August 2018 | Issue #22

THE PERFORMANCE DIGEST

A review of the latest sports performance research

Contents

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Welcome to the
PERFORMANCE DIGEST

OWEN WALKER
Founder and Director of
Science for Sport

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

LATEST NEWS

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

1. Free Books

As of this month, members of the "members-only" group on Facebook now have the opportunity to win free sports performance books of their choice every single month! The winner will titled as the "Member of the Month" and will be announced on the 20th of every month. To win, all you have to do is get involved in the group discussions and help other coaches with their questions and ask questions of your own. Basically, the "Member of the Month" will be the one who is the most interactive/helpful. So now you not only have the prime opportunity to learn and network with high-level coaches from all over the world, but you can also now earn books for doing so :)! **Click here to join the members-only group**, if you haven't done so already.

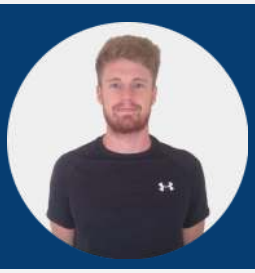
2. Netherlands Meet-Up

Science for Sport will be hosting its first ever group meet-up organised by group manager Matt Solomon. Based on the success of this trial meet-up, we may continue this trend and organize meet-ups all over the world.

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

Disclaimer: For information regarding the disclaimer associated with this document, please visit the Disclaimer on our website.

Research Reviewers



Owen Walker
MSc*D CSCS

Chief Editor

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

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PhD Candidate CSCS ASCA L2

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Dr. Will Vickery
PhD

The Science of Coaching

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

Tom Green
MSc UKAD Advisor

Youth Development

Tom 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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Strength & Conditioning

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

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PhD Candidate

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Carl Valle
BSc

Technology & Monitoring

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

Dr. Stephanie Allen
PT, DPT, OCS, CFSC

Injury Prevention & Rehab

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

Audio REVIEW

Sled-Resisted Training

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

with James de Lacey

WHAT WE DICUSS

In this episode of the "Audio Review", James and Matt discuss sled-resisted training and how coaches can, and should, use it for performance enhancement and rehab. They also cover what we currently know and don't know, from the research.

In this episode, you will learn:

- What sled-resisted training is
- Who sled-resisted training is for and which athletes can benefit
- How to load sled-resisted training based on the outcomes you wish to get
- A case study
- What research we hope to see in the near future

Episode length = 29 minutes

A bit about **James**

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

Listen Now

The Science of
COACHING

[Abstract]

Coaches and Adolescent Mental Health

Understanding the mental health of athletes is the first step to their development and success

INTRODUCTION

It is widely known that physical activity and sport has a considerable impact on the health of the general population and athletes alike. Furthermore, numerous studies have reported on the psychological benefits of organised sport within children and young adults. High levels of mental health issues amongst young adults suggests a need for intervention strategies to change this trend. Typically, young adults are more comfortable about discussing their mental health issues with peers or a trusted adult and within the sports environment (this trusted adult is very likely to be the coach). Due to the contact time and nature of the coach-athlete relationship, a coach is in an ideal position to provide information or assistance for young athletes with possible psychological issues. Having said that, there are obviously restrictions on how much information or intervening a coach can have given their typically limited experience and knowledge in the area of mental health. The aim of the current study was then to gain a greater understanding of how coaches perceive their role in the promotion of mental health for young athletes.

WHAT THEY FOUND

Using focus groups within 20 Australian coaches from an array of sports (swimming, cricket, basketball, Australian rules, and tennis), the researchers highlighted a number of key points relating to the mental health within the context of adolescents and sport:

- ⇒ Many of the coaches suggested that when working in youth sport they often feel required to serve a number of different roles including being a mentor, an educator, a motivator, as well as someone whom their young athletes can confide in.
- ⇒ Most coaches also saw their role within the mental health of their young athletes as someone who was better placed to identify possible psychological issues and refer them to those with more experience and knowledge in this area, as opposed to intervening and providing assistance.
- ⇒ A number of coaches found it challenging to discuss mental health with their young athletes or that this did not happen directly as they were unsure how their athletes might react. On the other hand, some coaches encouraged their athletes to discuss mental health issues with them and made this part of the club culture.
- ⇒ Coaches were generally unsure on how to approach the topic of mental health with young athletes after initially asking "Are you alright?" due to a lack of knowledge and experience within this area.
- ⇒ The coaches appeared to have some knowledge of the possible triggers linked to mental health problems within young adults including schoolwork, relationships (e.g. parents, teachers at school), and social media. Additionally, these same coaches tended to understand some possible recommendations on how to overcome these issues, including discussing their problems with a trusted adult or professional and sufficient sleep.
- ⇒ Coaches also believed that the parents of the young adults played a key role in the mental health of young athletes as well as their personal development. Unfortunately, the coaches noted that many parents do not see this as their role that may lead to future mental health issues amongst the young athletes.

WHAT THIS MEANS

It is clear that coaches, particularly of young adults, must play a number of different roles, which includes dealing with the mental health of their athletes. Although it may not be one of the reasons for a coach taking up employment with an athlete or a team, coaches understand that they have a responsibility to oversee and be mindful of the psychological well-being and development of their athletes. Coaches seemed to know what may be the cause of any mental health issues and what may be some approaches on how to overcome these. However, the manner in which coaches approach this though appears to differ considerably and, in most cases, as stated by the authors "...coaches were unsure of what help was necessary and unsure of how to provide that help."

This highlights that coaches do understand the impact an athlete's mental health can have on their development as well as performance, yet they are unsure on what they can really do about this.

Practical Takeaways

Psychological health is often taken for granted or not even a consideration for many coaches when constructing their training plans. A lack of education or experience in the area is likely to cause many coaches to ignore this part of an athlete's development, which is entirely understandable. Those involved in youth sport (or at any level) are encouraged to improve their mental health literacy. Again, as the authors suggest, this might include becoming more aware of the signs and symptoms of poor mental health as well as acknowledging when to seek professional help. As such, it may be recommended that coaches add mental health education to their continuing professional development list as this will most definitely develop the coach's skillset and ability to connect with their athletes, not to mention support their health and wellbeing.

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.

VELOCITY BASED TRAINING: CAN BAR-POWER OUTPUT BE USED INSTEAD OF 1RMS?
Loturco, I, et al. (2018) International Journal of Sports Physiology and Performance.

ARE CHANGE OF DIRECTION SPEED AND REACTIVE AGILITY ACTUALLY RELATED?
Hernandez-Perciado, JA, et al. (2018) Journal of Strength & Conditioning Research.

UNLOCK YOUR POWER POTENTIAL WITH THE FRENCH CONTRAST METHOD
Hernandez-Perciado, JA, et al. (2018) Journal of Strength & Conditioning Research.

[Abstract]

Velocity based training: Can bar-power output be used instead of 1RMs?

