September 2018 | Issue #23

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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Welcome to the
PERFORMANCE DIGEST

OWEN WALKER
Founder and Director of
Science for Sport

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

LATEST NEWS

1) Launch of our "Associate Program"

This month saw the launch of our brand new Associate Program. Due to a high number of requests for business development/support, we put together a FREE program (exclusively for members) to help educate members on this topic. This program is focused on teaching you how to increase your employability, maximise job security, and enhance your financial stability while earning commission and lifting the standard of the industry.

If you're interested in joining this FREE (for members) program, then click the link below for more details.

Find out more about the Associate Program

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

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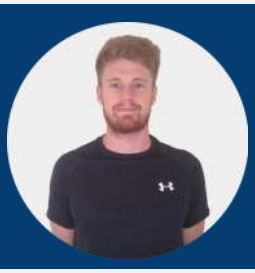
Research Reviewers



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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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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.

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MSc UKAD Advisor

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

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Technology & Monitoring

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

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Injury Prevention & Rehab

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

Audio
REVIEW

Speed & Conditioning Testing

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

WHAT WE DICUSS

In this episode of the "Audio Review", Carl and Matt discuss speed and conditioning testing, why it's so important, and what the future of testing looks like.

In this episode, you will learn:

- What speed and conditioning testing is
- Why it is important
- The physiology underpinning speed and conditioning testing
- How the physiology relates to health and winning
- How the physical side relates to the technical and tactical elements of sport
- Future of the research
- Top tips for your own testing

A bit about **Carl**

Carl is currently the lead sport technologist for SpikesOnly.com, and focuses his time on testing elite athletes and using technology to maximise human performance.

Episode length = 42 minutes

Listen Now

The Science of COACHING

What's the best way to coach young athletes?

A comparison between skill acquisition models.

[Abstract]

INTRODUCTION

There are numerous models which have attempted to explain how young athletes develop motor skills. Most know of the theory of 'Deliberate Practice' (commonly referred to as the 10,000 hour rule - **HERE**) which suggests a strong relationship between skill attainment and a large number of hours practicing a skill with a focused and deliberate attempt to improve it. Opposing this is the 'Developmental Model of Sport Participation' (**HERE**) which encourages multi-sport participation in high volumes of play activities. It's important to understand that both have support for the attainment and development of motor skills. Recent research also supports a combination of the previous two models (known as the 'Early Engagement Hypothesis'), which recognises engaging early in both sport-specific practice and play.

Having knowledge of these different models is important in the current context of sport given that it is common practice, on a global scale, for major sport organisations to identify and develop future professional athletes and place them into talent development programmes. Many of these programmes follow one of these models closely when designing practice sessions in the hope of creating the next superstar. In the case of this study, the relationship between soccer-specific practice and play activities during childhood and coach evaluations of skills (technical, tactical, physical, and creative) was assessed.

WHAT THEY FOUND

Coaches evaluated soccer-specific skills (technical, tactical, physical, and creativity) of elite youth soccer players at numerous time points (TP) over a 5-year period as they progressed through the academy system. At each time point, the players and coaches evaluated their soccer-specific skills and recounted the types of activities they were involved in. As it would be expected, the number of players involved in the study decreased over time due to some players not progressing within the academy system. Regardless of this, the results of the study did report a number of interesting findings:

- ⇒ There was no significant correlation between the accumulated hours spent performing the soccer activities and the skill ratings at TP1.
- ⇒ Although not significant, the percentage of hours spent in play versus practice at T1 was mostly low and negative for each measure of skill (i.e. weak relationship between more play and greater skill at TP1).
- ⇒ At TP2, there were significant correlations between the number of hours where soccer practice were performed and both technical and creative skill for those that made it to the youth professional stage.
- ⇒ There was again no significant relationship between play and each rating of skill at TP2.
- ⇒ A strong correlation existed between the total number of hours spent performing soccer practice across a career (start age to TP2) for each measure of skill for those progressing through to the professional stage.

WHAT THIS MEANS

Within the current sport environment, coaches are encouraged to get players involved in activities which are more representative of the 'Developmental Model of Sport Participation' (i.e. play) as opposed to that of deliberate play; especially those working with young athletes. The results of the current study somewhat oppose this with many of the results suggesting that an increased use of play with youth soccer players may not be as effective at developing the technical, tactical, physical, and creative skill as soccer-specific practice. Nor does it appear that increasing the amount of play allows coaches to better distinguish between the different skills of players across the different stages of their career. In other words, those involved in more soccer-specific practice may be more distinguished to coaches when they are looking for talented juniors within the academy systems. Overall, the measures of skill used at TP1 did not appear to be good predictors of success at adult level. It should be noted that many of the correlations reported in the current study were not considered significant and, therefore, these results should be read with caution.

Practical Takeaways

The way in which a coach designs a practice session can not only have short-term effects on an athlete's skill for an upcoming match, but also long-term effects on how they develop a whole range of different skills that are likely to be important for their future career. Although going against current convention, the use of more specific practice structures may be more influential on the long-term skill development of your athlete – according to this study. This is not to say that coaches should disregard the use of play-based activities, as a structured session delivered incorrectly may still be less effective for the development of skill.

The environment in which athletes train can greatly influence their development. For example, game-based training has been shown to effectively improve the tactical skill of team-sports athletes (see **HERE**). More structured training sessions though do typically provide a greater volume of skill-related activity, which some coaches may find useful for their athletes. Based on the current evidence, those involved with youth athletes would be encouraged to use a combination of specific practice and play coupled with effective coaching behaviours (see my reviews on coaching behaviours in various past issues of the Performance Digest).

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.

RETHINK YOUR WARM-UP: MAKE THE MOST OF PRE-GAME AND HALF-TIME WARM-UP STRATEGIES

Silva et al. (2018) Sports Medicine.

THE POWER CLEAN: SHOULD WE LEAVE OUT THE CATCH PHASE IN OUR PROGRAMMING?

Comfort, P et al. (2018) Journal of Strength & Conditioning Research.

OPTIMAL LOAD TRAINING VS. COMPLEX TRAINING: WHICH LEADS TO BETTER GAINS?

Freitas et al. (2018) Journal of Sports Science.

[Abstract]

Rethink your warm-up: Make the most of pre-game and half-time warm-up strategies

OBJECTIVE
A warm-up routine has been suggested to be critical in increasing preparedness for subsequent effort and thus maximising performance. An active warm-up consists of using physical activity, while a passive warm-up depends on the use of external means. However, the effectiveness of the warm-up routine appears to be dependent on many factors: such as the type of sport, athlete fitness and experience, tasks to be performed, environmental conditions, and constraints imposed by event organisers. The aim of this systematic review was to analyse research findings on the effects of warm-up, post-warm-up (time between the end of a warm-up and the start of the match), and re-warm-up (half-time break) strategies on explosive efforts in team-sports.

WHAT THEY DID
Of 330 studies, 30 articles were included. 19 used a warm-up strategy, 5 used a post-warm-up strategy and 6 used a re-warm-up strategy. Any peer-reviewed publication that had a warm-up intervention in team-sports were included.

WHAT THEY FOUND
A wide range of warm-up routines showed improvements in performance with a large effect size. For example, 8x50m sprints, a 5-minutes jog with 5RM leg press, or completing back squats at the end of a typical warm-up improves explosive performance. This shows that a short, specific warm-up is as effective as a long, specific warm-up for sprint performance. In addition, 7-minutes of dynamic exercises after 5-minutes of jogging was associated with general improvement in explosive tasks such as sprinting, jumping, and agility performance. Small-sided games and whole-body vibration may also improve explosive task performance. Static stretching was the least effective at improving sprint performance and agility.

For post-warm-up strategies, a progressive decrease in performance was observed in resting situations with a 4-6% decrease in sprint performance and 12-20% decrease in jump performance. The use of a heated garment had a moderate effect on sprint performance, but when combined with 3x5 jumps with 20% bodyweight, a large effect was observed on sprint performance. No strategy was found to be effective in improving jump performance. Similarly, a decrease in performance was identified when passive rest was implemented during the re-warm-up. Heat garments had the best effect size compared with resting in sprint and jump performance. Eccentric exercises was the only intervention found to be detrimental to sprint and jump performance.

Practical Takeaways

Of the 19 warm-up articles, 69% showed an improvement in sprint performance, 87.5% showed an improvement in jump performance, and 83% showed an improvement in agility performance. This suggests that a properly structured warm-up strategy can increase athlete performance in many different sports. However, comparing results between studies is difficult due to different control groups and different warm-up protocols. Therefore, to define a properly structured warm-up strategy, it is important to know which variables are critical for optimising subsequent explosive performance. Research tends to recommend a short, active warm-up that progresses in intensity (see Science for Sport article below for practical strategies) until maximal effort close to the end of the warm-up. Shortly afterward, passive strategies should be implemented before the game and the re-warm-up should include short sprints and jumps before entering the game.

Warm-up strategies:

1) Research suggests a short warm-up (<20 minutes) has the same benefits on performance as a long warm-up (>20 minutes).
2) Warm-ups performed at an intensity too high for too long could result in fatigue and impair subsequent exercise.
3) However, what must be considered is the athlete. Some athletes feel psychologically more prepared after a 25-minutes warm-up than a shorter warm-up, regardless of performance decreases.
4) Explosive tasks such as sprints and jumps require a more strenuous warm-up intensity (~90% of Max HR). For example, sprint tasks performed at the end of the warm-up have shown a 2-3% improvement in sprint and jump performance.
5) An optimal strategy may look like this: 10-15-minutes increasing intensity (~50-90% HRmax) ending with sprints.
6) Reducing warm-up time and intensity may delay fatigue and lead to overall higher performance during the match.

Post-warm-up strategies:

1) After 20-minutes rest, athletes decreased jump performance by approx. 15%. After 40-minutes rest, jump performance decreased by approx. 20% and sprint performance by 6%.
2) Standing up 20-minutes after the warm-up may reduce the decrease in performance compared with sitting on the bench. However, this would depend on the rules of the organisers and whether standing is allowed.
3) Passive strategies such as heat garments after warm-up can significantly maintain the benefits gained from the warm-up or at least reduce the decline.
4) Combining a passive strategy with an active one (e.g. 3x5 jumps) has been found to be even more beneficial.

Re-warm-up strategies:

1) Team-sport half-times are usually between 10-20 minutes. Passive rest of this time has been shown to decrease physical and cognitive performance.
2) Very little research has investigated the effects of different re-warm-up protocols. Of the few studies, 4x5 jumps and 7-8 minutes of running at ~70% HRmax have been shown to increase subsequent performance.
3) Theoretically, a re-warm-up could consist of a combination of heat maintenance strategies (active and/or passive), hormonal priming (feedback, video clips), caffeine, and carbohydrate consumption. These separate strategies have been shown to reduce performance decrements in the second half.
4) While these strategies haven't been tested together, some sort of heat garment and/or an active re-warm-up routine should be performed before subsequent activity.

