, and stretching appear to be associated with some harmful effects.

EDITOR'S COMMENTS

This is a very interesting study as the authors compared the effects of different recovery modalities on different markers of muscle damage, muscle soreness, and perceived fatigue. In the table on the results section, I have highlighted (in bold) the most effective recovery modalities.

In several previous issues of the Performance Digest I have reviewed articles on both compression garments and cold water immersion. In summary, the only harmful effect associated to the usage of compression garments is if it disturbs sleep due to increases in body temperature, which may, of course, lead to discomfort and disrupted sleep. If that is the case, athletes should refrain from using them during sleep. Apart from that, compression garments should be used for as long as possible (e.g. 6-12h after training/competition). I have also previously mentioned that the pressure exerted by the garments may dictate the effects on recovery. There are currently some brands that measure the limb volume and individualise compression garments (**HERE**).

In terms of CWI, I have previously described the potential harmful effects, as CWI may decrease anabolic responses from training (i.e. muscle protein synthesis). However, this harmful effect needs to be counterbalanced with the beneficial effects that are widely demonstrated in literature. In the April 2018 issue of the Performance Digest, I reviewed one of our own papers which looked at the practical applications of CWI for team-sport athletes. I would suggest you have a look in either the paper (currently in press) or the Performance Digest summary. Importantly, this study demonstrates that temperatures <15°C are more effective than warmer temperatures. Although this is in agreement with the findings from previous research, it is also true that very low temperatures (e.g. <10°C) may be harmful to recovery. Furthermore, it is much easier to get buy-in from athletes when you use warmer temperatures than trying to implement very cold temperatures for recovery (e.g. 5°C for ~10 minutes).

Lastly, from the results of this study, massage seems to be the number one recovery modality. A recent meta-analysis (**HERE**) demonstrated that a 20-30 massage implemented 2-hours after exercise is an effective way to reduce DOMS 24-hours after exercise. To add to that, this current study also found that massage is effective for reducing DOMS up to 96-hours after exercise. Although it is not feasible to have massages after every training day, I would suggest athletes have them done mid-week, after a training day and prior to the day-off, in addition to having one on the day before a game.

To conclude this excellent study, let me give you an example on how to implement these recovery modalities during the week according to two typical weekly training schedules (see programme below).

Example of two typical training weeks with implemented recovery strategies.

	Saturday	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
	Game	Off	Easy	Hard/moderate	Off	Hard/moderate	Easy
Massage				20-30 min massage		20-30 min massage	
Compression	During night	During day and night	After training and night	After massage and night	During day and night	After massage and night	During day and night
CWI						10 min (10-15ºC)	10 min (10-15ºC)
	Game	Off	Easy	Hard/moderate	Hard/moderate	Off	Easy
Massage					20-30 min massage		
Compression	During night	During day and night	After training and night	After training and night	After massage and night	During day and night	During day and night
CWI					10 min (10-15ºC)		10 min (10-15ºC)

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

Youth Development

This month's top research on youth development.

HOW MUCH IS ENOUGH? UNDERSTANDING THE TRAINING LOADS OF ELITE ADOLESCENT RUGBY PLAYERS

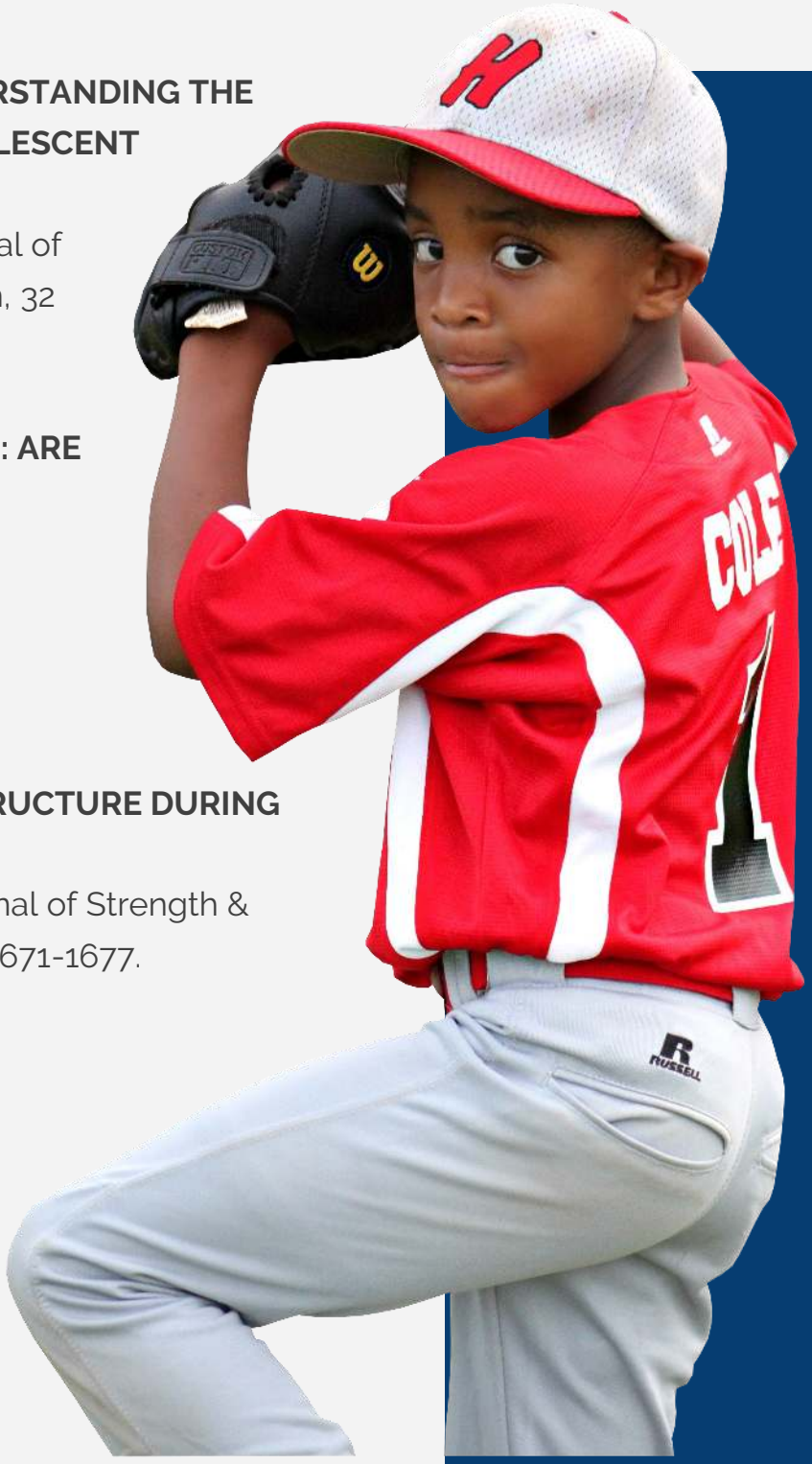
Phibbs, P.J. et al. (2018) The Journal of Strength & Conditioning Research, 32 (5), pp.1316-1323.