OBJECTIVE
1-repetition maximum (1RM) tests are widely used by coaches to evaluate performance and determine training loads. Due to the inherent difficulties in applying 1RM tests, velocity based training (VBT) has emerged as a practical alternative to control resistance training intensity. Several investigations have provided useful information on VBT and have correlated movement velocities with 1RM measures. Furthermore, 1RM does not reflect the force and velocity applied by an athlete against a load, which in high-performance sport, time and velocity play a critical role in determining the effectiveness of force application. Therefore, the aims of this study were to: 1) analyse the correlations between bar-power outputs and 1RM values; and 2) assess the sensitivity and specificity of the bar-power approach for athlete testing and monitoring.

WHAT THEY DID
61 elite athletes from 4 different sports (14 track & field sprinters and jumpers, 18 rugby 7s players, 8 bobsled athletes and 21 professional soccer players) participated in this study. The sample comprised of 15 athletes who participated in the previous Summer and Winter Olympic Games. Physical tests were performed on 2 non-consecutive days. Day 1) squat jumps (SJ), countermovement jumps (CMJ), and 1RM half-squat (HS); Day 2) maximum power outputs in the HS and jump squat (JS) exercises and a sprint test. SJ and CMJ were performed on a contact mat while the 1RM HS was performed on a Smith machine. Mean power (MP), mean propulsive power (MPP), and peak power (PP) were assessed with a linear position transducer for the HS and JS exercises. Optimal power load was also determined starting with a load corresponding to 40% body mass with a 10% body mass increase in external load for each set until a clear decrement in power was observed. For the sprint test, track & field athletes performed a 60m sprint while the other athletes performed a 40m sprint where timing gates were set at 10, 20, 30, 40, and 60m.

WHAT THEY FOUND
All power output measures from both HS and JS correlated significantly with SJ and CMJ heights (varying between 0.58 and 0.82). All power output measures significantly correlated with sprint time over each distance (varying between -0.35 and 0.91). No significant correlations were found between 1RM and the SJ and CMJ. The highest correlation values were observed between the power output measures and 60m sprint time (varying between -0.80 and 0.91) while the correlation between the 1RM with the same sprint distance was -0.63.

Practical Takeaways

The most interesting take away from this study was the greater correlations found between power output from HS and JS exercises and sprint times compared to 1RM and sprint times. This suggests that optimal power output may be a novel and alternative method to effectively assess elite athletes. Due to the high levels of precision and consistency that can be obtained through velocity tracking devices, practitioners can use MP, MPP, or PP to estimate and define optimal power zones. More importantly, practitioners can measure the athlete's ability to efficiently accelerate relative loads (thus reaching higher movements velocities), which is a selective factor in different sporting disciplines.

Furthermore, strength training is velocity specific, meaning training at certain velocities will improve performance in that velocity range (as specified in the infographic below). This shows the potential limitations when considering a strength measurement such as external load on the bar which only provides a mass moved through space and doesn't provide the "how it was moved". Furthermore, there are potential risks with 1RM testing due to maximum loading and it can be difficult to test 1RM during a competitive period where athletes need to be fresh for future competition.

Here are some guidelines/ideas that you can potentially play with in your practice with your athletes using this method. After performing a load-power profile (as per the methods above in the "what they did" section) and/or a ballistic force-velocity profile using the MyJump 2 app.

Idea 1: Rank your athletes based on their bar power-output and look to use the optimal load that expresses maximal power to improve the overall mean output of the team or improve individual athletes that are lagging behind others. An example day may look like:

A1) Jump Squat 3x3 w/ Optimal Power Load
B1) Back Squat 4x4 @ 0.45-0.50m/s average velocity or 80-85% 1RM or RPE 7-8
B2) Box Jump 4x2-3
C1) Posterior Hip or Knee Dominant 3x6-10

Idea 2: Create a force-velocity profile for your athlete as a separate test. Using this information, the MyJump 2 app can determine whether the athlete is force- or velocity-deficient by comparing their force-velocity profile to their "optimum profile" where they would maximise power. The imbalance of the profile will determine how the training programme will be structured (I've linked a paper below that has a table with guidelines of how to structure a session depending on the profile (e.g. a force-deficient profile will have more force-based exercises compared to a velocity-deficient profile)).

A well-balanced profile, however, will have an even number of exercises throughout the strength-speed continuum to try and shift the entire slope to the right (i.e. improving force and velocity). Instead of guessing the loads that maximise power for that athlete (general guidelines sit between 30-50% 1RM, in most exercises), the optimal power load determined through the bar-power method may allow you to maximise the training effect, especially in a well-balanced athlete with regards to a force-velocity profile.

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

James's Comments

"Velocity trackers I feel are such a useful tool for a strength coach as it provides practitioners with descriptive and prescriptive information without the need to maximally load an athlete. Furthermore, it provides a way to autoregulate training by providing velocity ranges to work off of, rather than percentages of 1RM. For example, you prescribe a velocity range of 1.0-1.05m/s for the squat for that day over a training cycle. Week 1 the athlete feels fresh and completes their sets with 140kg. However, in week 2, the athlete has accumulated massive fatigue from the previous match and is struggling in the weight room. So this week they hit their velocity range with 120kg. If percentages were prescribed, the athlete may struggle with the prescribed weight or may not even complete the prescribed work.

The bar-power output approach used in the study is a way to rank your athletes through more meaningful measures than just load on the bar. Using the bar-power approach with a force-velocity profile may not only provide optimal loading for power output, but also give useful information for optimising the athletes training programme to increase power output."

[Abstract]

Are change of direction speed and reactive agility actually related?

OBJECTIVE
Agility can be defined as "a rapid whole-body movement with change of velocity or direction in response to a stimulus." Agility can be defined as an "open" skill due to its reactive nature or perceptual component. Meanwhile, change of direction speed (CODS) is considered a "closed" skill. The decision-making process is essential to agility and several authors have reported that agility is a defining performance criterion in several sports. The aim of this study was to determine if there were differences in agility performance when testing CODS and then an agility-based task using identical scenarios. Secondly, the study aimed to identify the relationship between CODS and agility with straight-line sprinting, reactive lower-limb power, and anthropometric characteristics.

WHAT THEY DID
45 male and 31 female team-sport athletes participated. The agility testing protocol employed the use of FitLights, where LED lights can be programmed for specific or random activation and be deactivated by direct contact or proximity. Lights were placed in 4 different arrangements: frontal (FR), universal (UN), semi-circular (SC), and lateral (LA) - I've linked a picture of each configuration in the infographic link below.

The testing protocol for the CODS condition provided participants with advanced knowledge on the sequential order of the lights. In the agility condition, the light activation was unknown and non-sequential. Two trials were performed for each configuration. Each configuration was done in a separate session so testing was performed over 4 sessions. Speed and power testing involved a 15m sprint and a flying 15m sprint using timing lights. Lower-limb power was assessed by a 10m timed single-leg jump test where the subject jumped using their dominant leg as fast as possible for 10m.