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

James's Comments

"Team-sport warm-ups generally last anywhere from 20-40 minutes and this sometimes doesn't include the athletes individual preparation prior to the team warm-up. Based on this review, it may be more beneficial to shorten the team warm-up to potentially decrease subsequent fatigue and receive the same benefits. However, in sports such as rugby where coaches want to cover unit specific skills (e.g. attack and defence), as well as a short dynamic warm-up, it can be very difficult to fit this into such a short time frame of 20 minutes. Additionally, certain players like to be out earlier to do their own individual pre-warm-up or work on specific skill sets such as kicking. This study may be a case of what is good in the literature may not be good in a practical setting. However, that does not mean certain points cannot be adapted to the real world (e.g. gradually increasing intensity of the warm-up).

Potentially a warm-up could start with low-intensity skills to get the heart rate up. Following this, some more specific unit or team skills could be incorporated that are a little more intense. Following this some kind of offense or defence drill that gets HR closer to 90%. To finish, 1-2 sprints can be done for some high-intensity speed and potentiation. Post-warm-up and re-warm-up strategies presented in this study should be implemented with all team-sports. However, the time available along with environmental conditions must be taken into consideration. You don't want to put heat garments on players in 30+ degree Celsius temperatures. Rather, active strategies are better used in this situation."

[Abstract]

The Power Clean: Should we leave out the catch phase in our programming?

OBJECTIVE
Weightlifting exercises and their derivatives are commonly performed in many athlete training programmes. Recently, the mid-thigh power clean and mid-thigh pulls have been shown to result in significantly greater peak force, peak rate of force development (RFD), and peak power compared to hang power clean and power clean. It has also been suggested that variations of the power clean which omit the catch phase (e.g. hang high pull, jump shrug) may be advantageous when training athletes who are less proficient with the full weightlifting movements or are limited by injury. Therefore, the aims of this study were to compare the effects of the inclusion and exclusion of the catch during power clean derivatives on force-time characteristics during isometric and dynamic tasks, after two 4-week mesocycles of resistance training.

WHAT THEY DID
11 professional male soccer players and 23 collegiate athletes participated in the repeated measures within-subject study and were experienced and competent in the exercises performed. Baseline measures were taken in the first week (Week 0) of squat jump (SJ) and countermovement jump (CMJ) on a force plate. After this, an isometric mid-thigh pull (IMTP) for 5-seconds was performed from the position they would use at the start of the second pull of the power clean. Following this, a 1RM power clean was measured. A 4-week training block (Week 1-4) was then implemented where training was performed twice a week and subjects were split into either a Pull or a Catch group. Intensity was matched between groups as to equate volume load. Testing was repeated after the training block (Week 5) before the following 4-week intervention (Week 6-10) which reduced the volume-load due to being close to competition. Testing was performed again following this last training block (Week 11). Training intervention consisted of power clean or pull, push press, back squat, Nordic drop. Day 2 consisted of mid-thigh power clean or pull and RDL.

WHAT THEY FOUND
The Catch group achieved significant improvements in SJ height (12.6 + 10.2%) from pre- to post-intervention (Weeks 0-11). In contrast, a trivial and non-significant increase in SJ (2.1 + 11.8%) performance was seen in the Pull group. The Catch group showed a small yet significant increase in CMJ post-intervention (10.8 + 12.3%) while the Pull group showed small but significant increases (5.2 + 9.2%) with trivial to small non-significant differences between groups. Trivial to small non-significant differences in both the Catch and Pull group was observed for CMJ time-to-take-off. Significant improvements were observed for force at 100ms, 150ms, 200ms, and 250ms during the IMTP for both the Catch and Pull groups with trivial to small non-significant differences between the groups from pre-post intervention. Both groups demonstrated small significant increases in relative peak force pre-post intervention (13.7 +18.7% & 9.7 + 16.3% for Catch and Pull groups, respectively). Both groups showed small significant increases in power clean 1RM from pre- to post-intervention (9.5 + 6.2% and 8.4 + 6.1% for Catch and Pull groups, respectively) with only trivial differences between the groups. No significant changes in body mass occurred during the intervention.

Practical Takeaways

Both groups demonstrated significant improvements in CMJ, IMTP RFD, and relative peak force, and power clean performance after the intervention. However, SJ height only increased in the Catch group where no change occurred in the Pull group. It was theorised that this may have been due to the requirement of having to rapidly produce force to catch the clean (e.g. eccentric RFD improvements), whereas more time is available to decelerate the bar during the pulling derivatives. Meaningful increases in CMJ in both groups likely resulted from an increase in force production due to that fact that CMJ time-to-take-off showed no significant changes. Interestingly, both groups improved their power clean 1RM to a similar extent despite the Pull group not training the catch phase.

This information provides training implications for athletes that may have trouble in the rack position or injuries that prevent them from getting there. The pulling derivatives may provide a comparable stimulus to weightlifting catch exercises. The infographic I linked below shows how you can select certain weightlifting variations to cover various aspects of the force-velocity curve. In this study, however, it should be noted that the pulling derivatives were performed at the same volume and intensity as the power cleans. Generally, pulling variations are loaded in excess of 100% 1RM of the power clean. Though only speculative, increasing the load of these derivatives may have potentially led to greater improvements in some variables measured.

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

James's Comments

"Weightlifting and sports performance has been a contentious topic for many years now. If you scour the many blogs, podcasts, and articles written on the topic, you'll find some that swear by the Olympic lifts for sports performance and some that don't use them at all. It just goes to show there is some middle ground on this affair and it's likely going to depend on many factors such as training age, sport, equipment, etc. This study showed that performing weightlifting variations with the catch may not be necessary to gain the full benefits out of the movements.

Recently, a strength coach named Ed Cosner really had me think about the use of Olympic lifts for rugby. Previously, I used a couple of variations here and there to add some variety to our power work and teach the player some new movements as athletes often love learning new things. My bread and butter strength and power work though would generally not involve weightlifting variations. However, Ed mentioned how he loves the power snatch and pause clean pull for the front row forwards. Firstly, because for a tight bind in the scrum, your arms and shoulders are in overhead position (albeit slightly bent) so the power snatch can provide strength and stability in that position. Secondly, the paused clean pull develops huge isometric strength in an position similar to scrum posture. This is not, however, to be confused with a deadlift where the position is back on the heels."

[Abstract]

Optimal load training vs. complex training: Which leads to better gains?

OBJECTIVE
Maximal power is crucial in most sports-specific movements, particularly in basketball in which vertical jump and agility actions often occur. Furthermore, maximal power, along with strength, has been shown to differentiate competition levels among basketball players. Optimal load (expressed through % of 1RM or bodyweight) has been reported to provide the best stimulus for power enhancement. Therefore, the aims of this study were: 1) to investigate the effects of optimal load training (OLT) and a novel modified complex training (CT) on neuromuscular performance; and 2) to compare their effects after a 6-week intervention.

WHAT THEY DID
18 semi-professional male basketball players participated in a 6-week intervention with 1 week of testing both before and after the intervention. Players were matched by playing position and then randomly assigned to either an OLT or CT group. The intervention was implemented in-season with training load being monitored and kept constant. Pre- and post-intervention testing was done on 2 separate days. On Day 1, anthropometric measurements of height, body mass, circumferences, and skinfolds were taken. Additionally, maximal dynamic strength and power-load profiling in the half-squat, bench press, and hip thrust were measured in a Smith Machine with a linear position transducer attached. On Day 2, CMJ (force plate), broad jump (measuring tape), 10m sprint, and T-test (timing lights) were all performed. The training intervention was performed 2 times per week for 6 weeks. Both the OLT and CT groups training consisted of 3 exercises: half -squat, bench press, and hip thrust. The total number of sets/reps were the same for both groups. The OLT group performed all of their sets and reps with their "optimal load" for maximising power output. The CT performed a complex set with the first 3 reps at 80% 1RM then the remaining reps of the same exercise with their optimal load (4-5 reps).

WHAT THEY FOUND
The main finding was both protocols increased lower-body strength in-season without impairing physical performance variables (sprint, CMJ, broad jump, and T-test). The CT training group showed a 17.2% increase in the half-squat compared with a 10.8% increase in the OLT group. However, OLT group athletes were able to achieve a higher acceleration of the barbell during the half-squat. Bench press 1RM showed trivial effect sizes and small magnitudes of change of 2.2% and 4.3% in the OLT and CT groups, respectively. Trivial effects were observed in the CMJ while a moderate effect size was seen in the broad jump in the CT group. Interestingly, sprint performance showed a small likely positive effect in the OLT group, but effects were unclear in the CT group. The T-test showed a moderate likely positive effect in the CT group and a small likely positive effect in the OLT group.

Practical Takeaways

The CT group showed a greater increase in half-squat 1RM compared with the OLT group. This was most likely due to the CT group performing reps at 80% 1RM and not just at an "optimal load". If strength is the main outcome of training, then using a complex of heavy lifts paired with optimally loaded lifts may be an effective combination. Furthermore, only a few reps would be performed at or above 80%, potentially resulting in less overall fatigue. Despite this, this doesn't discount the use of just optimal loading as OLT also showed positive improvements in strength.

Using optimal loading could be a good way of decreasing the intensity of weight room work while still making strength gains, which could be important when the athlete is experiencing a lot of fatigue. Upper-body strength showed trivial improvements in the bench press. This was likely due to the low training volume of the upper-body in this programme (the lower-body had 2 exercises whilst the upper-body only had 1 [bench press]). If using these methods, incorporating velocity-based exercises such as jumps and sprints into the programme may enhance explosive task and change of direction performance, rather than just maintaining them. This could be in the complex itself or before the OLT or CT. OLT also provides a simple way to individualise programmes for athletes. Athletes love having their own special programme and giving them loads that are prescribed for them will likely increase their buy-in into the programme.

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

James's Comments

"As seen in this study, both protocols were great for maintaining or improving 1RM strength during an in-season period without being detrimental to performance tasks. However, these performance tasks of maximal power expression are more important to most team-sports (basketball in the case of this study) due to the fact that jumping and sprinting make up some of the core components of the sport, other than the technical skills. As mentioned by the authors of this study, traditional complex training may be better served for improving these performance tasks (e.g. half-squats paired with vertical jumps). Utilising high-velocity exercises in the exercise complex may enhance explosive performance in comparison to complexing with heavier loads as adaptations will be velocity-specific. Heavily loaded isoinertial or dynamic exercises don't have to be the crux of a complex either. As shown in the video below, the use of maximal intent isometrics serve as a good way of improving strength at specific joint angles and to potentiate subsequent work such as higher velocity exercises."

Technology & Monitoring

This month's top research on technology and monitoring.