DEVELOPING YOUNG ATHLETES: ARE YOUTH TALENT ID AND DEVELOPMENT SYSTEMS NECESSARY AND HEALTHY?

Rongen, F. et al. (2018) Sports medicine-open, 4(1), p.18.

DO YOUNG ATHLETES NEED STRUCTURE DURING THEIR OFF-SEASON?

Jensen, C.D. et al. (2018) The Journal of Strength & Conditioning Research, 32(6), pp.1671-1677.



[Abstract]

How much is enough? Understanding the training loads of elite adolescent rugby players

OBJECTIVE
To ensure that athletes can repeatedly produce quality bouts of physical performance, training must hit a "sweet spot", where it is neither too easy nor too hard. To assess this, coaches may wish to monitor training load due to its relationship with performance, where "too much" can lead to injury and illness.

According to this study, little is known about the training loads of English Adolescent Rugby Union players. In light of this, the authors wish to provide us with an evidence-based workload resource to support practitioners in their programming of future rugby programmes.

WHAT THEY DID
20 male adolescent rugby athletes (aged 17 ± 0.7 years) consisting of 10 forwards and backs were recruited for this study and observed for a 10-week period. Both external (Global Positioning Systems [GPS] and accelerometer) and internal (Session Rate of Perceived Exertion [sRPE]) were collected and compared using Cohen's d and magnitude-based interferences. Differences in position, distances, and player load (accelerometer data) were compared.

WHAT THEY FOUND
Overall, mean weekly training volumes and internal loads were lower than previously observed in a similar study on Australian adolescent rugby players (see attached article), with unclear differences between forwards (504 ± 160 AU) and backs (580 ± 169 AU). Backs had a far higher mean running time observed in their distance (13,063 ± 3933 vs. 10,195 ± 2,242 m), low speed activity distance (LSA) [12,142 ± 3,672 vs. 9,694 ± 2,215 m], and very high speed running distance (VHSR) [34 ± 51 vs. 5 ± 8 m] compared to forwards. In addition, there were large inter-individual differences (between players of similar positions [i.e. two fullbacks]), demonstrating the differences in a positions internal and external load. These findings suggest that whilst internal loads appear similar between positions, the external load differs substantially between the forwards and backs. Finally, adolescent athletes in this study were exposed to greater weekly mean running loads than those observed in senior professional teams, which may limit physical output in other domains.

Practical Takeaways

Due to the variation seen between positions (i.e. forwards vs back), and players within these positions (i.e. forwards vs forwards), this would highlight the importance and need for coaches to monitor and manage their athlete's individually. To do this, Dr. Craig Twist has provided a great podcast on monitoring training load and fatigue which can be found in the audio link below. In this podcast, Craig discusses how to individually monitor athletes, including how to find individual change when there is so much data being collected.

With regards to running intensity and loads, it may be important for the coaches in this study to reconsider the exposure they place on their athletes during the pre-season. The effect of high in-season running loads can be detrimental to performance, limiting appropriate recovery, feelings of 'readiness', and increase their likelihood of injury. By minimising this and focusing on quality rather than quantity, athletes may be able to perform better in their games by having the energy and ability to run faster and/or be more explosive.

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

Tom's Comments

"As a coach in practice, I like my athletes to put their upmost into their high-intensity efforts. As a result of this, I do speed sessions once a week and move to twice per week during the pre-season. This ensures that athletes are able to have sufficient rest between sessions/match-day, allowing them to perform at their maximum velocity on game day. For longer and less intense running, I would recommend some form of off-feet work (e.g. bike or swimming) that can also support recovery. With regular rugby training, I look at sRPE and use what the coaches do to dictate my approach to my sessions. This is something that I'd like to see change in the future, where coaches and S&C coaches bridge their practice.

Monitoring load is important to ensure that athletes can continue to produce quality and repeated bouts of good rugby. Most importantly, when working with a young athletes, I believe it's about giving them the best opportunity to move forwards in their athletic and personal career. In 2017, Padraic Phibbs produced a great video at the Carnegie Adolescent Rugby Research (CARR) conference. If like me, you can listen/watch small snippets of content over the space of a day, I would highly recommend you check out this video to utilise these methods in your own practice (see the video link)."

[Abstract]

Developing young athletes: Are youth talent ID and development systems necessary and healthy?

OBJECTIVE
The process of developing talent can be very complex and difficult to sustain over many years. This is made even more difficult by the differences seen over generations of children, with specific reference to their access to deliberate play, free play, and time spent in one or more sports. Talent identification and development systems (TIDS) are used by professional clubs to supplement the senior teams with new and exciting talent. An example of what TIDS look like in practice has been discussed by Hugo Perez, former international soccer midfielder and, more recently, assistant coach with the USA U15's (see attached podcast).

Some of the benefits of guiding a player through TIDS are that the player understands the cultural norms and behaviour expectancies of the club/organisation, allowing them to transition into the first team smoothly. However, by acknowledging that few players actually "make it", the authors have decided to question how TIDS can better support the athlete and entertain if they are necessary for producing talent.

WHAT THEY REPORTED
TIDS can be a great way of developing holistic skills, complimenting both on- and off-the-field qualities required to succeed in many different professions. TIDS are pyramidically structured, generating a clear expectancy and pathway for youth on the scheme. On one hand, this sets clear expectancies about the choices and requirements to reach sports professionalism. However, TIDS often remove young adults from school, limiting their formal education and, therefore, restricting their knowledge and likelihood of employment if they are unsuccessful in sport.

In this paper, the authors share the commonly utilised branches of the TIDS pathway, demonstrating the advantages and disadvantages of pursuing physical, psychological, and educational knowledge when undertaken in an academy setting (see table).

As you can see, both the advantages and disadvantages make a compelling argument both for and against the currently established aims. It would, therefore, seem that context is important, where the individual is a decisive factor in their experiences being either positive of negative.