WHAT THEY FOUND
The differences between CODS and agility testing protocols were statistically significant in most of the tests. The greatest difference was in the UN configuration, with 22% for men and 31% for women, followed by the SC configuration, with 16% for men and 10% for women. The smallest differences were in the LA configuration at approximately 10% in both groups. UN and FR configurations had weak correlations between CODS and agility performance in both men and women. However, LA configuration showed the strongest correlations with r = 0.66 for women and 0.52 for men. A significant positive correlation was also observed for CODS and agility in the SC configuration in women with r = 0.53.

Among men, significant negative correlations were observed between LA-agility and body height (r = -0.43) and LA-CODS and body weight (r = -0.42). Among women, body height generally had a negative effect on agility testing, where significant negative correlations were observed with FR-agility (r = -0.42), UN-agility (r = -0.64), and SC-agility (r = -0.64). Many of the tests correlated with 15m and flying 15m sprints, with strongest correlations between flying 15m and the SC-CODS and agility protocols (r = 0.58 and 0.64, respectively). Performance in the 10m single-leg jump test showed significant moderate to strong correlations with the SC and LA configurations. The rest of the correlations for the performance tests with agility were generally weak to moderate correlations.

Practical Takeaways

CODS and agility performance were found to be significantly different among men in all 4 configurations. Women showed smaller differences in CODS and agility during all 4 configurations. Interestingly, the UN configuration produced the greatest difference between CODS and agility in both men and women. This could be due to the complex demands of the test, requiring considerable visual scanning and attention. Hence, peripheral perception and other cognitive components are critical for performance in this test. It seems the more complex the movement structure, the greater difference seen between CODS and agility.

Body height seemed to negatively affect agility in both men and women, which is expected due to the higher center of mass putting the subject at a decreased biomechanical advantage for changes of direction. Sprint performance and reactive power testing generally showed weak to moderate correlations with most agility tests, suggesting that agility testing is not just dependent on physical potential or anthropometric factors, but also on cognitive and sensory factors. I've linked an article I wrote below (see article #1) that covers the perceptual components of agility and its importance to agility performance. In this article, you can see how that can be put into practical use, which I will also discuss in my comments to the right.

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

James's Comments

"It is clear from this and previous research that CODS and agility are 2 independent qualities. However, to really distinguish between athlete's ability to produce "a rapid whole -body movement with change of velocity or direction in response to a stimulus," the stimulus must be specific to the sport. It has been shown that higher skilled athletes only perform better in agility tests when reacting to a sport-specific stimulus compared to lower skill athletes (e.g. elite vs semi-professional). This asks many questions of practitioners and the use of cones, reactive lights, and other reaction methods. For example, are we improving agility using reactive stimuli that aren't sport-specific?

It is also important to note that in team sports, you have offensive and defensive agility and both scenarios require a different skillset to recognise various situations. There are many ways to be able to train both qualities in the same drill Some very simple examples of this are 1v1, 2v1, 3v2, 3v3, drills etc. Creating variation in these drills is simple and can be as easy as changing the athlete's entry position into the drill. Small-sided games can also be used with an agility focus. Here are some guidelines to have a game emphasise agility:

1) Reducing the number of players (3-a-side vs. 5-a-side).
2) Greater density of the game (more players in a given space), meaning they'll be a greater number of agility manoeuvers.
3) Reducing the number of passes allowed before scoring increases agility demand.
4) Having the sport coach provide encouragement during the game can help athletes that lack engagement get more involved.

If you are interested in the big hitters in this area, you can search for Dr. Warren Young and Dr. Sophia Nimphius who have published many of the papers in this area."

[Abstract]

Unlock your power potential with the French Contrast Method

OBJECTIVE
The ability to produce high muscular strength and power is considered one of the most important factors in various sports. Post-activation potentiation (PAP) has been demonstrated to be a good strategy to improve jump and sprint performance through the use of Complex Training (i.e. near maximal effort followed by a biomechanically similar explosive exercise). Complex Training seems to have the greatest benefit for high-level athletes. Similar to Complex Training, the French Contrast method, which consists of 4 exercises, has also been proposed to maximise PAP. These 4 exercises typically consist of a resistance exercise with maximal load, a plyometric exercise, a resistance exercise trying to maximise power production, and lastly, a short ground contact plyometric exercise. Currently, there is no research analysing the effects of the French Contrast method on performance. Therefore, the aim of this study was to analyse the potentiation effects of this method on vertical jumping ability.

WHAT THEY DID
31 recreational athletes with at least 1 year of resistance training experience and who are able to countermovement jump (CMJ) at least 30cm were selected for this study. Subjects performed single-repetition squat warm-ups with 50, 60, 70, and 80% of 1RM (recorded with PowerLiftApp). Actual 1RM was estimated through the load-velocity profile created from the app. After 1RM was established, subjects performed 3 CMJs using MyJump 2 where the best jump of 3 was kept.

After the CMJ testing, subjects then started the potentiation protocol (intervention group n = 17), whereas the control group (n = 14) simply rested for 15-mins. After each set of the intervention, the subjects rested for 5-mins before performing the CMJ. After that, they then immediately started the next set. The control group performed a CMJ after every 5-mins. The French Contrast intervention consisted of 20-sec rest between exercises and involved: Exercise 1) 1-Rep yielding isometric partial squat for 3-sec with 85% of 1RM at self-selected knee angle; 2) 3 drop jumps from 50cm box; 3) 3 dynamic half squats (90deg knee angle) with 50% of bodyweight; and 4) 3 hurdle jumps with minimal ground contact.

WHAT THEY FOUND
The subjects were homogenous (i.e. similar) in terms of anthropometrical characteristics but heterogeneous (i.e. different) in terms of performance. The French Contrast group improved their CMJ significantly over time when compared to the control group. After the first French Contrast set, CMJ improved 5.1 + 1.1% (ES = 0.27, small effect). After the second set, CMJ improved 6.8 + 1.8% (ES = 0.41, small effect) and an improvement of 8.5 + 2.9% (ES = 0.44, small effect) after the final set when compared to baseline. However, no significant improvement was seen from the second to third set. The control group showed a decrease in CMJ height over time reaching -2.1 + 1.6% after 15-mins of recovery.

Practical Takeaways

I really do like the versatility of French Contrast training. You can use it to potentiate a training session through the use of less fatiguing exercises like isometrics and other jump/sprint variations. You can also use the French Contrast method as the main work of the day by using a heavy main lift as the primary force -based exercise; this is extremely useful if you are short on time. I've listed below some example French Contrasts that you can use as a template to create your own.