SHOULD HRV BE USED TO FOR MONITORING AND FOR MEASURING FITNESS LEVELS?
Flatt A and Howells D. (2018) JSAMS

SHOULD WE BE MEASURING BLOOD BIOMARKERS IN ADDITION TO TRAINING LOADS?
Huggins, RA. Et al. (2018) JSCR

CAN THE GYMAWARE VBT SYSTEM BE USED TO MANAGE SQUAT DEPTH?
Appleby B. (2018) JSCR

[Abstract]

Should HRV be used to for monitoring and for measuring fitness levels?

OBJECTIVE
Objectively monitoring training load response and daily readiness with teams is useful for reducing injuries and improving performance. In addition to fatigue management, using Heart Rate Variability (HRV) for possible changes in physiological adaptation from conditioning programmes and practice without laboratory testing is valuable for coaches. The objective of this study was to see how short HRV sampling could help add insight to external load monitoring and maximal aerobic speed (MAS) testing.

WHAT THEY DID
Every day for three weeks the researchers measured the daily morning HRV of rugby sevens athletes and monitored the athlete's training load with both subjective and objective methods. Subjectively, the athletes used a standard rating of load while the external load was measured with a GPS device. Testing of MAS was done with a field test at the beginning and at the end of the study. After they performed a routine statistical analysis, the researchers investigated the relationships between HRV, subjective load, external load, and the field MAS test.

WHAT THEY FOUND
The two objectives, the usefulness of daily monitoring and the association between locations of HRV and aerobic fitness were found to be very probable, even with a short period of training (21 days). Similar to the seasonal study by Buchheit shared previously (**HERE**), the researchers found that three weeks might be enough time to create a difference in fitness that could detected by HRV. Due to the small changes, the researchers were cautious to suggest that a tiny percentage of improvement in MAS (MAS range −1.5 to 2.9%) may not be representative of true improvements of the aerobic system, but instead could be freshness. What was important to note, was that over time those that were responding well to the programme had more stable daily scores, hinting that the athletes were more resilient to the training loads.

Practical Takeaways

The coefficient of variance (i.e. the frequency of distribution/how much something changes) in the HRV metric (specifically the LnRMSSD metric), is likely to be more sensitive as a training response measure than the weakly mean counterpart (LnRMSSDm) when monitoring elite field sport athletes. Importantly, LnRMSSDcv did not respond linearly to loads. Perhaps LnRMSSDcv might be capable in determining what athletes are responding well or poorly to in training programmes; for instance, the volume of weekly training load. Rugby players, specifically those at an elite level, may want to use HRV monitoring as an aerobic fitness surveillance option, and not just a way to monitor fatigue.

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

Carl's Comments

"Similar to the studies performed years ago on ultra-short sampling periods to measure HRV with athletes, it appears that this investigation can help find the minimal time period to assess possible adaptation necessary to build a more robust and resilient athlete in the real world (e.g. 3 weeks). Coaches should reconsider daily HRV monitoring as a way to flag athletes who are clearly impaired and use the data as another way to strengthen their analysis of fitness, if conventional heart rate or field tests are too difficult."

[Abstract]

Should we be measuring blood biomarkers in addition to training loads?

OBJECTIVE
The use of blood biomarkers is a data rich opportunity for sports medicine, sports performance, and even sports coaches to gain knowledge of how athletes adapt or fail to manage a soccer season. While this study was purely investigative on how training loads interact with blood biomarkers (endocrine, muscle, inflammatory, and immune markers) and general fitness, other areas such as sports nutrition and lifestyle factors may have the potential to help with recovery to the loading that soccer receives over a brief soccer season.

WHAT THEY DID
Over a 12-week college division I soccer season, the researchers blood tested (with a comprehensive panel) the athletes an impressive five times, in addition to monitoring the training load (GPS and HR) over the same time period. The researchers also tested the athlete's aerobic fitness with a Yo-Yo IR2 field test, a classic VO2 max treadmill test, and an anaerobic threshold test. Subjective monitoring was performed over the course of the short season and all of the data was extensively analysed and reported.

WHAT THEY FOUND
The results of the findings were surprising, as some biomarkers trended downwards while others were maintained. Due to the wide range of biomarkers, even a short collegiate schedule did show patterns similar to longer professional seasons. Based on the results of the blood testing and load monitoring, muscle damage and inflammation was elevated, while some measures of lipid health fell outside clinical ranges. The data supported that the ranges typical in a college soccer season had ranges and trends outside basic health profiles.

Practical Takeaways

The authors concluded that the entire staff should not only adjust the training loads to facilitate rest in the championship period at the end of the season, but the focus should be rest and recovery. What was fascinating was that some nutrients and minerals fluxuated and the vitamin D levels (**HERE**) dropped at the end of the season. Based on the pattern of endocrine changes, it may have indicated that sleep could have been affecting the recovery, as the athletes were likely managing school stress; a factor that all scholastic sports should note.

Finally, the elevated muscle damage markers could be used to see how sports nutrition could be utilised in facilitating recovery. A simple ferritin, Vitamin D, Complete Blood Count, and Omega Index test is a high value set of biomarkers for those with standard budgets.

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

Carl's Comments

"Spending two years with a blood analysis company that supported Olympic athletes as well as professional teams, I believe this is one of the best research studies I have seen, period. If I were to make any suggestion for improvement, I would have made an effort to test haemoglobin mass (if possible) as a direct measure of oxygen transfer ability; this would have made this a utopian study. In addition to the total haemoglobin mass test (more **HERE**), splitting the group into position, like a few studies have done in the past, may have added more information and value. Again, this study is a great example of what can be done with a few blood tests done throughout a season."

[Abstract]

Can the GymAware VBT system be used to manage squat depth?

OBJECTIVE
Strength coaches are always looking for tools to help add more precision and accuracy to their training. The weight room is fairly straightforward to monitor, but power and range of motion still benefits from external objective measurement. In this study, the objective was to see if the GymAware system could be useful for not only measuring barbell speed, but the actual barbell stroke distance with heavy squats.

WHAT THEY DID
A dozen well-trained rugby athletes were tested using conventional barbell velocity based training (VBT) practice and had motion capture measuring their true movement pattern. The motion capture was the criterion measure (Barbell and cervical area), while the GymAware measuring barbell displacement was the experimental comparison. The athletes were instructed to squat to the satisfaction of a properly qualified strength coach and the data was analysed for range of motion to the millimetre.

WHAT THEY FOUND
The researchers found that the barbell linear position transducer (GymAware) measurements were overestimated slightly, but the usefulness of the system was pragmatic and reliable. Much of the theoretical issue is that the barbell whip, which is common in training, creates an increase in range of motion from the heavy load and composite of the bar. Barbell whip (deformation) has been researched earlier and more information can be found **HERE**.

» **Practical** Takeaways

Interestingly, the researchers recommended mounting the GymAware device from above (e.g. to the ceiling) to reduce error, but due to charging the equipment and the need for portability, not many facilities are adopting that approach. However, other options, such as attaching the sensor tether more centrally, is possible.

The practice of measuring the barbell externally is popular in many circles, so sacrificing absolute accuracy for practicality is a common struggle in training. Besides changing the mounting of the system and the attachment zone, barbell selection with back squats might respond to slower velocities and bars that are stiffer, as this will ultimately reduce the barbell whip/ deformation.

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

Carl's Comments

"As a prolific writer about VBT systems, I have been shocked that not more attention is paid to the simple need to accurately and efficiently monitor barbell stroke distance in training. While range of motion may elicit different training effects, some athletes orthopedically should not be squatting deep due to their pelvic structure and should be using tools to ensure that they are not causing damage to their hip joints.

Companies should take note on the importance of squat depth (a great article can be found **HERE**) and refine their measurement approaches to improve the function of their products."

Fatigue & Recovery

This month's top research on fatigue and recovery.

DIFFERENT SELF-MYOFASCIAL RELEASE DURATIONS LEAD TO DIFFERENT NEUROMUSCULAR RESPONSES

Phillips J, et al. (2018) J. Strength Cond. Res.

HOW IS SLEEP AFFECTED BEFORE AND AFTER A NIGHT-TIME GAME?

Vitale J, et al. (2018) IJSPP.

DIFFERENT RESISTANCE TRAINING SET CONFIGURATIONS LEAD TO DIFFERENT RECOVERY TIME COURSES

Pareja-Blanco F, et al. (2018) J. Strength Cond. Res.

[Abstract]

Different self-myofascial release durations lead to different neuromuscular responses

OBJECTIVE
Self-myofascial release (SMR) is widely implemented in both the applied and research settings. Although previous literature seems to be clear on the effects of SMR on range of motion (ROM), there seems to be some controversy on it effects on performance. Differences in the duration of SMR (e.g. 5 seconds vs. 3 minutes) seem to be one of the reasons for the conflicting findings. Therefore, the goal of this study was to investigate the ROM and performance responses to different SMR durations.

WHAT THEY DID
24 active individuals completed two experimental conditions (1 minute SMR [SMR1] and 5 minutes SMR [SMR5]; both conditions using a foam roller) and a control (CON) condition where no SMR was implemented. Intervention conditions were balanced in the number of individuals, using a partial random assignment. Measures of lower-body ROM and performance were obtained before and after each condition. ROM measures included a modified version of the weight-bearing lunge (WBL [i.e. ankle ROM]) and the kneeling lunge (KL [i.e. knee ROM]) tests. Performance was measured through a vertical jump (VJ) and the pro-agility (PA) tests.

WHAT THEY FOUND
Participants increased 12.5% their KL test and 16.4% after 1 and 5 minutes of SMR, respectively. These changes were associated to moderate and large effect sizes (ES) for SMR1 and SMR5, respectively. No meaningful effects on the KL for the CON group were observed. Moreover, ROM on the WBL remained almost unchanged for each condition.

Jumping performance decreased by 5.1, 0.7, and 1.9% for the SMR5, SMR1, and CON groups, respectively, with these changes being associated to small to moderate ES. PA performance was improved for the SMR1 (1.1%), and decreased for the SMR5 (0.5%) and CON (1.2%), meaning these changes were associated with a small ES.

Francisco's Comments

Self-myofascial release with a foam roller is a technique widely implemented by athletes and fitness enthusiasts. This study provides three important recommendations in respect to the influence of SMR duration (i.e. 1-minute vs. 5-minutes):

⇒ 5-minutes of foam rolling leads to slightly greater increases in knee ROM;

⇒ 5-minutes of foam rolling leads to a decrease in bodyweight power events such as the vertical jump;

⇒ 1-minute of foam rolling seems beneficial for power events (e.g. vertical jump).

From the findings of this study, and as mentioned by the authors, it is important to understand that we are not able to tell what are the effects of implementing SMR for longer than 1-minute and shorter than 5-minutes will be. More importantly, we do not know how long the effects from foam rolling persist. In my experience, athletes implement SMR and other forms of preparation for up to 1-hour prior to the start of a game or a training session. Therefore, when the duration is this long, it may be that this and other techniques have no effect on performance (i.e. beneficial or harmful). Future research should investigate the duration of the effects imposed by SMR usage. Despite all this, most athletes perceive SMR to be beneficial to their performance, therefore, I would recommend practitioners are careful when interfering with an athlete's routine.