Advantages	Disadvantages
Physical Improved physiological capacity, body composition, skill, and long-term health.	**Physical** Overtraining, injury, illness, long-term health (e.g. joint health)
Psycho-Social Impact Increased self-esteem and confidence, self-regulation, character development, peer relationships, and the development of life skills.	**Psycho-Social Impact** Decreased self-esteem, excessive pressure, burnout, social isolation, and engagement in unhealthy behaviours.
Education Academic high achievers and graduation rates.	**Education** Educational sacrifice, poor performance, and reduced career options.

Tom's Comments

As someone who works in a professional Academy, I would feel confident in saying that for most, the skills they gain and the experiences they have are life-lasting and positive. Sadly, some do lose their place which can be tough on their parents, the coaches, but, most importantly, themselves as a person. The degree of pain that they feel often increases with their progression up the hierarchical scheme, whereby surviving for years and climbing the ladder makes the fall greater.

Sadly, as an S&C coach, this is something which we don't have much of a say in, other than the performance and attitude displayed during our sessions. It is hoped, however, that due to the professionalism of academies and their emphasis on networking, they would refer them to another club that could further them as a player and person.

I've shuddered a few times during this review when I've referred to the people I work with as "athletes". It is always important to remember that behind every sports machine (i.e. athlete) is a human, with their own struggles, strategies, and visions of themselves and positions at the club. Academies should continue to look to develop these athletes, but inevitably, will let some down in the process. Chris Kirkland discusses this in the short attached video, suggesting that individuals feel like part of the furniture after time. In my opinion, clubs could support players better by avoiding fixed and rigid behaviours, as a strong cultural identity may limit their transition and enjoyment into other clubs/organisations.

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

[Abstract]

Do young athletes need structure during their off-season?

OBJECTIVE
Before and during the rugby season, training programmes are designed to effectively prepare players for the intensity and volume of repeated fixtures. Designing training plans that fluctuate periods of high and low stress (both physically and mentally) is a fundamental basis for programming, known as periodisation. During a year, there are periods of time typically known as the 'off-season', where players have unsupervised breaks and are left to look after their training, diet, and rest. The aim of this study was to assess if unsupervised and fully autonomous periods are effective at improving anthropometric and physical capacities of athletes,

WHAT THEY DID
14 males were analysed in this study, with the mean age of 19.6 ± 2.0 years; the youngest was 18 (n = 3), the oldest was 26 (n = 1), and the most common age was 19 (n = 7). Height and weight (hydrostatic body composition) were taken before and after the study. The following variables were measured below:

1. Vertical Jump Height (Vertec Measuring device).
2. Power (10-yard dash).
3. Strength (1RM Squat and Bench Press).
4. Aerobic Capacity (Progressive treadmill test to voluntary exhaustion [Bruce Protocol]).

All athletes in this study kept a weekly log of their activities, paying special attention to the frequency, duration, intensity, and dietary habits. All variables were statistically analysed using a paired sample t-test (i.e. V02 pre- vs. V02 post-intervention).

WHAT THEY FOUND
To both my own knowledge and the authors, this is one of the first studies to have investigated the effects of a 4-week unsupervised and unstructured break from rugby. The results indicated that this break did not impair performance, with some performance parameters actually improving.

With regards to anthropometric data, BMI increased in 11 of the 14 athletes, with every athlete's body fat percentage increasing. When expressing vertical power (vertical jump), 11 improved after the break, with 1 producing a lower height, and 2 remaining unchanged. In the 10-yard sprint, 7 of the athletes performed worse, with the other 7 performing marginally better. Mixed results were found for the bench press, with 6 demonstrating an increase in strength and the rest remaining the same, with 1 athlete actually losing strength. These results were not echoed in the squat, with all 11 subjects improving in their squat strength.

Finally, all 12 who completed the V02 test actually improved, with paired sample t-tests reporting significant changes in V02 max, squat max, vertical jump, and body fat percentage.

Practical Takeaways

Strength and conditioning coaches generally agree that periods of rest are required to allow the athlete to recover. This study introduces the idea that a 4-week break may be a good starting point for unsupervised breaks. This study suggests that this may be due to a reduced allostatic load, which reduces cortisol levels, adrenal fatigue, and increases testosterone. Mark Pettus, who has produced the attached podcast, provides some actionable and well-researched advice on how to reduce allostatic load through several lifestyle changes (very much worth listening too).

In addition, squat max and vertical jump improved, proposing that players engaged in relatively less 'on-feet' training may have supported recovery and feelings of 'readiness' due to reduced leg fatigue that accumulates through repeated loading.

A break from a structured training routine can often mean that a player "lets their guard down" with their diet, which may explain the increase in body fat. To support athletes during this period, it is important to emphasise that although we'd like the athlete's to relax, have fun, and enjoy their food, increased body composition can increase the likelihood of injury and also make the pre-season a more daunting experience. As a result, Irish Rugby has produced realistic and simple off-season nutritional guidelines which players can easily follow (see attached article).

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

Tom's Comments

"Rugby players do need high volume and intense training regimes in their early years to prepare them for the demands of the game. With players beginning senior fixtures at a younger age, we can't wrap them in cotton wall and avoid challenge. At the same time, I think it's important that young players do have time to be young and enjoy their time off from training. It is worth mentioning that the athletes in this study performed on average 15 sessions throughout the 28 day rest period. In light of this, it is safe to say that these athletes must be in a hard-working culture, with the impact of exercise and its use within performance thoroughly ingrained in the athletes idea of improvement. In my opinion this is one of the primary jobs of the S&C coach, to ensure that the athletes understand the benefits of S&C in their regime.

Some interesting concepts to reduce training pressure and load have been suggested by Buck Anderson in the attached Video. Buck is New Zealand's youth development officer, whose primary job is to develop talent, encourage participation, and ensure enjoyment. This approach emphasises fairness, similar to the theory of bio-banding seen in football (Soccer). The reason I have attached this is because I believe that if young athletes play against varied players, their enjoyment will improve and the 'off-season' may be seen as less of a rest, and more of an unwanted experience that boosts their 'readiness' to play in-season. However, the biggest take-home message from this study is to ensure that athletes maintain their dietary standards during the off-season."

Nutrition

This month's top research on nutrition.

PROTEIN RECOMMENDATIONS FOR WEIGHT LOSS IN ELITE ATHLETES: HOW MUCH, HOW OFTEN, WHAT TYPES?

Hector, A. J., & Phillips, S. M. (2018). International Journal of Sport Nutrition and Exercise Metabolism.