Example French Contrasts depending on the end goal:

Goal = Vertical Jump

A1) Heavy half-squat off pins x 2-3 (knee angle approx. same as jump)

A2) Drop Jump x 3 (or Box Jump for a non-plyometric variation if looking to reduce some ground impacts)

A3) Barbell CMJ 30-50% 1RM x 4

A4) Band-Assisted CMJ x 4-5

Goal = Sprint

A1) Heavy Sled March x 10m or Heavy Hip Thrust x 5-6

A2) Broad Jump Bound x 4

A3) Band-Resisted Acceleration Step x 4/leg

A4) Alternate-Leg Bounding or any other Bounding variation x 5/leg

Goal = Lateral Movement (Stepping, Cutting, Shuffling etc)

A1) Lateral Wall ISO Push x 6sec/side

A2) Diagonal Bounding x 4-5/side

A3) Lateral Sled Sprint x 10-15m/side

A4) Band-Assisted Rebound Skater Jump x 3-5/side

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

James's Comments

"The main finding of this study was that the French Contrast method is an effective strategy to acutely induce PAP and improve jump performance. Two sets may be optimal to maximise results and to minimise time investment, as three sets showed no further improvement in jump performance compared to the 2nd set. This could be due to the increased fatigue derived from the extra work completed. Regardless of being a high-level athlete or not, it appears that French Contrast training can positively benefit performance.

A French Contrast set can be tinkered with to suit your sport/athletes needs within a certain cycle. The first force-based exercise can be a dynamic or isometric exercise, as long as high levels of force are being produced. Exercises don't just have to be traditional sagittal plane exercises either, they can be from any plane of movement. Exercises with similar force vectors can also be picked depending on the physical quality you want to improve (e.g. heavy sled drags for sprinting or isometric lateral wall pushes for lateral movement). The final exercise can also be tinkered with by either making it the movement itself you want to improve (e.g. jump or sprint) or an accelerated version of it to emphasise the velocity side of the power equation (e.g. Band-assisted jumps or bounds)."

Technology & Monitoring

This month's top research on technology and monitoring.

THE VALIDITY OF A NEW EXTERNAL:INTERNAL TRAINING LOAD RATIO

Akubat I, et al. (2018) Sports (Basel).

CAN SMARTPHONES RELIABLY MEASURE METATARSOPHALANGEAL JOINT RANGE OF MOTION?

Otter, S.J. et al. (2018) Journal of Foot and Ankle Research.

SLEEP AND STRESS HORMONE RESPONSES TO TRAINING AND COMPETITION

O'Donnell S, et al. (2018) European Journal of Sport Science.

[Abstract]

The validity of a new external:internal training load ratio

OBJECTIVE
Monitoring sports, specifically the changes in both fitness and fatigue, is a challenge due to the complex interaction between internal and external measures. In addition to the needs of finding useful measures of player load and response to work performed, changes in actual fitness and performance competence is important to manage training and rest properly. The goals of this study were to explore the relationships of objective measures of load internally and externally with novel metrics using TRIMP and to see how incomplete recovery interacts with those proposed ratios.

WHAT THEY DID
The researchers performed a battery of tests on ten soccer players using the Catapult GPS athlete tracking system, heart rate measures, lactate testing (more info **HERE**), and even gas exchange assessment using a gas analyser. Athletes simulated soccer workload with a repeatable conditioning circuit BEAST 90mod, and both objective load data as well as subjective reporting of muscle soreness and fatigue response was recorded. After the field test data was collected, standardised effect size was calculated using conventional methods.

WHAT THEY FOUND
As the researchers made a strong case for ratios of internal and external workloads and enough statistical power supported the association, two important findings were revealed with this study. The advanced metrics that are double composites, meaning they were two algorithm scores combined into one ratio, were no more valuable than the simpler singular ratios. The second finding was the notion that detection of true fitness changes were unlikely, as the data suggests the measures be exploratory rather a diagnostic to absolute change.

» **Practical** Takeaways

The key takeaway is the value of using both internal and external metrics (**more here**) to determine how output trended with context to effort. The researchers were extremely valuable in pointing out the need to know if an athlete is decreasing work because they are choosing to (voluntary) or they are unable to match the demands of the game simulation (involuntary).

This singular conclusion alone is valuable to coaches wanting to interpret GPS tracking systems so they are not jumping to conclusions. Another possible takeaway is the question of monitoring players under fatigued conditions, and the need to assess both neuromuscular exhaustion as well as the lab-grade physiological responses for robust conclusions instead of looking at just player output (e.g. distance covered).

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

Carl's Comments

"My experience with TRIMP is in agreement with the researchers, meaning that without physiological (internal) load readings, external mechanical player load measures are deceptive and limited. With heart rate monitoring on the backburner for many coaches, those with budgets that support both external and internal systems might want to look at TRIMP as a solution to complement their sport science initiatives. Heart rate monitoring is best used with continuous monitoring with as many training sessions as possible, as more data can better detect changes in fitness and fatigue. Finally, the use of the BEAST90mod may have value, but due to the needs of practice, it would be great to see a follow-up study being used for repeated skill based workouts."

[Abstract]

Can smartphones reliably measure metatarsophalangeal joint range of motion?

OBJECTIVE
Mobility is an important part of athlete preparation and vital in sports medicine screening for baseline comparisons. Objective measurement of an athlete's range of motion, along with other testing can create a profile and needs analysis that is highly individualised and easy to track. Due to the convenience of smartphones, an inexpensive and reliable alterative to a goniometer is especially useful in settings that need to evaluate joint mobility. With dorsiflexion testing of the ankle being accepted as valid and reliable (**HERE**), the next step with measuring the metatarsophalangeal joint with a smartphone would be useful to everyone in running-based sports.

WHAT THEY DID
The large group of researchers evaluated 57 (ages 18-55) patients using a conventional goniometer and the smartphone and compared the eight raters from a podiatric school during their final year. After looking at both passive motion and joint position of the first metatarsophalangeal joint, the researchers scored the intra -rater and inter-rater reliability of both the smartphone and the conventional goniometer using the SPSS software.

WHAT THEY FOUND
Perhaps unsurprisingly, the researchers found that a simple smartphone is reliable, and with a moderate to a high degree with both inter- and intra-reliability. However, the devices were not similar enough in measurement performance, meaning that their scores cannot be used interchangeably in a clinical or research setting.

Practical Takeaways

Those in sports medicine who are trained clinically to assess the first metatarsophalangeal joint will be able to use the Dr Goniometer app as an option for dorsiflexion evaluation. Due to the high amount of turf toe experienced in sports such as the NFL (**HERE**), this may be a practical way to track changes over the season and career of an athlete. Unfortunately, the data isn't interchangeable, meaning past tests or legacy data with conventional goniometers can't be compared directly. Since the popularity of smartphone apps is growing for crude evaluation of athlete performance, tracking mobility with mobile devices seems to be a great option beyond ankle range of motion.

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

Carl's Comments

"This study is important because ankle range of motion testing is gaining in popularity due to the connection with squat depth and jumping technique. First metatarsophalangeal joint dorsiflexion is less tested than other movement qualities, therefore, it is a fresh way to see added information to performance and athlete health. Also, the app uses the camera, so it can potentially help keep the process honest with better documentation of the evaluation."