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

Francisco's Comments

"The main practical takeaway from these findings is that different SMR durations lead to different outcomes in ROM and essentially jumping and agility performance.

Longer SMR durations (i.e. 5-minuyes vs. 1-minute) seem to be only slightly more effective for increases in ROM. Nevertheless, shorter SMR durations seem to be more effective for short-duration performance (e.g. agility and vertical jump tests). Given the effects of SMR5 on VJ performance, practitioners are discouraged to implement SMR for extensive periods of time (e.g. > 1 minute) prior to power events. Nevertheless, if ROM is a key factor to perform in a given sport, then longer duration SMR may be appropriate."

[Abstract]

How is sleep affected before and after a night-time game?

OBJECTIVE
Sleep is well recognised as one of the pillars for health, recovery, and adaptation from training. Night games are common in team-sports and are thought to negatively influence sleep duration and quality. Nevertheless, no previous research has investigated the effects of night games on volleyball athletes. Therefore, the aim of this study was to measure the effect that a top-level volleyball match has on sleep quality, sleep duration, and perceived recovery.

WHAT THEY DID
24 top-level volleyball athletes used an actigraph during three consecutive nights: one night before and two nights after a match. The following measures were obtained from the actigraph: Time in Bed, Sleep Latency, Sleep Efficiency, Wake After Sleep Onset, Total Sleep Time, Immobility Time, Moving Time, and Fragmentation Index. Moreover, perceived recovery was measured in each morning using a Total Quality Recovery Scale (TQRS; link below).

WHAT THEY FOUND
The main finding of this study is that athletes' sleep duration, sleep quality, and perceived recovery were negatively affected on the night of the game. Significant differences were observed for all actigraph measures and TQRS between the three time-points. These differences are demonstrated in the table below. A "+++" with a green background means it is significantly greater than "+" in a yellow background. In other words, time in bed on "Game day -1" and "Game day +1" was significantly longer than on "Game day".

	Game day -1	Game day	Game day +1
Time in bed	+++	+	+++
Sleep latency	+++	+++	+
Sleep efficiency	+	+	+++
Wake after sleep onset	+	+++	+
Total sleep time	+++	+	+++
Immobile time	+++	+	+
Moving time	+	+++	+++
Fragmentation index	+	+++	+
Total quality recovery	+++	+	+++

Francisco's Comments

Although the results of this study showed the sleep and recovery was affected after the match, the athletes' sleep the night before the match appeared to be unhindered. In my opinion, these findings are interesting as they contrast the findings from previous studies which show how sleep quality and duration are negatively affected in the night prior to the match. However, it is important to mention that in the majority of the studies that observed a decrease in sleep quality/duration on the night prior to competition, the athletes competed in the morning or afternoon. While in the current study, the athletes competed at night. It is likely that these athletes were not anxious or stressed in the night prior to the game and, therefore, sleep was not affected.

Unfortunately, this study does not show us the individual sleep responses from each athlete. Sleep responses are very likely to differ between athletes, therefore, practitioners are advised to individualise the approach with each athlete. This can be done by reinforcing good sleep strategies with athletes who demonstrate poor sleep quality in the night prior to and after the game. It may also be useful to do this with those athletes who tend to get anxious/nervous before and during competition. Moreover, if sleep duration is reduced due to competition, sleep extension techniques should be implemented (e.g. inclusion of napping periods during the day).

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

Practical Takeaways

"Sleep duration, sleep quality, and perceived recovery were acutely affected by competition (i.e. match night negatively influenced sleep and recovery). These findings provide important information to practitioners to implement effective sleep hygiene strategies on the night after a match.

Frequent monitoring of post-match sleep duration and quality is advised in order for practitioners to individualise and prioritise sleep hygiene strategies among the squad."

[Abstract]

Different resistance training set configurations lead to different recovery time courses

OBJECTIVE
While the different responses and adaptations from different resistance training set configurations have been widely investigated, less is known on the effects of different set and rep schemes on the time course of recovery. Therefore, the goal of this study was to investigate the time course of recovery from 10 different resistance training set configurations.

WHAT THEY DID
10 male subjects with 2-4 years of resistance training experience participated in this study. These participants randomly performed each rep protocol with 14 days between each protocol. All reps' protocols consisted of 3 sets with the prescribed reps and loads, with 5-minutes of recovery between set. The reps protocols were implemented for the squat and bench press exercises and can be seen in the attached image (see link below).

Performance and biochemical measures were obtained before, after, and 6, 24, and 48 hours after each rep protocol and included: Countermovement jump height (CMJ), and bench press (BP), and squat (SQ) mean velocity with a load that elicited a 1 m/s mean velocity. Moreover, the fastest and the slowest velocity reps, and the mean loss velocity within a set were obtained from the bench press and squat exercises with a linear position transducer.

Biochemical measures were obtained from blood samples collected before, after, and 48 hours after each rep protocol and included: Testosterone, cortisol, growth hormone (GH), prolactin (PRL), IGF-1, and creatine kinase (CK) concentrations.

WHAT THEY FOUND

Within-set velocities:
The fastest repetition within each protocol did not differ from the expected velocity for each %1-RM load. As expected, the mean and the lowest velocity were lower when repetitions were performed to failure. Moreover, the mean loss velocity was greater when higher repetitions were performed.

Mechanical changes in CMJ, BP, and SQ:
All loads lead to significant decreases in CMJ, BP, and SQ when measured immediately after each protocol, with higher reps (i.e. ≥ 8 reps) performed to failure decreasing performance in BP and SQ to a greater extent in comparison to the other protocols. Moreover, higher reps (i.e. ≥ 6 reps) also lead to significant decreases in fatigue, observed 24 hours afterwards.

Biochemical responses:
PRL was significantly increased immediately after higher reps to failure protocols (i.e. ≥ 8 reps). GH was significantly increased immediately after the 10(10) protocol, and IGF-1 was significantly increased immediately after the 10(10) and 4(4) protocols. CK increased significantly in most of the protocols, especially after the higher reps to failure protocols (i.e. ≥ 8 reps), and peaked 48 hours after.

Practical Takeaways

The main findings from this study were that when a set is performed until failure or, essentially, when higher repetitions are performed, biochemical markers are substantially increased in comparison to sets performed with lower loads and/or reps (i.e. 50% of the maximum predicted reps).

Importantly, mean velocity loss was greater in the sets to failure in comparison to sets performed with lower loads. These findings have important implications when high velocities or power outputs are desirable. Moreover, sets with higher loads and performed to failure lead to higher levels of fatigue. This simply means that when athletes use these types of set protocols, neuromuscular function and hormonal homeostasis will take longer to recover.

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

Francisco's Comments

"This was a very well designed and interesting study on different resistance training set configurations.

Typically, higher repetitions performed at higher intensities (with respect to the predictive maximum load for the prescribed number of reps) are programmed for early in the week, and lighter and lower repetitions protocols are prescribed later in the week. This study demonstrates the higher training loads prescribed in the weight room may negatively influence performance (e.g. weight room or high-intensity actions in the field) closer to the match day. Moreover, these findings reinforce and demonstrate why more fatigable protocols are not implemented on training days closer to match day.

It is, however, important to mention that the subjects used are not well-trained athletes. It may happen that well-trained athletes recover faster from more intense protocols. Moreover, in my experience, it is rare to see athletes performing higher repetitions (e.g. ≥ 8 reps) protocols to failure. More likely, athletes lift loads >85% 1-RM with sets not to failure (e.g. 4 reps with 85% 1-RM), however, it is frequent to see a more intense week during a training block of 3 -5 weeks where loads can be lifted to failure (e.g. 6 reps with 85% 1-RM). When this is the case, practitioners need to be aware that an increase in fatigue is expected and, therefore, performance may be reduced on the pitch and during strength/ power sessions."

Youth Development

This month's top research on youth development.

RESISTANCE TRAINING IN SCHOOLS: HOW TO INTEGRATE THIS INTO THE CURRICULUM

Pichardo, A.W. et al., (2018) Strength and Conditioning Journal.

HOW DOES AGE AND MATURATION AFFECT MOTOR COORDINATION AND PERFORMANCE?

Rommers, N. et al. (2018) Journal of Sports Sciences.

DOES PLYOMETRIC TRAINING SUPPORT ANAEROBIC PERFORMANCE IN YOUNG ATHLETES?

Assuncao, A.R. (2018) The Journal of Sports Medicine and Physical Fitness.

[Abstract]

Resistance Training in Schools: How to integrate this into the curriculum

OBJECTIVE

Young athletes provide the S&C coach with the unique challenge of supporting an individual through growth. The importance of developing physical qualities during this time is essential for long-term health and participation. As youth spend a majority of their day at schools, it would seem a no-brainer that S&C could be incorporated into a curriculum given its relationship with physical, emotional, and academic health. Therefore, the aim of this study was to provide an overview of how this can be integrated into a school in New Zealand.

WHY RESISTANCE TRAINING?

Engaging in an active lifestyle can hold several health benefits such as improving physical and mental health (see attached video). However, perhaps one of the most important and overlooked benefits that may be seen in a school-setting is resistance training's ability to develop social and emotional relationships between peers. Resistance training can act as a preventative measure to the declines seen globally in neuromuscular control, fundamental movement skills (FMS), and levels of physical activity in children.

Generally, resistance training may be defined as activities that include bodyweight, machines, free weights, elastic bands, and medicine balls. In light of these considerations, resistance training should prove an effective method of developing muscular strength and bone density, as supported by the World Health Organisation, who recommends that these activities are engaged in roughly 2-3 times per week.

Practical Takeaways

The recommendations from this study are that resistance training must be supervised by a qualified practitioner, which echoes the findings of most studies I read on youth strength and conditioning. As well as supporting sessions, the coach should also look to periodise training in and around the curriculum to support buy-in and a natural transition into the working day. For more information on this, Craig Harrison (attached podcast) has provided us with a fascinating discussion on how he has incorporated S&C into schools. Periodisation refers to the planned programming of tasks that naturally compliment athletic qualities. The annual plan recommended in this study (located in the appendix) offers the reader with some examples of the macro-, meso-, and micro-cycles used in schools which will add to our understanding.

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

Tom's Comments

"Having personally worked in schools, I know that these environments can be incredibly effective when looking to incorporate strength-based initiatives. I believe that a great way to do this is to upskill the teachers throughout the process, so they not only feel included, but also "buy-in" to the concept. This will benefit the students by allowing school-based initiatives to happen when you are not present. These initiatives should, however, be easy to perform (i.e. a push-up) so that teachers do not attempt to replicate the detailed work we do.