A PRACTICAL NUTRITION KNOWLEDGE QUESTIONNAIRE FOR ULTRA-ENDURANCE ATHLETES

Blennerhassett, C. et al. (2018). International Journal of Sport Nutrition and Exercise Metabolism, 14, 1-27.

THE EFFECTIVENESS OF PREBIOTICS AND PROBIOTICS ON ATHLETIC PERFORMANCE

Pane, M. et al. (2018) Journal of Clinical Gastroenterology.

[Abstract]

Protein Recommendations for Weight Loss in Elite Athletes: How much, how often, what types?

OBJECTIVE
Amy and Stuart from McMaster University are both well respected leading researchers in their fields and provide a clear and up-to-date review on the hot topic of protein recommendations. This manuscript forms part of the wider International Olympic Committee special edition series from the International Sport Nutrition and Exercise Metabolism Journal.

WHAT THEY DID
Both authors provide a review of the large body of scientific evidence supporting protein intakes (in excess of the recommended dietary allowance) to promote not only the retention of skeletal muscle, but also the loss of fat mass during periods of dietary energy restriction. Many leading articles are cited, as well as meta-analyses for data in athletes, and where research in athletes is limited or unavailable, they discuss overweight/obese or specific situations of energy balance.

WHAT THEY FOUND
How much protein?
In brief, the discussed studies clearly demonstrate that consuming higher protein intakes (1.8-2.7 g protein/kg body weight), combined with structured resistance exercise training, are effective at retaining lean body mass whilst promoting fat mass loss during reduced energy intakes (see infographic below)

How often to consume?
To maximally stimulate rates of skeletal muscle protein synthesis, approximately 0.24g protein/kg at each meal time is recommended (so 24g of protein at each meal if you are a 100kg athlete). The authors also discuss that total protein intake, rather than post-exercise protein ingestion, was related to enhanced strength and hypertrophy. A protein intake pre-bed (typically when we have an 8-hour fast due to sleeping) is another strategy to improve lean body mass retention during calorie restriction.

Type of Protein
Whey protein is a fast-digesting protein derived from milk which contains a high proportion of the branched chain amino acid leucine, and ingestion results in a robust increase in muscle protein synthesis significantly higher than consumption of an iso-energetic and iso-nitrogenous amount of soy protein. Further, meta-analyses have demonstrated that increased diary consumption during energy restriction results in superior lean mass retention and fat mass loss.

Practical Takeaways

This IOC scholarly review provides us with some great take-home messages to utilise with athletes. Clearly, the timing, type, and total (3 T's) protein ingestion can play a big part in achieving individual body composition targets. Some other hot topic areas to be highlighted are:

Protein-derived supplements:

For elite-level athletes, supplements, including whey protein, are commonly used. Whey protein, when used as either a supplement or incorporated into a weight loss or weight maintenance diet, can promote lean body mass retention and fat mass loss. BCAA supplements have also generated wide interest in promoting skeletal muscle anabolism. However, the current data regarding the ingestion of BCAA's during dietary energy restriction is equivocal and would rather suggests that ingestion of a complete protein such as whey should be recommended. A similar statement is made on the use for HMB, with conflicting studies suggesting more work is needed to determine the effectiveness of this supplement.

Other proposed weight loss supplements:

Both authors discuss the use of other purported weight loss supplements beyond protein and amino acid derivatives, however, the supporting evidence is currently limited. This includes a number of substances: Garcinia cambogia, chitosan, Beta-glucans, raspberry ketone, glucomannan, frucoxanthin, green coffee, bitter orange, and Hoodia gordonii.

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

James's Comments

"This review provides a clear message that the use of weight loss supplements poses a high risk to athletes when trying to reduce weight. Instead, athletes should focus their attention to much favorable shifts in lifestyle modification.

Indeed, advising athletes of the benefits of consuming a higher than recommended protein intake for promoting both high-quality weight loss and maintaining or improving athletic performance during dietary restriction is advised. A nice podcast with Stu Phillips is below which would be a great listen in addition to a GSSI article on protein consumption.

Whey protein is clearly a convenient source of protein to promote muscle protein synthesis for those athletes travelling on the road or for convenience. Having said that, whole food will always contain added nutrients to support training adaptation and recovery and should always be consumed over supplements, if possible."

[Abstract]

A Practical Nutrition Knowledge Questionnaire for Ultra-Endurance Athletes

OBJECTIVE
Ultra-endurance events are becoming increasingly popular, with more athletes at all levels looking for optimal nutrition to support individual training needs. Typically, the nutritional intake of ultra-endurance athletes is often poorly matched with the demands of the sport, however, existing research conducted on extreme sporting activities (>4 hours) has been limited to case studies or observational studies. In addition, too often these studies also only focus on dietary practices and energy balance, which is likely due to difficulties in recruiting such athletes to undertake experimental studies.

Furthermore, previous studies have assessed nutritional knowledge using a variety of tools deemed unsuitable for this athletic population. There are certain advantages to sport-specific questionnaires, for example, they contain specific questions applicable to the demands of the sport. Therefore, this study aimed to validate a sport-specific nutrition questionnaire and to assess the knowledge in a cohort of ultra-endurance athletes.

WHAT THEY DID
Initially, the authors validated an existing questionnaire (sport nutrition knowledge questionnaire [ULTRA-Q]) for use with ultra-endurance athletes. Claire, the lead author, then amended and related the questions to suit their target population, and recruited three groups of examiners: 1) Sports and Exercise Nutrition Register (SENr), 2) registered dietitians (RD), and 3) individuals who had no nutrition education (GenPop) in order to assess the construct validity and test-retest reliability of the adapted questionnaire.

Following the questionnaire validation, it was then implemented to a group of endurance athletes. 74 male and 27 female ultra-endurance athletes, aged 42 ± 8 and 39 ± 10 years, respectively, completed the finalised version of the ULTA-Q via a UK-based research website for endurance athletes. Athletes who expressed their interest in taking part this study received a link to the online questionnaire.

WHAT THEY FOUND
The main finding indicated that the ULTRA-Q is an appropriate tool to determine sports nutrition knowledge (at least in this population of athletes) which researchers, practitioners, and healthcare professionals can use in practice. Overall, the ultra-endurance athletes had a reasonable level of nutrition knowledge, however, the degree of inter-athlete variability suggests a need for targeted nutrition education. Furthermore, the athletes' knowledge in this study (68%) was lower than the threshold set from previous research to demonstrate adequate knowledge (75%; **HERE**). Overall, the ultra-endurance athletes' nutrition knowledge was weakest in the supplement and fluid themes. Only 7.8% of athletes acquired nutrition information from a registered Dietitian/Nutritionist, compared to 74% from magazines, and 73% from other athletes.