[Abstract]

Sleep and stress hormone responses to training and competition

OBJECTIVE
All teams recognise the value of sleep, and adding both wearable devices and stress hormone testing could be a promising solution to learn more about the impact of intense match and practice variables. Measuring precise metrics of sleep along with the biochemical patterns of rest and performance could lead to better interventions and ways to cope with the strain of competition. Therefore, the purpose of this study was to provide both the mental and physical cost of training and competition and how those stressors interact with objective sleep data.

WHAT THEY DID
Over a period of 7 days, researchers collected data from ten elite female athletes in the sport of Netball. Each event, be it competition, intense training, or a rest day were collected for comparison purposes. They estimated workload, recorded subjective stress responses with a questionnaire, and measured both salivary cortisol and sleep using an accelerometer device. After the data was collected, the researchers used conventional statistical software packages to breakdown the three types of days, the cortisol levels, and the sleep metrics into meaningful comparisons.

WHAT THEY FOUND
Not surprisingly, the researchers did indeed find relationships between cortisol and sleep, but the most striking was the impact on psychosocial stress (**HERE**) from the match compared to the practice response. The researchers reported that the "salivary cortisol levels were significantly higher, and sleep quantity and quality were significantly reduced, following competition when compared to training and rest days." As a result, it seems that sleep is disrupted (both duration and quality) from the environmental stress of competition, leading to emotional and mental strain in the athlete.

Practical Takeaways

The practical takeaways are very theoretical as no intervention was studied in the experiment, leading only to speculation. From this study, it appears that when both training and match physical intensity are the same, the match is still more demanding (higher cortisol levels and disrupted sleep) which is likely attributed to the higher psychological demands of the game. It appears that both a direct adjustment to training after a competition would be appropriate, and methods to reduce the biochemical strain of elevated evening cortisol would be worthwhile.

Also, the study supports the use of both combined saliva biomarker and non-invasive sleep monitoring with athletes, making the use of hormone and portable sleep tracking practical and valid with athletes. As sleep is disrupted by competition, the use of supplementary sleep aids, be it physical (e.g. massage or meditation) or nutritional (e.g. melatonin or lemon balm), could be useful in order to ensure a good quality night's sleep.

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

Carl's Comments

"I especially enjoy research studies that do objective sleep monitoring instead of subjective reporting, as the information is far more useful and trustworthy. Having said that, research has found that some subjective questionnaires are effective, such as this one from Driller et al. (**HERE**). This article is perhaps a perfect example how wearable sensor options in the sleep monitoring market could explain how each athlete may need individualised support and programmes based on their sleep patterns and psychological responses to competition. Another important factor is that the researchers could start looking at the importance of winning and losing and how each athlete performed as a way to anticipate sleep quality and quantity metrics."

Fatigue & Recovery

This month's top research on fatigue and recovery.

COLD WATER IMMERSION FOR RECOVERY: WHAT ARE THE CHRONIC EFFECTS?
Tavares, F. et al. (2018) International Journal of Sports Physiology and Performance.

FATIGUE MONITORING: WHICH METRICS SHOULD WE BE TRACKING?
Carling, C. et al. (2018) Sports Medicine.

COMPRESSION GARMENTS: DO THEY ENHANCE PERFORMANCE?
da Silva, C.A. et al. (2018) Sports Medicine.

[Abstract]

Cold water immersion for recovery: What are the chronic effects?

OBJECTIVE
Cold water immersion (CWI) is widely implemented by practitioners in order to speed-up the recovery of their athletes'. Although there is an abundance of research on CWI, surprisingly, no studies have investigated the effects of CWI on highly-trained athletes exposed to dense training schedules. Therefore, this study aimed to measure the effects of CWI in elite rugby players during a 3-week, high-volume training period.

WHAT THEY DID
We exposed 23 super rugby players to either CWI (10-min at 10°C) or passive recovery (CON) after each training session during the three training period. Training loads (running, gym, and conditioning sessions) were similar between the two groups. Countermovement jump (CMJ) performance, lower-body muscle soreness (DOMS), and wellness were obtained twice during each week. In addition, cortisol (C) and interleukin-6 (IL6) were collected once per week.

WHAT THEY FOUND
Although no significant differences were observed between the groups for most of the measures, the athletes exposed to CWI demonstrated a faster recovery in comparison to the ones in the CON (i.e. moderate effects were observed for DOMS and IL6, and small effects for CMJ).

Francisco's Comments

When it comes to cold-based recovery modalities, two theories have been in debate in the past years:

1) CWI decreases anabolic responses, therefore reducing muscle adaptation to training;

2) CWI speeds-up recovery and, therefore, allows for athletes to perform subsequent training sessions at a greater intensity or perform a larger volume of work.

Based on these theories, one can easily understand that if an athlete can recover sufficiently without the need to implement any cold therapy (e.g. time between sessions is long enough), why would he or she use it? For me, this is a crucial point! For a better understanding of who, when, and how to utilise cold therapies, please refer to the March 2018 issue of the Performance Digest where I reviewed one of our papers (see the article link below for the original review).

From these two theories, an unsolved question has been raised: Would an athlete benefit more from be able to perform at higher intensities, with a possibility of compromising anabolic responses, or would he/she benefit more from moments where fatigue is increased, but anabolic responses are not compromised?

While we are still not able to completely answer that question, we aimed (for the first time in team-sport athletes) to investigate the second aforementioned theory by answering the following questions:

1) Can elite rugby athletes' sufficiently recover within the week when they are exposed to high training loads?

2) Can these athletes' sufficiently recover from consecutive high training load weeks?

In this study, we have observed that CWI can be beneficial to speed-up the recovery (question number 1) and reduce residual fatigue (question number 2) in elite rugby athletes. By speeding up recovery, we have demonstrated that athletes were able to perform at higher intensities (e.g. CMJ peak force) and, therefore, we speculate that there was an increase in the overall adaptive stimulus (theory number 2). Similar findings were observed in a previous study which investigated the effects of CWI in highly-trained cyclists exposed to a dense training schedule.

As a result of this study, we are now able to say that when athletes are exposed to a high-density training schedules, CWI can enhance recovery within the week and from week-to-week. In order to answer the "unsolved question", our study needs to be replicated with the addition of a muscle size measure.

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

Practical Takeaways

"In this study, the athletes were exposed to a dense training schedule (two speed sessions, four gym sessions, seven rugby sessions, and three conditioning sessions per week), therefore, the available time to recovery between training days was limited. The findings from this study demonstrate that exposing athletes to CWI after each training day can speed-up the recovery of neuromuscular performance and improve perceptions of lower-body muscle soreness.

More importantly, the findings from this study demonstrate that when high-volume training is maintained for several weeks, athletes' cannot sufficiently recover from week-to-week due to accumulative fatigue. As a result, CWI can help reduce this accumulative fatigue from successive high-volume training weeks. For example, in comparison to their baseline test, neuromuscular performance decreased by 6.9% for the CON group on the first day of week 3 (after ~65h of no training). Meanwhile, neuromuscular performance only decreased by 1.3% in the CWI group. In summary, CWI can be implemented to enhance recovery within, and between, high-volume training weeks."