A similar review to this one has been produced by James Baker (see attached article), who documents not only the periodisation model used within a curriculum, but some of the performance ranges for children around the ages of 11-16. Some of these measures and tests could easily be utilised in your practice, allowing you to prescribe individual-based reports and feedback. One of the weaknesses of all of the literature that I've read which has been produced for S&C when working with children is that many fail to acknowledge the complexities of working with large groups of children of multiple abilities and behaviours. It would be far more useful if some of the coaches spoke about their experiences and pedagogical practices to support work in schools. Teachers and educational institutions operate far differently to performance centres, so we must adapt accordingly to ensure that we are transparent and skilled enough to work with multi-faceted children who have no interests in sport."

[Abstract]

How does age and maturation affect motor coordination and performance?

OBJECTIVE
Football (soccer) is the most popular sport in the world and currently hosts approximately 21.5 million youth players under the age of 18. Many of these players strive to perform in a professional setting which requires a high degree of technical and tactical skills, as well as performance-related characteristics such as speed and agility. Many of these performance traits develop with the adolescent growth spurt which, ultimately, leads to an advanced physical profile (e.g. a taller, faster, and more powerful athlete). In turn, this leads to early maturating players being selected for youth academy positions rather than their late developing peers. Whilst there is some evidence that the late maturing player "catches up" over time, these players can often end up out of the system and less likely to reach a professional standard. This study investigates the differences in both generic and soccer-specific motor coordination to understand the affect of age and maturity on elite youth soccer players.

WHAT THEY DID
A total of 619 youth soccer players (U10's to U15's) were recruited from 6 different youth academies from the Belgian premier league. Both anthropometric and field test data were collected at the site of the academies by trained assistants over the 2016-17 season. All tests below were collected on the same day with a 10-minute warm-up performed between measurements and performance test. The total duration lasted roughly 45 minutes per player.

To assess maturation level, the Mirwald equation was used (See attached article for a great single-use calculator) which allows sports scientists to predict the average timeframe of peak height velocity (PHV). To account for underestimation of PHV, specific z-scores were generated that classified the youths as either 'early', 'on-time', or 'later' maturing.

Several generic tests were also collected, including a shortened version of the Körperkoordinationstest für Kinder (KTK) test. A soccer-specific test was conducted which included a circuit set out by cones with four left and four right turns at different angles, to be completed as quickly as possible. These were performed without a ball first for familiarisation and then with a ball. Speed was assessed over 5 and 30m. Agility was measured using a T-test which was executed twice with both a right turn and left turn to assess multi-directional agility.

WHAT THEY FOUND
The present study examined age and maturity status differences in talent identification programmes. The main findings of this study were that both speed and agility improved with maturation where the adolescent growth-spurt is likely to occur (under 14's and 15's). In addition, generic motor coordination showed a significant affect on age and maturity, suggesting that these improved with both physical and chronological age due to a larger number of generic training hours. The soccer-specific test revealed improvements with age, but there was no significant main effect size for maturity, indicating that age, not maturation, affected these results in this study. The gradual increase in performance characteristics and skill acquisition are thought to be accrued through a larger number of contact time in professional training.

Practical Takeaways

This study emphasises the link between maturation and performance improvements in all tests apart from soccer-specific motor coordination. As a result of this, it may be valuable for academies to think about if the age brackets (14-16) are a good time to assess a player's worth based on physical and performance qualities. During this time, fluctuating levels of coordination and differences in the maturation stage may lead to large variability in performance, causing some players to not stack up to their peers who are physically more developed and can express greater force/speed characteristics. At this time/age groups, players may be unfairly removed from the squad, whereas a more considered approach that allows the athlete time to grow may have provided the team with greater talent for the senior squad.

A recommendation for academies would be difficult to suggest and may be more appropriately designed by the club or sport. However, a cut-off period of at 17-18 may give players a greater likelihood of reaching their potential, as PHV should have already occurred by this time (i.e. PHV typically "levels out" at approx. 17 years).

During this confusing period, players should also be supported with small snippets of knowledge that are digestible and can help them through these challenging times. For example, please see the attached video on 'what makes your muscles grow' which can be shared with your athletes.

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

Tom's Comments

"A major strength of this study is that the sample size (619 participants) is not only large, but incredibly varied in terms of age (10 -15) and, therefore, maturation stage. This allows us to see the relationship between age and coordination, where coaches could consider how they train around these times of natural physical development.

In light of these findings, this project emphasises the need for progressive training around the age of peak height velocity, as this period is a critical time frame for skill acquisition and physical development. A fantastic insight into maturation monitoring and training adaptation has been provided by Gary McDermott, Steve Grinham, and Joel Moody during their time at Southampton F.C. in the attached podcast recorded in 2016. This podcast identifies the measures taken to find the next superstar and also the aim to produce good people. I think that we have to guide our players through these periods and provide them with a good mix of consistency and variability to ensure growth and development that will support them into adulthood."

[Abstract]

Does plyometric training support anaerobic performance in young athletes?

OBJECTIVE
Plyometric training has often been incorporated into programmes due to its ability to create athletes who can produce and reduce forces during landing tasks. These naturally transfer into many athletic tasks such as linear speed, change of direction tasks, and jumping/landing. However, their effect on anaerobic performance in young athletes remains relatively unknown. Therefore, the aim of this study is to evaluate the effects of PT on anaerobic performance.

WHAT THEY DID
This study recruited 29 adolescent athletes, with 15 assigned to the control group (16.85 ± 0.68 years; 68.38 ± 8.10 kg) and 14 in the plyometric group (16.79 ± 0.7 years; 65.24 ± 6.93 kg) over 10 weeks. The control group participated in only their regular training. The plyometric group participated in normal training with the addition of a twice-weekly, low-volume plyometric session consisting of both unilateral and bilateral multidirectional jumps. Baseline tests were collected prior to the 10-week intervention. The tests consisted of a Flying Start 30m Sprint Test (f30), time to complete 1600m, and running-based anaerobic Sprint Test (RAST).

WHAT THEY FOUND
The main findings of this study were that both the control group and plyometric group improved in all tests after the 10-week period. However, the plyometric training group improved to a greater degree than the control group in all tests:

⇒ f30 = (4.2% for PLYO vs. 1.1% for CON).
⇒ Fatigue Index = (9.9% for PLYO vs. 1.5% for CON).
⇒ Minimum = (19.4% for PLYO vs. 0.3 for CON)
⇒ Mean = (14.7% for PLYO vs. 0.2% for CON)
⇒ Peak Power = (10.9% for PLYO vs. 0.8% for CON)

Fatigue Index, minimum, mean, and peak power were all collected from the RAST test. For more information on the RAST test and the fatigue index, please read the attached article.

Practical Takeaways

This study reinforced that plyometric training can be a safe and effective method for improving power and sprint performance in young athletes between the ages of 10-15. The jumps in this study consisted of bilateral horizontal jumps, unilateral zig-zag jumps, bilateral vertical jumps, unilateral horizontal jumps, and depth jumps performed over 2 sets of 6-15 reps, with roughly 50 reps performed per session as a minimum (see the full study for the exact scheme). These benefits were experienced by adding two sessions a week into training, which lasted roughly 25 minutes.

When we consider the importance of anaerobic performance in team-sports, where a majority of intense and short bouts of exercise are performed through anaerobic energy pathways, the relevance of this study becomes better understood to current coaches. To further my knowledge, I have listened to Mike Young's podcast on plyometric prescription which outlines the sequences, timing, and common mistakes seen in other coaches. This should be a great resource to supplement our knowledge, so be sure to listen to attached podcast.

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

Tom's Comments

"When combined with strength training, plyometric training is a fantastic way to ensure that athletes have an opportunity to express their strength and power in a way that transfers to performance. Some of my favourite experiences have been watching either young children or older adults grow in both enjoyment and confidence as they negotiate plyometric sessions at greater intensities. In the attached video, some examples of plyometric-based training have been suggested (IMPORTANT: you must always consider the athlete and their existing levels of strength). These exercises, in conjunction with this study, can act as a great guide for current practitioners, allowing us to justify our training to others that may be interested (e.g. parents, teachers, and coaches). Moreover, this information can also help us assign certain set and repetitions configurations that will lead to adaptations in children aged 10-15."

Nutrition

This month's top research on nutrition.

LOW ENERGY AVAILABILITY AND BONE HEALTH IN DISTANCE RUNNERS
Heikura, I.A. et al. (2018) Int J Sport Nutr Exer Metab.

CAN SHORT-TERM SODIUM BICARBONATE SUPPLEMENTATION IMPROVE PERFORMANCE?
Delextrat A. et al. (2018) Int J Sport Nutr Exerc Metab.

HIGH VS. LOW PROTEIN INTAKE IN FEMALE PHYSIQUE ATHLETES
Campbell, B.I. et al. (2018) Int J Sport Nutr Exerc Metab.

[Abstract]

Low energy availability and bone health in distance runners

OBJECTIVE
Low energy availability (LEA) is defined as insufficient energy intake to cover the energy expenditure required for optimal health, function, daily living, and reproductive and metabolic function, once the cost of exercise and sporting activities is considered.

LEA is currently emerging as one of the most significant factors associated with athlete illness/injury and has been reported in both female and male athletes. Not until recently, research on LEA in male athletes was lacking almost completely, and not until 2014, the concept 'Relative Energy Deficiency in Sport (RED-S)' was introduced to include a wider spectrum of health and performance-related concerns than the 'Female Athlete Triad' that exist of low energy availability (EA).

The aim of the study was therefore to report EA, metabolic/reproductive function, bone mineral density, and injury/illness rates in national/world-class female and male distance runners, and to investigate the robustness of various diagnostic tools to identify the risks associated with LEA.

WHAT THEY DID
In a cross-sectional study design, investigators examined EA via a 7-day energy intakes and exercise energy expenditure, metabolic and reproductive hormonal function, bone mineral density, injury and illness rates, and dietary characteristics in a large cohort of elite distance athletes during a high-load pre-competition training block.

Athletes were divided into genders and subgroups according to benchmarks of reproductive function which is seen below:

⇒ (Females: amenorrhoeic, n = 113 versus eumenorrheic, n = 22)
⇒ (Males: low, n = 10 versus normal testosterone, n = 14) and,
⇒ EA calculated from diaries (< or > 30 kcal.kg-1 fat-free mass. day-1).

WHAT THEY FOUND
The authors found that 37% of females with amenorrhoea and 40% of males with low testosterone levels had significantly lower sex hormone and T3 concentrations and 4-5 times greater incidence of bone injuries compared to eumenorrheic females and males with normal testosterone levels. The study also found that the Female Athlete Triad and RED-S tools were able to detect symptoms of impaired endocrine-metabolic function and bone health in both sexes with better accuracy than using food and training logs for the assessment of energy availability.

Practical Takeaways

The findings suggest that assessing physiological symptoms of LEA such as hormonal concentrations, menstrual function, and bone density, or using Low Energy Availability questionnaires and RED-S screening tools provides a more objective and accurate assessment of the overall health of an individual than a dietary and training estimation of EA and may be more sensitive way to diagnose LEA.