Practical Takeaways

This study demonstrated that applied practitioners in the UK, including coaches, could use ULTRA-Q to assess nutrition knowledge amongst ultra-endurance athletes and tailor their interventions accordingly. Clearly, the nutrition for ultra-endurance events is important, and these athletes are likely to make more effort to understand the nutritional guidelines than other athletes and coaches. However, a need for targeted nutrition education would be beneficial for this population, possibly from a SENr practitioner given their highest score on the ULTRA-Q questionnaire.

Interestingly, only 8% of the athletes acquired nutritional guidelines from SENr practitioners, this indicates that nutritional practitioners need to engage in promotion activities to raise their profile amongst these athletic groups. The lack of knowledge on fluid types and needs for optimum hydration is valuable information to the coaches and practitioners, and therefore fluid themes and electrolyte-balance should be a priority in the education material to prevent incidence of fatal hyponatremia and gastrointestinal complaints in athletes competing in ultra-distance events.

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

James's Comments

"The current study did have a few limitations which need to be highlighted. First, a low response rate from cyclists and adventures prevented a comparison of these groups with runners and triathletes. Therefore, in agreement with authors, future research should obtain a larger sample size of athletes to analyse sub-group comparisons. It is worth mentioning that this questionnaire is adapted to UK food products and, therefore, this questionnaire may not be applicable to other countries due to differences in the availability of food types and cultural eating behaviors. Consequently, additional alterations may be required if athletes are unfamiliar with specific products.

Finally, with less than 1% of athletes obtaining their knowledge from registered dieticians or nutritionists, this certainly highlights at least a huge area to correct and I wonder how similar or different this figure maybe across other individual- and team-sports."

[Abstract]

The effectiveness of prebiotics and probiotics on athletic performance

OBJECTIVE
Rather than a piece of experimental research, this article nicely collates evidence regarding the effectiveness of prebiotics and probiotics on athletic performance and explains the mechanisms by which they have their effect.

WHAT THEY DID
This article explains how the collection of microorganisms in our digestive systems (known as the microbiota) contribute to a large variety of functions in our body. These functions include things such as inflammation, homeostasis, and the synthesis of neurotransmitters, such as dopamine, GABA, and serotonin, which are crucial in neuromuscular control. Furthermore, the authors present evidence for the effect of various probiotic interventions on the incidence of gastrointestinal (GI) and respiratory pathology, including how probiotic supplementation may aid in both athletic performance and recovery.

WHAT THEY FOUND
Various strains of Lactobacillus and Bifidobacterium may exert a beneficial effect on the incidence of GI or respiratory illnesses in both male and female athletes from many sports. One piece of evidence demonstrates how daily probiotic supplementation during 3 months of exhaustive aerobic exercise in wintry conditions significantly reduces upper-respiratory tract illness incidence (i.e. colds) in trained athletes. Evidence is also presented which suggests that the co-administration of two probiotic strains (Bifidobacterium and Streptococcus) may have anti-inflammatory effects following muscle-damaging exercise. In addition to this, it may also attenuate the reduction in muscle performance after exercise when compared to a placebo.

Practical Takeaways

First of all, it is important to understand the terms 'prebiotic' and 'probiotic' as they are sometimes (wrongly) used interchangeably. Probiotics refer to the living cultures of bacteria that reside in our body and make up the microbiota. Prebiotics are types of fibre that cannot be digested by our body and serve as a food source for probiotics. Sources that contain both prebiotics and probiotics are termed 'synbiotic' (please see infographic below).

Probiotics do not require prebiotics to function, but there is some evidence that prebiotics may augment the function of probiotics. Now that you are familiar with the biotics, it's important to understand that this article shows the potential benefits of incorporating probiotics into nutritional strategies for athletes. These may also be more useful for athletes who may find themselves at risk of developing GI or respiratory illnesses due to environmental conditions (e.g. winter), chronic high-intensity exercise, or a combination of the two. There is also emerging evidence for the role of probiotics for aiding recovery following muscle-damaging exercise, particularly when the time available to recover is short (e.g. during tournaments or multi-event competitions).

Probiotics can be purchased as supplements, but foods such as yoghurt and cheese, provide a great source of probiotics and may be incorporated into nutritional strategies to ensure a healthy microbiota is maintained and the protective effects are fully utilised. Furthermore, the authors suggest how the microbiota can mediate psychiatric factors (e.g. stress and anxiety) via the synthesis of neurotransmitters – a link known as the "gut-brain axis" (please see podcast link below). Although research in this area is still within its infancy, this potentially further emphasises the importance of maintaining a healthy gastrointestinal system. Suggestions could be made for athletes to increase diary intake to support an increase in naturally probiotics (please see video link below).

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

James's Comments

"Although Pane and colleagues are not providing us with any new experimental research, this presentation article provides a helpful collation of current evidence on the effects of probiotics on health and performance. Taking care of the microbiota and gut health can often be ignored in order to prioritise training volume or adequate fuelling for performance without consideration of how these affect the gastrointestinal systems. However, with 30-50% of athletes reporting some kind of abdominal discomfort during exercise, it is undoubtedly an important factor of performance that should be regarded on an equal level to all other aspects of training and competition.

Evidence for the effects of probiotic supplementation is increasing, but there is still gaps in the literature regarding optimal timing and quantity of doses. This is something that should be calculated for individual athletes to suit their specific training and nutritional regimes."

Injury Prevention & Rehab

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

HOW FEMOROACETABULAR IMPINGEMENT SYNDROME AFFECTS LOWER-LIMB MOVEMENT
King MG. et al. (2018) Br J Sports Med.

ACL INJURY: RETURN TO RUNNING CRITERIA
Rambaud AJM. et al. (2018) Br J Sports Med.

HOW TO MANAGE PATELLOFEMORAL PAIN (I.E. RUNNER'S KNEE)
Barton CJ. et al. (2018) Br J Sports Med.

[Abstract]

How femoroacetabular impingement syndrome affects lower-limb movement

OBJECTIVE

Femoroacetabular impingement syndrome (FAIS) has a complex presentation. It is more so a movement-related issue that results from either over coverage of the femoral head by the acetabulum (i.e. pincer morphology) or from a larger, irregularly shaped femoral head (i.e. cam morphology). For greater clarification of this, see the attached infographic below. The best treatment approaches are unknown, and arthroscopic surgery rates are increasing, despite a lack of evidence supporting it. This study aimed to (1) identify differences in hip and pelvic biomechanics between individuals with FAIS and those without (control group), and (2) evaluate the effects of surgical intervention on these same biomechanics.