[Abstract]

Fatigue monitoring: Which metrics should we be tracking?

OBJECTIVE
A lot of research has been conducted around different tests and methods to monitor fatigue in football. However, the practicality, reliability, and sensitivity of different methods still remains uncertain. Therefore, the objective of this study is to review the different methods utilised to monitor fatigue and their applicability to a real-world football environment.

WHAT THEY DID
The authors reviewed a series of papers on fatigue monitoring in football and:

⇒ Debated if monitoring fatigue after matches is needed;
⇒ Raised critiques to the real-world relevance of the current research literature on fatigue monitoring;
⇒ Discussed the applicability of different tests and methods, and the data they can provide to the real-world scenario;
⇒ Proposed future research perspectives.

WHAT THEY FOUND
In order to make it easier for the reader, I decided to present the authors findings point by point, using the four points presented above.

1) From a performance perspective, the authors questioned about the importance of using post-match fatigue monitoring tools. Nevertheless, higher fatigue levels have been demonstrated to be related to non-contact injury, therefore, from an injury perspective, it may useful to monitor fatigue.

2) The authors mentioned that research vulgarly interpret results independently of the players standard/level. Moreover, research is typically based on a single dataset. Using a single dataset may provide erroneous findings due to numerous factors such as: match-to-match physiological variation, effects of training, period of the season, individual minutes of match during the season, etc.

3) The time-points used in research to analyse fatigue after matches are either to short (i.e. up to 24h post-match) or conflict with other team activities. Furthermore, research is dependent on a variety of factors that may make the data found in research non-representative of another population. The complex, expensive, and time-demanding measures used in research can rarely be implemented in everyday football environments. Although time-motion measures (e.g. GPS) are collected by most teams, practitioners need to be aware of the methodological limitations. Despite being easy to apply and almost cost-free, self-reports are dependent on the players honesty and several other factors.

4) Suggestions were made for research to focus on the effects of neuromuscular related fatigue on mechanical workload metrics. In order to investigate mental fatigue, mentally fatiguing tasks with high ecological validity for soccer need to be created. Researchers should also be focusing on collecting a combination of training and match derived data.

» **Practical** Takeaways

In order to detect an individual athlete's response to exercise, fatigue markers should be collected over a long period of time, whenever possible.

In addition, instead of collecting just a single measure of fatigue, the researchers recommend practitioners collect at least 2-3 different measures. These measures need to be appropriate to the reality of each club and training schedule. Common laboratory measures typically utilised in research (e.g. measures including nerve-stimulation, electromyography, and biochemical analysis) are not practical for the real-world environment. On the other hand, practitioners must be cautious when using field tests that induce further fatigue (e.g. repeated sprints, maximal sprints, etc.).

Sub-maximal tests that can be implemented during the warm-up may be a worthwhile option. Maximal actions that do not involve extensive eccentric actions (e.g. countermovement jump) can also be a useful option. Care must be taken when selecting the measures to use, ultimately, practitioners should aim to utilise measures that are derived from training to monitor fatigue/readiness.

Lastly, practitioners should be aware of the limitations when interpreting published data and utilising methods implemented in the scientific world as they may provide little information to the real-world scenario.

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

Francisco's Comments

"My first comment is aimed at a statement made by the authors in this study. The authors suggested that even when a player is not fully recovered, he/she can still perform at a similar level as they can when they're fully recovered. This comment demonstrates the limited importance of monitoring fatigue.

In my experience, self-reported tools (e.g. wellness questionnaires) still provide the most meaningful information on how a player feels. Importantly, education is a key component for these tools in order to produce valid data. From an injury prevention perspective, these self-reported tools can be combined with measures of muscular and joint health (e.g. knee-to-wall test, Lasègue's test, etc.). Some of these tests should be implemented for the entire squad, whilst others should be individualised according to individual's injury history and playing position.

In order to monitor the athlete's levels of neuromuscular fatigue, practitioners can select 1-2 tests that are commonly involved in their training programmes (e.g. 10-m sprint, CMJ, squat mean velocity, etc.). In order to have a more comprehensive indicator of fatigue, these performance results should be combined with the self-reported measures.

Fatigue monitoring measures should only be obtained when there is an actual possibility that practitioners will make changes to the programme based on the data. These changes can include a reduction in training load (e.g. decrease the number of high-intensity meters performed, increase on the number of reps in the tank on the gym session, etc.), a reduction on the number of sessions (e.g. 1 instead of 2 field sessions), a delay on the start of the day (e.g. if the fatigue is associated with poor/reduced sleep), or an increase in the recovery modalities and focus on recovery. It's also worth understanding that if the athletes feel the test data is not being used for anything meaningful, they will often lose motivation to perform the test maximally, thus harming the data. So, make sure the data you collect is meaningful."

[Abstract]

Compression garments: Do they enhance performance?

OBJECTIVE
Lower-limb compression garments (CG) are frequently used by athletes in an attempt to enhance recovery. These garments are implemented both during and/or after exercise. The methodological approaches used within the research regarding the effectiveness of CG during high-intensity exercise is diverse. Therefore, the goal of this paper was to review the current body of research in order to identify the evidence-based effects of CG during high-intensity exercise.

WHAT THEY DID
A systematic review with a meta-analysis was conducted to review the effects of CG during high-intensity exercise in sports performance and physiological markers. Twenty-three research articles on the effects of using CG during were included for analysis.

WHAT THEY FOUND
Wearing CG did not improve running performance in any of the distance tests (50-400m, 800-3000m, >5000m). Furthermore, no differences were observed for vertical jump height, maximal oxygen uptake, sub-maximal oxygen uptake, blood lactate concentration, or ratings of perceived exertion.

Practical Takeaways

The main takeaway from this review is the lack of evidence supporting the efficacy of CG for improving high-intensity exercise performance or physiological markers. These findings were also observed when the authors added gender, athletic status, and running distances as variables into the analysis.

Although the findings of this study do not support the usage of these garments during high-intensity exercise, the authors do point out some of the limitations of the research studies analysed in this review. Some of which being the small sample sizes used, imprecise effect sizes (i.e. wide confidence intervals), and no control for a placebo effect. Moreover, it is important to mention that although no differences were found in some measures, it does not mean that such differences are not meaningful for some events. For example, the authors give the example of the observed 6-seconds improvement on 800-3000m running events when using CG.

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

Francisco's Comments

"I found this study very interesting as most previous research has primarily focused on compression garments for exercise recovery. Personally, I believe the significant limitations of the current research – as highlighted by the authors – are of more concern than the actual findings of this study. As the authors mentioned, these limitations may have an impact on the findings of the current and previous reviews.