The accurate measurement of EA outside of a well-controlled laboratory setting is challenging given the lack of reliable and validated protocols for identifying self-report energy expenditure and energy intake. However, this study suggests that screening tools can be implemented to facilitate and improve the management of both male and female athletes at risk for relative energy deficiency in the field. Further, the LEAF-Q for female athletes (**HERE**) and RED-S (**HERE**) clinical assessment tool (CAT) have been recently developed to help determine if athletes are suffering from RED-S. For more information on these, please visit the related links and podcasts attached below.

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

James's Comments

"Although any athlete can suffer from RED-S, those at particular risk are those in judged sports with an emphasis on the aesthetics (e.g. physique sports, synchronised swimming, and dancing), weight category sports (e.g. combat sports and horse racing), and endurance sports (e.g. runners, cyclists, and triathlons). Early detection is of importance to maintain and improve performance and prevent long-term health consequences.

While the use of menstrual status is probably one of the best markers of long-term energy availability, the use of oral contraceptive may mask the amenorrhea with withdrawal bleedings in female athletes. In the case of oral contraceptives, low bone mineral density, increased incidence of bone-related injuries, and low metabolic hormone concentrations may be used to detect LEA in these athletes.

Certainly, many suggest that energy availability is an on-going process which requires communication between the athlete, coach/teacher, parents, and health care/sport science professional (both medical and non-medical) working with female and male athletes."

[Abstract]

Can short-term sodium bicarbonate supplementation improve performance?

OBJECTIVE
Delextrat and colleagues set out to determine how a 3-day (3 equal doses a day) serial loading phase of sodium bicarbonate would affect repeated sprint and jump performance in female university basketball students compared to a placebo.

WHAT THEY DID
In a double-blinded, cross-over design study 15 female university basketball athletes performed the same Basketball Exercise Simulation Test (BEST) twice, one week apart, at the same time of day. Each BEST was preceded by either a serial loading phase of Sodium Bicarbonate (SBC) or a placebo (calcium carbonate, PLA) in capsule form.

The loading phase consisted of 3 equal doses throughout the day, for three days preceding the BEST. Doses were consumed with breakfast, lunch, and dinner and equated to a total daily dose of 0.4g per kg of bodyweight (0.4g.kg-1) with the last dose being consumed at dinnertime on the day before the BEST.

During the loading period, participants also reported any gastrointestinal (GI) side-effects on a 10-point scale. The BEST consisted of sprints and jumps in a circuit workout design. Sprint, jump, and total circuit performance were measured as well as decrements in sprint and jump performance as the BEST progressed. Fingerprick blood samples were taken at rest, pre-warm up, and immediately after completion of the BEST to be analysed for blood lactate concentration.

WHAT THEY FOUND
Significant decreases in mean sprint times and mean circuit completion times were seen in SBC conditions compared to PLA and sprint performance decrements were also significantly lower in the SBC group. Mean jump height was significantly higher after SBC loading versus PLA, however, there were no differences in decrements in jump performance between the two conditions. Surprisingly, significantly higher post-BEST blood lactate concentrations were found in the SBC condition compared to PLA. Participants reported none, or very minimal, gastrointestinal side effects in both conditions.

Practical Takeaways

The results here demonstrate how sprint and jump performance can be improved with a 3-day loading phase of sodium bicarbonate. Typically, sodium bicarbonate loading takes place acutely, with higher doses consumed near performance with the idea that sodium bicarbonate acts as a buffering system to attenuate metabolic and intramuscular acidosis associated with high-intensity exercise which utilises the glycolytic energy metabolism system.

The issue with acute loading is the presence of gastrointestinal side effects such as vomiting, diarrhoea, and/or abdominal cramping, which are obviously deleterious to performance. This research suggests that sodium bicarbonate still acts as an ergogenic aid when consumed in a serial loading protocol and, importantly, with minimal (if any) gastrointestinal discomfort. The two video links below also discusses chronic versus acute use and current dosage suggestions.

Coaches and athletes of basketball and similar sports where continuous short bursts of movement are required (e.g. football, rugby, hockey, etc.) should consider implementing a serial, rather than acute, loading phase of sodium bicarbonate to effectively benefit from the buffering capabilities without the usual adverse side effects. As with all supplements, there is likely to be a high level of variability in responses between athletes and, as such, experimenting with doses and timing is recommended to determine optimal loading strategies for each individual athlete. If you wish to, you can read more about individual responses to buffering agents by clicking **HERE**.

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

James's Comments

"The finding of higher post-BEST blood lactate concentrations in the SBC condition is initially a surprising one. However, the authors of this research sensibly offer up an explanation: that the higher blood lactate is ascribable to the enhanced sprint/jump performance that the sodium bicarbonate facilitates. Quicker sprints and higher jumps will require more fuel to be metabolised (via the glycolytic system in this case) which will result in more lactate produced as a by-product. Furthermore, the main priority of coaches and athletes is likely performance-based and so a higher blood-lactate concentration compared to placebo is probably deemed to be somewhat irrelevant, so long as performance has been enhanced.

Finally, the use of buffers should be practiced before the start of any competition due to some of the potential adverse effects on performance (i.e. trial it in training first). This is nicely discussed in the podcast outlined below by Abbie Smith-Ryan and Craig Sale."

[Abstract]

High vs. low protein intake in female physique athletes

OBJECTIVE

In previous years, there has been great interest in comparing high protein intake to low protein intake in resistance trained individuals, however, optimal daily protein intakes to maximise body composition is a subject of great discussion. This is especially true of highly-trained female populations such as female physique athletes. Low body fat levels and high levels of muscle are key features for competitive success in physique events and, therefore, it is vital that these athletes maintain and increase their lean muscle mass throughout the competition season. The purpose of this study was to investigate the effects of higher versus lower daily protein intakes on body composition changes in aspiring female physique athletes following a supervised daily periodised resistance training programme.

WHAT THEY DID

Seventeen females (21.2 ± 2.1 years and 61 ± 6.1 kg) were randomly assigned to a high protein diet (HP: 2.5.kg-1.day-1, n = 8) or a low protein diet (LP: 0.9.kg-1.day-1, n = 9). Participants visited the laboratory on two occasions, immediately prior to and after an 8-week supervised resistance-training programme.

Prior to each visit, participants were instructed to fast for 10-hours (an overnight fast) and refrain from physical activity for the previous 36 hours. Body composition measures using Body Metrix (fat-free mass, fat mass, and body fat percentage) and maximal strength (back squat and deadlift) and resting metabolic rate (RMR) were all measured.

WHAT THEY FOUND

Fat free mass was increased significantly more in the HP group compared to the LP group (+2.1kg vs. +0.6kg) during the 8-week period. Maximal muscle strength significantly increased in both groups, however, there was no significant difference between the groups. Another important finding from the study was that the HP group lost a significantly greater amount of fat mass, whereas the reductions in the LP group were not statistically significant.

Practical Takeaways

The main findings suggest that higher protein intakes are advisable for females engaging in physique competitions or females engaging in resistance training who seek to optimise their body composition. Given that female physique athletes are judged in competition on a combination of muscle symmetry, size and proportions, lower-body fat levels and large muscle mass are, therefore, requisites for success in the sport. A video link about the sport and study is attached below.

Typically, athletes will reduce their total energy intake during competition preparation and, as such, this study highlights the importance of consuming a high protein intake during this phase with a high training load in order to maintain the lean muscle mass. However, one must consider that there is a large discrepancy between 0.9 and 2.5 g.kg of protein intake per day, so it becomes speculative whether there would be a significant difference between the current recommended amount of 1.6 g.kg. day-1 compared to 2.5g.kg. day-1.

Furthermore, this study confirms that both training groups can obtain a body re-composition and maximal strength after 8 weeks in a hypocaloric and hypercaloric state, provided that a structured exercise and nutritional protocol is followed. For updated information about protein research and protein dosing per meal, listen to the excellent podcast below by Professor Stu Phillips and Prof Kevin Tipton and Caolileann Murphy.

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

James's Comments

"In the HP group, participants ingested significantly more kcals per day (423 kcals.day-1) in the form of proteins as compared to the LP group. It therefore remains unclear whether the changes in lean muscle mass observed were due to elevated caloric intake in the HP group and decreased caloric intake in the LP group during the 8-week dietary intervention. Furthermore, the reliability of body composition measurement should be raised given the potential errors involved in using ultrasound to detect differences between tissues (i.e. fat mass versus lean mass). Furthermore, it is important to underline that the investigators did not control the participants menstrual cycle during the study and, as such, it is unclear what menstrual phase participants were tested on (i.e. early, late follicular phase, or luteal phase). Taken together, these factors may have influenced body water and thus lean muscle mass assessment.

Overall, from these findings, it is clear that consuming high amount of protein during training is superior for optimising body composition in young highly resistance-trained women. Having said this, these results cannot necessarily be extrapolated to other populations."

Injury Prevention & Rehab

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

ACL INJURY PREVENTION FOR YOUNG FEMALE ATHLETES: WHICH PROGRAMS WORK?
Petushek EJ. (2018) Am J Sports Med.

SPORT CONCUSSION ASSESSMENT TOOLS: HOW WELL DO THEY WORK?
Hänninen T. (2018) J Sci Med Sport.

MUSCLE TEARS: ARE WE FORGETTING ABOUT THE SURROUNDING CONNECTIVE TISSUE DURING REHAB?
Prakash A. (2018) Br J Sports Med.

[Abstract]

ACL Injury Prevention for Young Female Athletes: Which Programs Work?

OBJECTIVE
Knee injuries, specifically anterior cruciate ligament (ACL) injuries are extremely common and potentially career ending. Females are also approximately 3 times more likely to injure their ACL than males. Structured neuromuscular control training programmes have been shown to significantly reduce ACL injury in females (up to 50%). The purpose of this study was to determine the common and effective components of ACL neuromuscular training (NMT) programmes as well as to create a user -friendly tool to assess the quality of current ACL NMT programmes.

WHAT THEY DID
A literature search was performed using PubMed and EBSCOhost in January 2018 with specific inclusion criteria and the Physiotherapy Evidence Database (PEDro) scale was used to assess quality and risk of bias (see infographic link). Data extracted from the studies included publication year, study design, sample size, number of ACL injuries, group characteristics (e.g. age and sport), and NMT characteristics, including exercise type and number per session, volume, duration, training time, and implementer training. Data analysis focused primarily on ACL injury odds ratio (OR), which essentially looked at the odds of an injury occurring after being exposed to an intervention (in this case, a NMT programme).

WHAT THEY FOUND
Eighteen studies were included, with and average PEDro score of 5.45 out of a possible score of 10. After analysis of the collected data and establishing odds ratios, the authors concluded that the most successful programmes included the following: some form of implementer training, emphasis on landing stabilisation, and lower-extremity strengthening, targeted younger (middle and high school) athletes, and were continued throughout the season, rather than pre-season only.