WHAT THEY DID

Two reviewers searched Medline, CINAHL, EMBASE, Scopus, and SPORTDiscus databases from the earliest dates available, through 2017. Included studies were scored on their reporting quality using the Epidemiological Appraisal Instrument (EAI) and rated as high-, moderate-, or low-quality based on this. They grouped together data on pelvic kinematics and joint torques (forces), organised them via planes of motion, and analysed them for differences between individuals with FAIS and matched controls during walking, squatting, jump and landing, sit to stand, and ascending stairs. They also looked at the reported effects of surgical intervention on FAI symptoms.

WHAT THEY FOUND

Despite there being a fair amount of variability among studies, and some contrasting findings, overall data analysis concluded the following: moderate evidence of decreased hip extension and overall sagittal plane ROM during walking in those with FAIS, but no other significant differences between groups in pelvic or hip biomechanics during walking, stairs, sit to stand, and drop landing. However, there was a difference in squat depth and hip external rotation (ER) force generation between the groups, with the individuals with FAIS squatting to shorter depths and generating lower ER force than individuals without FAIS/control group.

Practical Takeaways

The decrease in hip extension, particularly at the end of stance phase in walking (terminal stance), is likely in an effort to lighten the load on the anterior hip musculature, and/or a compensation stemming from "protectively tight" hip flexors. The potential problem with this, however, is twofold: (1) the relative off-loading of the anterior hip musculature may negatively impact overall hip stability and contribute to the ongoing cycle of protective tightness. In addition, an altered gait pattern, even slightly, can affect movement patterns and promote global compensations if it persists long enough. Therefore, when the coach or clinician observes a lack of hip extension in an athlete or patient with FAIS, he/she should review and encourage normal gait pattern, as well as properly educate the individual on WHY it is important.

The findings of lower peak hip ER force, coupled with smaller hip IR angles makes sense, but also likely needs to be addressed. Individuals with FAIS often have the most discomfort in deep hip flexion, adduction, and IR. The authors hypothesized that a lower hip IR angle, in turn, demands less force to be produced by the hip external rotators (ERs). Over time, this can result in generally poorer neuromuscular control of the ER's on the symptomatic side. This can have implications with many daily and sports related tasks that demand strength of the hip extensors and rotators (e.g. stair climbing, walking uphill, running/sprinting, etc.). Knowing this, the coach or clinician should attempt to increase the athlete's IR ROM (and confidence with that motion), as well as to increase hip ER strength.

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

Steph's Comments

"Once all of the data are sifted through and simplified for application to a human athlete or patient, they promote just that: simplicity. The measurements are many in this study, but very few significant differences in pelvic and hip biomechanics were found. Other than the hip flexion and IR angles, and hip ER strength differences, the major issue appeared to be squat depth. This is something coaches and clinicians can have a huge impact with, and this can be tremendously helpful for individuals dealing with discomfort due to FAIS.

What was interesting here, is that overall squat depth was consistently shorter in those with FAIS, but hip flexion angle was no different. This is interesting considering that a typical symptomatic position is deep hip flexion. What this suggests, is an alteration in motor patterning of the squat and potentially fear of the exercise itself. This is a perfect point of entry for the coach and clinician, as we are skilled in instructing the person on appropriate modifications to the pattern that will allow for proper form and depth with minimal/no discomfort."

[Abstract]

ACL Injury: Return to Running Criteria

OBJECTIVE
The return to running (RTR) changes the focus from impairment-based exercises to more sports-specific exercises; an important milestone in post-operative ACL rehab. However, there is no consensus on when is the optimal point to initiate running. The aims of this review were to: (1) describe criteria used in RTR post-op ACLR, (2) report how these criteria, surgical approaches, and post-op rehab have changed over time, and (3) help clinicians and patients make quality decisions regarding RTR post-operatively.

WHAT THEY DID
A literature search was conducted using a 3-step approach. Step one was a pilot search in MEDLINE and SPORTDiscus using specific search terms. Step 2 was analysing titles and abstracts in order to identify the best keywords to use in the final search. Step 3 was the final search using the search strategy and terms developed in steps 1 and 2. Two reviewers divided the 201 included studies into time-based and criteria-based RTR reports and independently extracted data based on 8 categories. They also designated whether a rehab protocol was "protective" or "contemporary," based on level of activity and ROM restrictions in the early phases.

WHAT THEY FOUND
198 of the 201 studies reported clear time-based recommendations, with an average RTR at 12 weeks. In the sub-group comparisons, RTR with "open surgery plus protective rehab" was 29 weeks. However, when contemporary rehab was implemented, there was no significant difference in RTR for either open vs. arthroscopic surgery (open = 10 weeks, arthroscopic = 12 weeks).

36 studies reported on criteria-based protocols for RTR, categorised into clinical, strength, and performance criteria. The most common measurements in each category were as follows: knee flexion ROM, effusion, and pain as clinical criteria, isometric and isokinetic quadriceps and hamstring ratios as strength criteria, Y-balance, hop test, single-leg squats, and step-up and holds as performance criteria (for more info on single- and triple-hop testing for return to sport, see article link #1 below).

Practical Takeaways

The general consensus was that a post-op timeline is the mainstay in RTR decisions and that strength and functional testing are important, yet not as heavily weighted. This study also shed some light on another interesting concept: that the RTR timelines were similar for those who underwent open surgery and those who had arthroscopic surgery (10 to 12 weeks), as long as they went through what the authors deemed a "contemporary" rehab protocol vs. a "protective" protocol. A protective protocol was characterised by a period of immobilisation and/or weight bearing restriction, whereas a contemporary protocol had no mobility restrictions, encouraged active knee extension and quad activation, and early weight bearing. This demonstrates the positive impact that a solid, progressive post-operative physical therapy and training plan of care can have on recovery. For a more detailed look at return to running and a general post-op protocol, see articles #2 and #3 below.

The bottom line here, is that it is safe to initiate running at an average of 12 weeks post-op, but that there should also be some basic functional testing performed to determine the "passing quality" before the athlete is formally cleared.