In my experience, various athletes find wearing compression garments during exercise beneficial for their performance. Given that compression garments are very unlikely to cause any negative effect on performance, would we really exclude their use from an athlete's routine? My personal belief is, no. Moreover, although no acute effects in performance may have be observed, if CG are worn during training, it may promote recovery for the following session (i.e. if the athletes keep them on for the subsequent hours after exercise).

When it comes to improving performance, it's very important that practitioners can distinguish between what is significant within the research and what may be meaningful in an applied, real-world scenario. In order to help you decide whether or not you should use a recovery modality, I have created a simple two-step approach that can be used as a general guidance for practitioners – simply click the infographic link to check it out."

Youth Development

This month's top research on youth development.

FUNDAMENTAL MOTOR SKILLS: WHAT EXACTLY ARE THEY?
Logan, S.W. et al. (2018) Journal of Sports Sciences.

JUMPING THROUGH TIME: DOES MATURATION IMPACT LANDING MECHANICS?
Read, P.J. et (2018) Physical Therapy in Sport.

HOW JUMP-TRAINING CAN ENHANCE PERFORMANCE: A REVIEW OF LOADED, UNLOADED, AND ASSISTED JUMP TRAINING
Loturco, I. et al. (2018) Strength & Conditioning Journal.

[Abstract]

Fundamental Motor Skills: What exactly are they?

OBJECTIVE
Previous research has identified a strong link between fundamental motor skills (FMS) and an athlete's degree of sporting competence. Of the numerous research produced surrounding FMS, there still remains some confusion over the definition, which will limit any publications applicability to real-world coaching, or the readers understanding of such terms. This article aims to explore the terminology, allowing the reader to understand the current state of FMS research and hopefully support us in practice.

WHAT THEY DID
This article systematically analysed studies that were peer-reviewed, printed in English, and were published between January 2000 and December 2015. In addition, this search was refined by only allowing studies with 'FMS' as their main objective, but further, measured FMS as an outcome (i.e. 'The effect of a 6-week balance intervention on FMS). In total, 198 articles were identified but only 124 met the inclusion criteria, with 33% of these studies published in Australia.

WHAT THEY FOUND
Of the 124 articles included in this review, the term 'fundamental movement skill' was more prevalent than 'fundamental motor skills', occurring in 86 (69%) of the studies. Both were used interchangeably and were concluded to mean the same thing.

With regards to the quality of an FMS definition, approximately 24% of studies were left out of the analysis because they lacked a definition of FMS. Those studies that used the term movement rather than motor were reported to be at a higher level in terms of quality. This was assessed using a quality score which denoted if a study had 1, 2, or all 3 of the inclusion criteria.

Of the studies reviewed, a majority (79%) used a process-oriented measure (defined as assessing the quality of movement) to assess FMS with the main test being the 'Test of Gross Motor Development'. Product-oriented measures, defined as the outcome of a specific skill, only accounted for 19% of the studies with the most common being the 'FMS Test Package'. Only 5% contained both process and product orientated measures.

Practical Takeaways

The terms 'motor' and 'movement' seem to be used interchangeably which may be confusing for those from a different educational background (i.e. healthcare workers vs. sports coaches). Both may have an invested interest in knowing/reporting on FMS, but may present different terminology that may be confusing. It would be a lot easier if one term was used to ensure both consistency and understanding across disciplines. In addition, it would be fascinating to understand why some researchers choose motor over movement and vice versa to understand the differences, if any, based on a specific rationale. To support the practitioner, some of the skills that fall under 'FMS' have been included in the attached website link, which is a fantastic coaching resource with some great information.

When selecting studies to review, the tests used to assess FMS were described as being either product (outcome-focused) or process-driven (assessed by the quality of movement), with product accounting for 63 (51%) of studies and process only 23 (19%). An explanation for this may be that product tests, such as the Test of Gross Motor Development are often quicker to perform, demonstrate greater relatedness to commonly performed sports activities, and may be financially more viable in youth set-ups (see attached video). Process-driven testing can often be expensive, with this study stating that a process-driven test may require "radar gun, or video equipment and software for biomechanical analysis," One factor that the study fails to mention is that once gathered, these also require a qualified professional who can dissect and evaluate these skills with a more refined knowledge on kinesiology, physiology, and biomechanics.

This is where S&C coaches and physiotherapists could make great impact in youth set-ups, lending their expertise to prevent the wider implications of poor FMS (Obesity, poor mental health, morbidity, etc.). In light of this, I would certainly think about how we, as coaches, can have influence in our local areas, especially if we have access to such equipment.

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

Tom's Comments

"In reviewing the existing content coupled with this publication, the general consensus is that both fundamental movement and motor skills are the same thing. These are defined as the foundational movements (e.g. running), which are often described as "building blocks" that lead to more specialised and complex movements (e.g. evading). A detailed explanation of FMS and their role in holistic athletic development can be found in the attached podcast.

At first I thought when reading this study, "does this really matter?", but then I thought of others who may not understand the difference between these terms and the implications that this may have on the profession. Strength and conditioning already struggles to justify its position with teachers, parents, and even coaches, so it is vital that all of the terms we use are as transparent as possible to ensure people know exactly what it is that we do. By using multiple terms, we continue to blanket other people's understandings in a cloud of mystery which may lead to confusion over what it is that a child is doing. Moving forward, I would like to see those who use either of these definitions justify their choice by really pinpointing what the difference is between 'motor' and 'movement' in both an academic and practical context."

[Abstract]

Jumping through time: Does maturation impact landing mechanics?

OBJECTIVE
With so many physiological adaptations that accompany maturation, it is only logical to assume that physical outcomes (e.g. jump height) would be affected. During these periods, coaches must remain sensitive to the psychological and physiological hardships experienced by the athletes and tailor their programmes appropriately to support adaptation, prevent injury, and improve self-esteem. With these considerations in mind, this study aimed to explore the landing mechanics of those at certain stages of puberty to support coaches in practice.

WHAT THEY DID
This study analysed the data of 400 elite male youth football (soccer) players (aged 10-18 years) from six professional UK academies during the 2015-16 pre-season. These players were all involved in training, and undergoing involvement in the Elite Player Performance Plan (EPPP). Body mass (kg) was taken, along with standing height, seated height, and leg length (cm). The Mirwald equation was used to 'band' youths into a maturation bracket.

These were: Pre-peak height velocity (PHV) [before], Circa [during] PHV, and post-PHV [after]. Those who fell in between these measures were removed from the data-set. After this process, only 340 players met the inclusion criteria. All of these completed a single-leg countermovement jump (SLCMJ) on a force plate. Participants were instructed to maintain hand-hip contact, whilst having one knee flexed at 90°. Players performed a self-selected depth countermovement followed by a maximal effort vertical jump. To complete this process, participants had to land in a stable position on the force platform.

NOTE: Mario Chavez wrote an article on the Science for Sport website on the topic of Bio-Banding which also contains a free maturity and bio-banding calculator (**HERE**).