Taking all of this into consideration, they created a scoring tool for coaches and clinicians to rate their current and/or proposed risk reduction programmes. With a maximum score of 11, they determined that a score greater than 3 indicates a protective effect of the programme.

Practical Takeaways

This study is incredibly practical and provides very actionable insight for creating programmes that can truly reduce risk of ACL injury. It essentially provides us with a checklist of important components to be included in such programmes, which is incredibly helpful for coaches and clinicians that perhaps do not have a lot of resources or access to outside expertise. The authors acknowledge that injury prevention through NMT is relatively low across the U.S., and even lower in rural areas. This is another reason why the simplicity of this scoring tool is so important and lends itself well to being successfully implemented, even in rural areas. As mentioned previously in the "what they found" section, a score of ≥3 out of 11 indicates an effective programme. As such, I would highly recommend you checkout this ACL injury prevention checklist via the second image link below.

It is also interesting that they found that programmes with more balance, core-strengthening, and stretching did not increase their effectiveness. This is also important as it assists coaches and clinicians in deciding which types of exercises to spend more time on, and which can potentially be left out so that efficiency is maximised and results are still positive. When working with groups and younger athletes, simplicity is an asset rather than a detriment.

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

Steph's Comments

"Perhaps the greatest takeaway from this article, for me, was that it's very straightforward, simple advice. This allows the coach and/or clinician to feel confident in whatever they are creating for an athlete or group of athletes, while still leaving room for individualisation for a team, sport, or single athlete. The way this tool is structured lends itself well to application with a team or an individual, which is another way that it is unique. I have recently implemented a programme with a local high school soccer team that was absolutely influenced by this article (see podcast link below where I speak on this).

The bottom line really is this: we have a lot of research to back up what goes into a solid risk reduction programme, and now we even have a way to rate what we are doing and improve it. With this knowledge, we must be critical of the programmes we are already engaged in, and we must start to push for the initiation of programmes where they do not exist."

[Abstract]

Sport concussion assessment tools: How well do they work?

OBJECTIVE
Timely recognition of a concussion and appropriate removal from play is essential to prevent further injury and/or prolonged symptoms. Accurate detection is still somewhat tricky, as concussions can have diverse symptom presentations. Assessments such as the SCAT-3 and SCAT-5 have been instrumental in improving detection, though proper interpretation of their results could benefit from greater standardisation. This study aimed to describe day-of-injury performance on the SCAT-3, and to determine the ability of both pre-injury individual SCAT-3 baseline scores and normative reference values to detect acute deficits of concussion.

WHAT THEY DID
The authors reviewed day-of-injury SCAT-3 (see link to PDF below) and Standardized Assessment of Concussion (SAC) results from the Finnish Ice Hockey league between the 2013-2016 seasons. Both league normative data and a large test-retest sample of uninjured players were used to calculate cut-off scores for abnormal performance on the SCAT-3. To evaluate the two interpretation methods (comparing day-of-injury scores to individual baselines or to reference values), they chose a 10th percentile cut-off (they accepted up to a 10% false-positive rate on each component of the SCAT-3). They also calculated receiver operating characteristic (ROC) curves to examine accuracy of testing for injured and non-injured athletes.

WHAT THEY FOUND
Post-injury symptom number and severity and M-BESS errors were significantly greater, while total SAC scores were significantly lower on day-of-injury compared to normative values and individual baseline scores. The ROC curves revealed high levels of accuracy for symptom score and severity in distinguishing between concussed and non-injured players. However, accuracy was poor with the M-BESS, SAC score, and tandem gait.

Regarding the SAC subtests, orientation appears to help predict injury, as most athletes (91%) had perfect scores at baseline, and 26% scored a 4 or lower following concussion. Immediate memory, concentration, and delayed recall were not reliable indicators. As for the M-BESS, any errors in the double-leg stance subtest raises suspicion of injury. For single-leg stance, greater than 3 errors raises suspicion, and for the tandem stance subtest, greater than 4 errors raises suspicion.

Practical Takeaways

One of the major strengths of this study is that it provides us with a better understanding of which aspects of concussion testing hold greater weight and predictive accuracy than others. It takes some well supported objective measures and teases out some of the ambiguity in their interpretation. It shows us that symptoms are truly the most sensitive SCAT-3 component, though relying on symptoms alone to determine a diagnosis of concussion is not recommended. It demonstrates that changes in orientation and in M-BESS subtests of single- and double-leg balance have high accuracy in detecting concussion.

The authors also acknowledge some limitations to this study. First, the participants were a somewhat homogeneous (similar) group, as they were all Finnish ice hockey players. Second, some of the symptoms of concussion overlap with other diagnoses, which must be considered in the overall assessment. Third, it can be assumed that not all incidences of concussion were reported. Lastly, the baseline-adjusted post-injury scores could be misleading in those athletes that reported high levels of symptoms to begin with at baseline.

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

Steph's Comments

"Tools such as the SCAT are incredibly helpful in objectively measuring and assessing concussion (see reference below), but taking a score change from baseline or normative data and determining that it is significant and indicative of concussion on its own can result in either a false-positive or a missed diagnosis. We need a more standardised view and use of this and other assessment tools. This article does a very good job of reviewing (in depth) the components of the SAC and SCAT-3, and reiterating the importance of utilising both normative and individual baseline test data (when possible) in interpreting results and arriving at a diagnosis.

I also found it interesting that (and I agree with) the authors' opinion that we need further research investigating prolonged return-to-play times. They speculate that perhaps, if we can identify certain clinical symptoms that appear to be correlated with prolonged return-to-play, that we can better determine prognosis initially and better educate the athletes on their course of post-injury care. Included in the references is the link to a helpful podcast regarding how we can assess and manage athletes to the best of our current knowledge."

[Abstract]

Muscle tears: Are we forgetting about the surrounding connective tissue during rehab?

OBJECTIVE

Calf muscle injuries are one of the 4 most commonly experienced in sports. Previous MRI studies have focused on site and size of tear, the muscle affected, intramuscular tendon tear, and haematoma, though have not looked into integrity and injury severity of the associated connective tissues. This study aimed to assess the integrity of the calf muscle connective tissue in individuals with acute calf muscle injury. These authors also proposed a grading system, and measured its correlation with time to return-to-play (RTP).

WHAT THEY DID

The authors performed a retrospective database search for patients who were referred for MRI of the leg from March 2017 to September 2015. Return-to-play was included (defined as time from injury date to the return to full play). Consistent MRI techniques and specific inclusion and exclusion criteria were used. The MRI's of 100 consecutive patients were analysed by 3 experienced radiologists who were blinded to clinical history, sporting background, and patient outcome. Each image was evaluated for the muscle involved, location within the muscle, myofibril disruption, and integrity of the surrounding connective tissues. Each muscle was graded using the proposed 0-3 scale (see infographic below).

WHAT THEY FOUND

Of the 100 patients, 89 were men, 11 were women, and the majority were professional or semi-professional athletes. A total of 114 muscle tears were documented, 79 in the soleus, 31 in medial gastrocnemius (gastroc), and 4 in the lateral gastroc. Time to return-to-play based on grade of muscle tear was shown for 3 groups: all muscle tears, soleus muscle tears only, and gastroc muscle tears only. For all three groups, there was a significant correlation between injury grade and time to return-to-play. The higher the injury grade, the more time was required to return-to-play.

Practical Takeaways

This study clearly demonstrates that the integrity of the connective tissue supporting the calf muscles may be linked to recovery time. This makes sense if you imagine those connective tissues as a support system or the "scaffolding" from which the muscles exert their power and effect. This scaffolding consists of intramuscular bands/tendon and an outer covering (epimysium and aponeuroses), and research has shown that these soft tissues heal more slowly than muscle tissue (see video on soft tissue layers below). Therefore, if the injury extends past just muscle fibre layers into the surrounding soft tissues, it is easy to see how increased time may be needed for full healing and return to prior level of sport participation. This study is helpful with this, in that it provides time frames that coaches and athletes can refer to based on injury severity (see the article for more details on this – click the "abstract link in the upper right-hand corner), providing imaging has been done.

This leads to one of the limitations: what if imaging has not been performed? Measuring swelling and bruising only is not accurate. Therefore, future research should investigate more clinic-based tests and measures that can be used to accurately estimate return-to-play time frames when imaging is not necessarily indicated or available.

A couple of other limitations of this study were that the population was fairly homogenous in that it was mostly elite-level athletes, there was a bias towards more severe injuries, likely due to the level of play of most of the patients, and there was no long-term follow up.

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

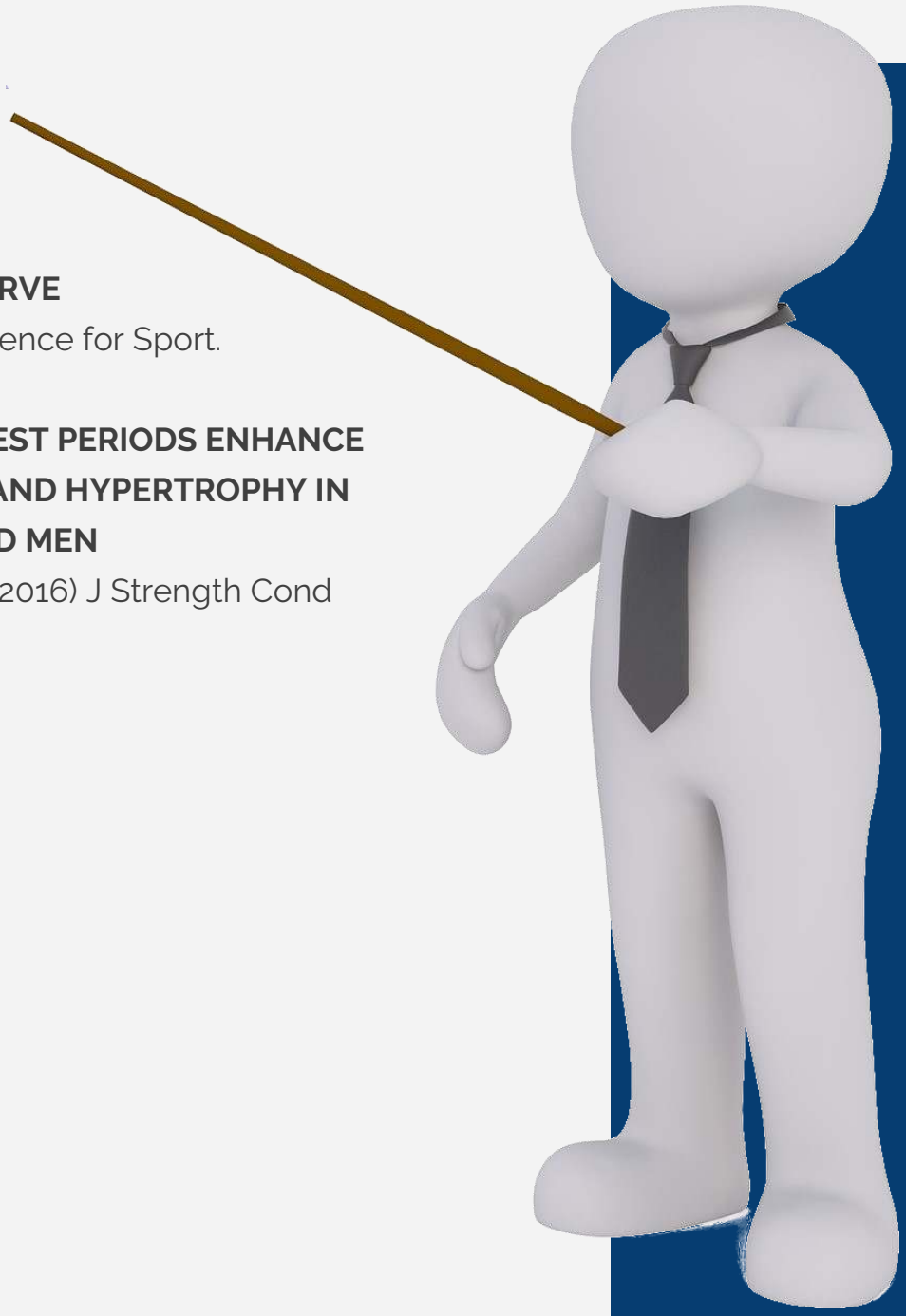
Steph's Comments

"I found this study to be helpful in determining return-to-play expectations and, therefore, proper patient education regarding this. It is also beneficial to include the brief anatomy review of the muscle fibres and soft tissue supports, as understanding this also lends itself well to educating patients on the importance of respecting healing time for the slower healing soft tissues following injury.