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

Steph's Comments

"It is somewhat concerning that even in 2018, it is still uncommon to require functional- and performance-based testing as part of the equation in determining RTR in post-op ACL rehab. I think that many clinicians forget that running is a skill, a repeated gentle plyometric even, with pre-requisites that an athlete should express control of. Therefore, time from surgery alone is an insufficient method of determining readiness to run; just as we would not be comfortable using time alone in clearing an athlete for full participation in sport/activity.

This study does acknowledge that an individualised protocol is essential for return to running and to sport/leisure activity, and is a proponent of further research, of which I am in full support. I feel as though this is a case of the research being behind clinical and athletic practice, and this is a critical entry point for coaches and clinicians to implement more objective, functional testing before giving the athlete the green light for running."

[Abstract]

How to Manage Patellofemoral Pain (i.e. Runner's Knee)

OBJECTIVE
Patellofemoral pain (PFP) is common in both the general and adolescent population, but it is prevalent in up to 29% in adolescents. It also tends to become persistent and long-term outcomes tend to be poor; 57% of individuals report unsatisfactory outcomes 5-8 years following onset. The goal of this review was to provide an overview of the physical therapist's management of PFP, then progressing through treatment and return to activity or sport (where the coach is invaluable).

WHAT THEY DID
The authors began with symptom onset and an introduction to the "complex pain experience," as it pertains to the often ongoing symptoms of PFP. They acknowledge that there are often a number of variables that go into symptom onset, and not just one structure. They suggest that the pain experience be acknowledged and respected, and that proper education along with graded exposure to activity can be very beneficial. They then show how they conduct the initial evaluation, including history, physical exam, ROM/muscle testing, strength testing, balance assessment, and movement assessment. Finally, they describe the best supported treatment options, with appropriate progressions and transition to sport/activity.

WHAT THEY FOUND
Strength testing should evaluate muscles that cross the knee, hip, and ankle. Knee and hip extensors, and hip abductors and external rotators tend to be weaker in those experiencing PFP.

Balance testing should include static single-leg stance with eyes open and closed, and the dynamic Star Balance test (see article #1 below). Individuals with PFP often exhibit poor balance with eyes closed.

The movement assessment should include single- and double-leg squatting, drop jump and land, hopping, walking, stair ascent and descent, and running. With these, compensations such as dynamic valgus (knees buckling in) should be identified.

Exercise therapy is the "treatment of choice", though other options were included. Of these options, strengthening/exercise, neuromuscular retraining, activity modification, and gradual loading had the greatest support and outcomes.

Practical Takeaways

The authors take into consideration that PFP often persists for months or even years, and that the complex pain experience is very important for physical therapists and coaches to understand. Though beyond the scope of this article, the main takeaway regarding this concept is the following: we need to realise and educate athletes that these types of persistent symptoms may outlive their adaptive purpose, even after tissue healing occurs. This means that avoiding loading is actually detrimental, that graded exposure is beneficial, and that full function and strength may return without full pain resolution.

Where coaches in particular can have a huge impact is movement assessment, and monitoring soreness (see soreness rules - Table 3 in the study). Coaches are already experienced and well versed in picking up on movement pattern abnormalities or compensations and, with this added data, they can identify which may be contributing to PFP symptoms. In addition, setting a threshold for pain/soreness levels that are "acceptable" (e.g. 3-4/10 on the VAS Scale) during exercises, dispels the myth that pain is bad or pain equates to tissue damage; therefore, making rehab or training through some symptoms less scary. This concept is similar to the "envelope of function" idea, which is well explained by Scott Dye's research (see attached article #2).

Lastly, the detailed layout of the different aspects of the clinical evaluation and the most successful treatment techniques provides clear tools for the clinicians involved to use and increase overall effectiveness and success in treating conditions like PFP.

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

Steph's Comments

"I think we are all guilty of "labelling" PFP as just some tricky anterior knee pain that is usually a problem for young female athletes. It tends to be a vague issue that is viewed as both difficult to treat as a physiotherapist, and difficult to train around as a coach. This article provides actionable methods to approach PFP and shows that it does not have to be seen as a chronic issue that an athlete needs to learn to deal with. More importantly, it shows that some pain may be part of the progressive overload process and is not inherently a bad thing. This is huge for coaches to use in educating and comforting athletes outside of the clinic.

I also feel that there is tremendous value in the coach and clinician having an equal understanding of the nature of such a condition. It allows the coach to be more confident in knowing when to push an athlete vs. regress. It allows the physical therapist to more accurately educate the patient/athlete and prevent the symptoms from becoming persistent or fear avoidance and psychosocial issues from entering the picture."

Infographics

A round-up of our monthly research infographics.

CAN 6 SPRINT INTERVAL TRAINING SESSIONS IMPROVE RUNNING PERFORMANCE IN TRAINED ATHLETES

Koral J, et al., (2018) JSCR

WARM-UPS

Walker, O. (2016) Science for Sport.

Can 6 sprint interval training sessions improve running performance in trained athletes?

SCIENCE for SPORT

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WHAT THEY DID

16 TRAINED TRAIL RUNNERS

30s SPRINT INTERVAL TRAINING

6 SESSIONS IN 2 WEEKS

MEASURES

- Maximum aerobic speed (MAS)
- Time to exhaustion at 90% MAS
- 3000m Time Trial

WHAT THEY FOUND

INCREASED PERFORMANCE...

42% Time to exhaustion at 90% MAS

2.8% MAS

5.7% 3000m time trial

WHAT THIS MEANS

"The results of the current study demonstrate that a very short-term low-volume sprint interval training on a track or field is an effective means of improving both endurance and anaerobic performance.

Study Koral, Jerome, et al. "Six Sessions of Sprint Interval Training improves running performance in trained athletes." *The Journal of Strength & Conditioning Research* 32.3 (2018): 617-623.

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WARM UPS

SCIENCE for SPORT

Key information

Warm-ups can both reduce injury and improve performance. It is extremely important that exercise professionals use a well-designed warm-up if they are to maximise the athletic potential of their athletes

RAMP protocol

The RAMP framework allows activities to be easily classified and constructed in the following warm-up sequence:

Raise

Body temperature, heart rate, respiration rate, blood flow, and joint viscosity.

Activate & Mobilise

Activate key muscles, mobilise key joints.

Potentiate

Reach the same intensity of subsequent exercise, utilise post activation potentiation if applicable.

Time in warm up

A 15min warm up 4x per week over 12 weeks is 12 hours of training time.

Warm up effects

Include but are not limited to:

- Strength and power
- Rate of force development
- Reaction time
- Muscle contraction and relaxation speed
- Blood to muscles
- Oxygen delivery

Our Summary

Planning the warm-up should be given as much attention as the main training content itself. Warm-ups should not only be tailored to each training session or competition, but also to each athlete's highly-specific strengths and weaknesses.

For the full article check out the Science for Sport website

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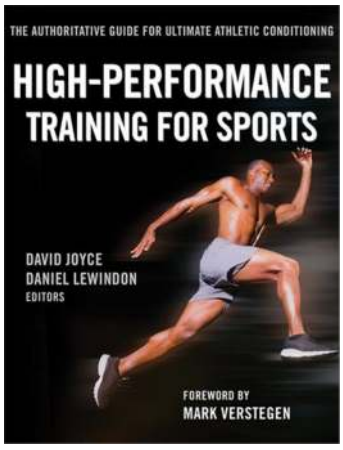

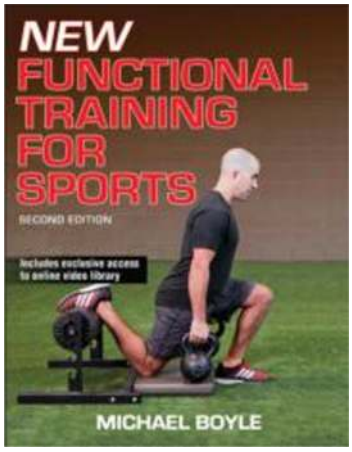

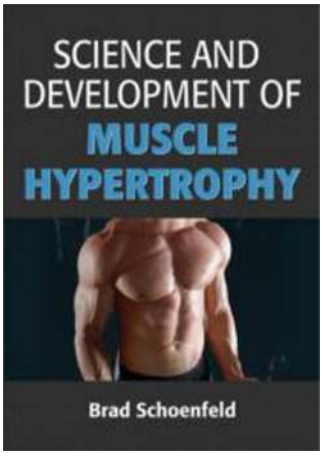

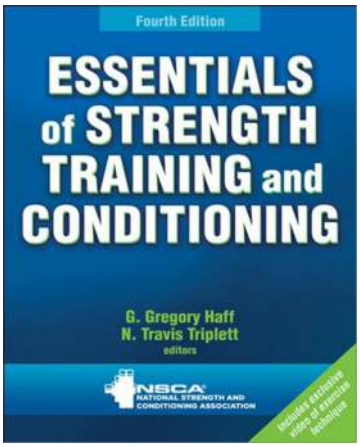

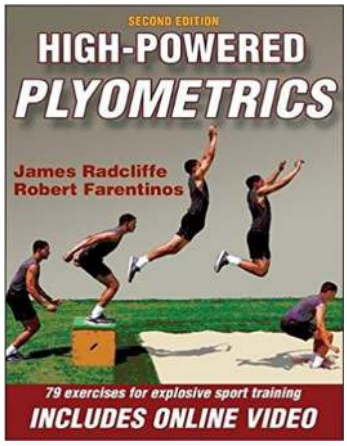

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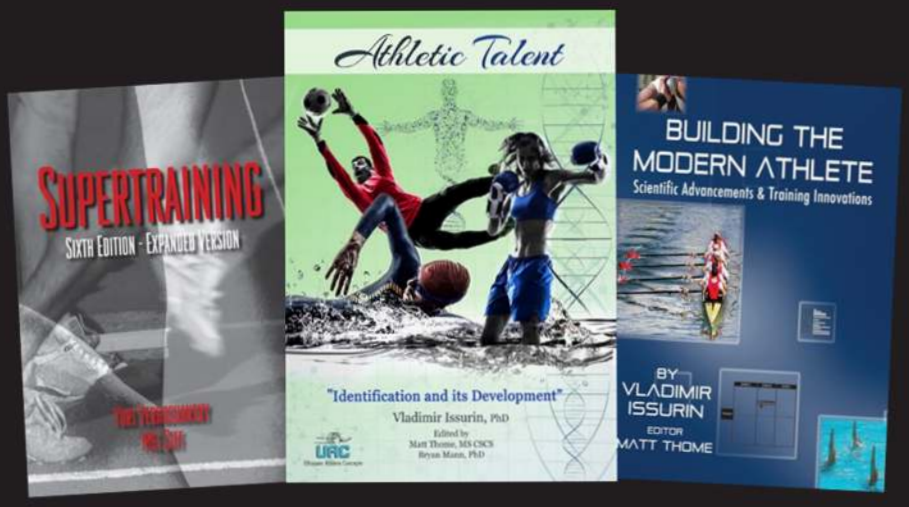

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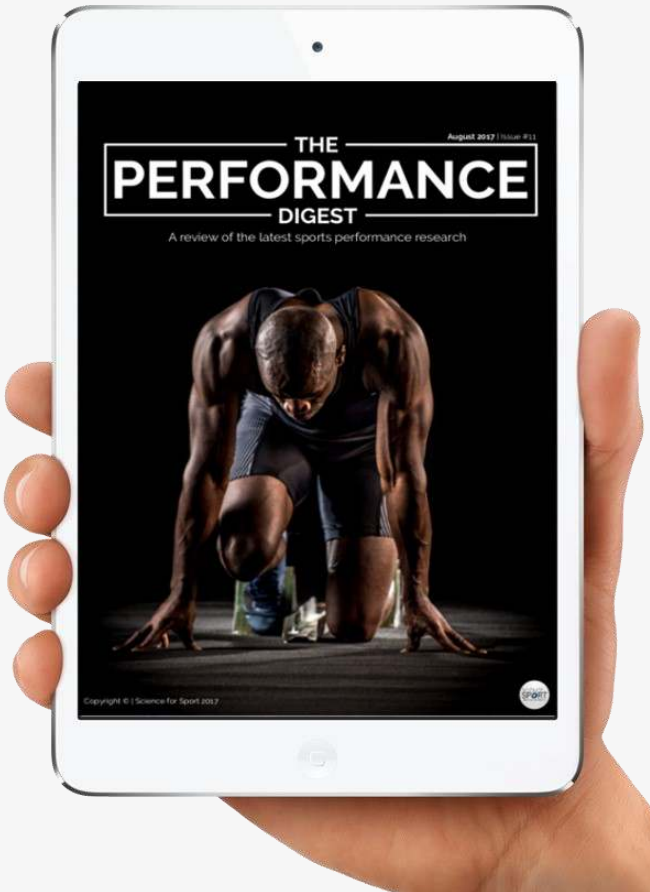

Thanks for Reading!

The next issue will be published on 1st August, 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