I do feel as though this information is more applicable to the professional and semi-professional athletic population, as those groups tend to have easier and quicker access to imaging, even with minor injuries. I also propose that this review may somewhat be encouraging imaging when it may or may not be indicated in the general population. At times, with the general population in the physical therapy setting, we attempt to hold off on imaging until totally necessary, as it can instil fear of movement or causation between tissue damage and pain. Though this is clearly not the intent, and may not be an issue in professional sports, it is always something we need to consider. Either way, proper education surrounding imaging for any patient is of utmost importance."

Infographics

A round-up of our monthly research infographics.



FORCE-VELOCITY CURVE

Solomon, M. (2018) Science for Sport.

LONGER INTERSET REST PERIODS ENHANCE MUSCLE STRENGTH AND HYPERTROPHY IN RESISTANCE-TRAINED MEN

Schoenfeld, B.J. et al. (2016) J Strength Cond Res.

@ScienceforSport

FORCE-VELOCITY (F-V) CURVE

F-V curve

The curve shows an inverse relationship between force and velocity, meaning that an increase in force would cause a decrease in velocity and vice versa.

Practical applications

Generally the objective of strength and power training is to shift the curve to the right (Figure 1). This results in the athlete moving larger loads at higher velocities and therefore becoming more explosive.

Figure 1: Force velocity curve

Training zones

Max strength

Typically classified by using intensities of approximately >90% of 1RM.

Strength-speed

The 'middle-ground' between maximal strength and peak power. Relatively high intensities are used (80-90% 1RM).

Peak power

The zone in which optimal force is produced in the shortest possible time (30-80% of 1RM).

Speed-strength

Leans more towards speed rather than strength. Relatively high velocities are used within this zone (30-60% of 1RM).

Max velocity

Is simply the maximum movement velocity, this is typically classified by using intensities of < 30% of 1RM.

Our Summary

The objective in most training programmes is to improve the rate of force development, resulting in a rightward shift in the F-V curve. Understanding the F-V curve is paramount to working as a strength and conditioning specialist, and explicit understanding is essential to become a great coach.

For the full article check out the Science for Sport website

Do long (3min) rest intervals increase strength and hypertrophy when compared with short (1min) rest intervals?

SCIENCE for SPORT

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WHAT THEY DID

21 Trained Males

Short Rest (1min)

Long Rest (3min)

8 Weeks Resistance Training

Measures

Strength
- 1RM Bench
- 1RM Squat

Muscle Thickness
- Anterior quadriceps
- Vastus Lateralis
- Elbow Flexor
- Triceps Brachii

Muscle Endurance
- 50% bench press (max reps)

WHAT THEY FOUND

Pre-Post Training

- Long rest improved in ALL outcomes.
- Short rest improved in 1RM Squat, muscle endurance, and leg thickness measures.

WHAT THIS MEANS

"The present study provides evidence that longer rest periods promote greater increases in muscle strength and hypertrophy. Our findings are consistent with current recommendations for maximal strength gains but run counter to general hypertrophy training guidelines"

Schoenfeld, Brad J., et al. "Longer interset rest periods enhance muscle strength and hypertrophy in resistance-trained men." *The Journal of Strength & Conditioning Research* 30.7 (2016): 1805-1812.

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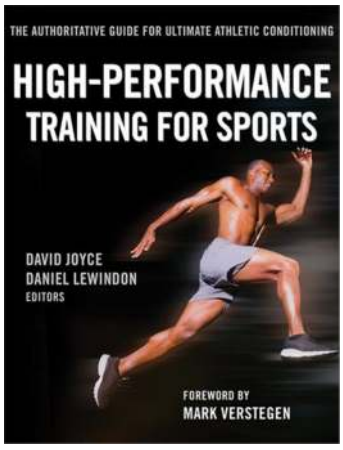

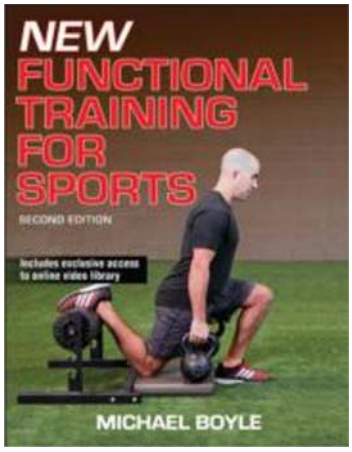

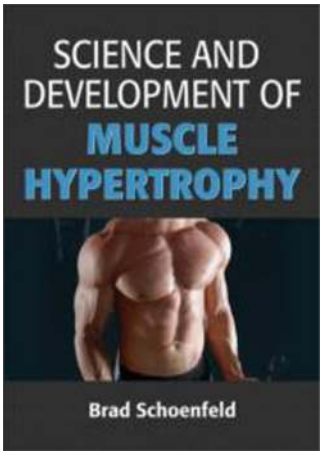

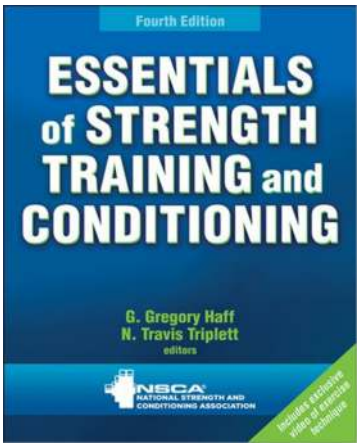

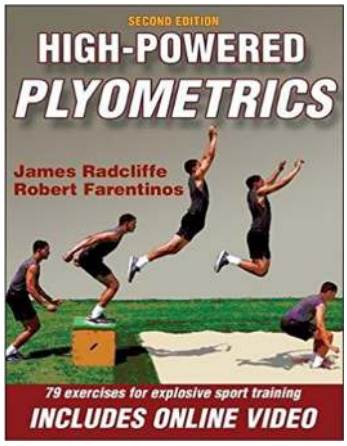

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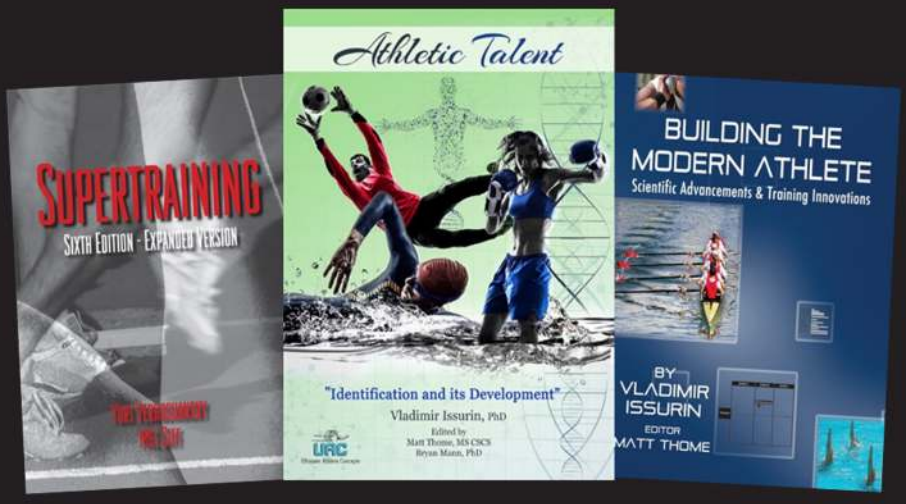

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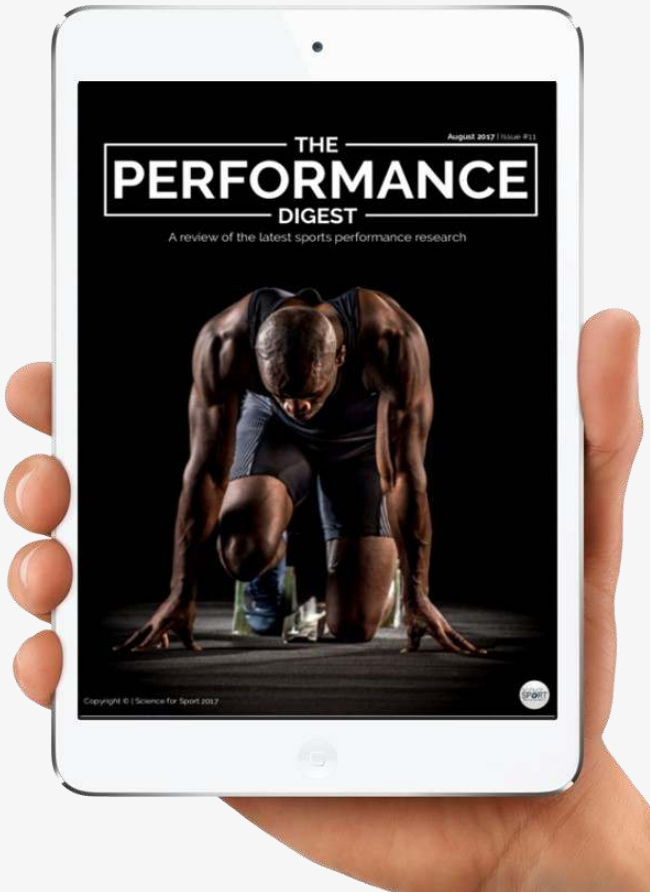

Thanks for Reading!

The next issue will be published on
1st October, 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