WHAT THEY FOUND
The results of this study found that jump height (pre-PHV 10.93 ± 2.57cm; circa-PHV 13.17 ± 2.65cm; post-PHV 15.79 ± 2.87cm) and absolute vertical ground reaction force (pVGRF) increased with each stage of maturation, with higher landing forces observed circa-PHV. Knee valgus reduced as participants moved through maturation, with significant differences recorded between pre- and post-PHV in the left leg only. However, a reduction in knee valgus was accompanied by greater ipsilateral lateral trunk flexion angles as participants progressed through maturation.

Practical Takeaways

When evaluating jumping technique, the whole body can paint a complex picture of what is happening on a biomechanical level. However, the most important joints, in my opinion, are the knee and hip, as these often reveal flaws in technique (e.g. knee valgus) or muscular strength (see attached video).

In this study, increases in absolute peak ground reaction force were believed to accompany maturation due to increases in body mass. An increase in body mass when running or jumping can also increase the likelihood of injury. To prevent this, a mixture of corrective neuromuscular (NM) training, strength training, and landing mechanics will be invaluable when working with young athletes. Some great ideas can be found in the attached article link below, in which commonly used exercises are constrained and can be used in warm-ups to support knee health.

Increased force output and jump height is something that coaches should look for in most team-sports. However, in the absence of sound technique and strength, greater vertical height alters the centre of mass which will challenge an individual's landing stability and ability to dissipate all of these forces. This is a recipe for disaster, so we should look to reinforce the points made above (i.e. improve NM, strength, and technique) to support our athletes.

Finally, younger children showed reduced hip and knee flexion, indicative of a 'stiffer' landing position. An analogy I like to use is imagining dropping a spring from a height with both a small stone and a large brick on top of it. The small stone will not really change the properties of the spring very much (Pre-PHV). However, the large brick will force the spring to work hard to maintain structural integrity. If the spring is unable to do so (excessive height/pVGRF), it will warp and bend (similar to trunk flexion as a compensatory method for weakness in the hip abductors and lateral trunk stabilizers. In light of this, it may be important to continually seek strength improvements post-PHV, whilst paying special attention to technique through plyometrics that produce less force (e.g. reactive hops etc.) until there is enough trunk and hip strength to support higher force landings (e.g. forward bounds or box drops).

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

Tom's Comments

"This has been a really interesting read, in which the authors guide the reader through the kind of questions that are so applicable to our roles. To support my understanding whilst reading this, I felt reassured by the continual reference to application in a 'real-life' setting. For example, when discussing trunk flexion during landing, most of this was accredited to increases in height and weight, which would significantly alter centre of mass (COM), coordination, and landing mechanics. However, I was presented with additional knowledge, where it was suggested that trunk flexion during landing may also be due to previous ankle inversion sprains, where poor ankle stiffness and stability alters force dissipation, forcing the knee/hip to compensate.

Based on the above, my recommendations for plyometric activities in youth are twofold:

1) Ensure that a full history of injury is maintained which may explain and support future injuries or injury-prevention programmes. In the case of an ankle sprain, an easy-to-implement programme has been discussed in the attached Podcast by Andrew Strickland (Length = 5.25 Minutes).

2) Ensure that form follows growth. Merely producing greater heights and force does not always imply that an athlete is progressing. In the absence of sound landing mechanics, you will predispose your athlete to an increased likelihood of injury. As such, coaches should re-educate their players during and after PHV to ensure the correct methods are adopted in their early and late adult career. Programmes should focus on technique, balance, ankle stiffness, and muscle strength during these periods."

[Abstract]

How jump-training can enhance performance: A review of loaded, unloaded, and assisted jump training

OBJECTIVE
Football (soccer) is an intermittent game, requiring high levels of aerobic and anaerobic fitness levels to compete. During the 2006-2007 premier league season, the number of sprints performed per game equated to roughly 31 ± 14, which when compared to 2012-2013 (57 ± 20), marks a notable change in the physical and tactical demands of modern football. The ability to produce high running speeds is, therefore, important and can be achieved through many training methodologies. Of the numerous methods that can enhance speed, jump-based training has proven a great method as this closely mimics the stretch-shortening cycle seen in sprinting. This paper looks at the effects of different loading schemes on performance, but more specifically, their application to football performance.

HOW CAN JUMP TRAINING SUPPORT SPEED PERFORMANCE?
Superior jump performance is achieved when an individual can produce and apply high levels of force against their own mass over distance or height. When compared to sprinting, these factors remain the same, as the athlete must overcome their own weight to accelerate both vertically and/or horizontally which can support a football player in winning the ball, attacking space, or intercepting a pass.

From a mechanical perspective, jumps that are both vertical and horizontal support different phases of running and should be programmed accordingly. For example, horizontal jumps (e.g. broad jump) would benefit an individual in the early phases of acceleration, where a forward-lean allows the athlete to send forces into the floor and propels them forwards. This training may lend itself to phases in the game where the play is congested or players like to move the ball quickly and must be explosive. Alternatively, jumps that are vertical in nature, such as a countermovement jump, would benefit an athlete that is transitioning into a more upright posture to develop top-speed. In this example, higher vertical ground reaction forces (GRF) are created by a high knee and equally stiff ankle that acts as a delivery mechanism to augment impact forces and support leg rebounding. This form of jump training would benefit teams who play an aerial game, in which players must get onto the end of the ball with generally longer running distances. Such differences present the S&C coach with interesting dilemmas for practice, but moreover, indicate the role that can be played in training a team in a gym with consideration of their tactics.

Characteristics of unloaded jumps

Unloaded jumps typically fall on the velocity side of the force-velocity curve (see attached article). These jumps are generally fast and require less force to produce. Children who are heavy and take a long time to accelerate may rely on their mass and force to accelerate them. In this instance, children may be described as 'velocity-deficient', and could benefit from these types of movements.

Characteristics of loaded jumps

Unlike unloaded jumps, loaded jumps use additional weight to help the individual overcome their mass, plus a bit more. This not only increases neuromuscular efficiency (e.g. motor unit recruitment and coordination) but can support novice athletes at both ends of the force-velocity curve. However, it is advised that solid technique and pre-existing strength levels are present before loading any movement, especially jump-based tasks.

Characteristics of Assisted Jumps

Assisted jumps overload the velocity component of a movement by reducing the individual's body weight. An example of this can be seen in the attached video, where a band is used to support the athlete in a countermovement jump during ascent. This may be beneficial at improving power and sprint speed by increasing the maximum acceleration that the athlete experiences. By reaching artificial speed, the body can treat this as a new stimulus that may support power output and sprint speed.

Practical Takeaways

"From this review, it is important that the S&C coach utilises a mixture of jump-based tasks that allow the athlete to experience jumps that produce high levels of force and jumps that also produce high velocity. These naturally lend themselves to different performance variables seen in a game. For example, in players who are slow in acceleration, it may be of particular importance to focus on horizontal-based jumps. These strategies should be periodised and monitored like any other training intervention. However, it has been advised that these strategies are more effective when they form the sole focus of the programme to avoid any interference effect from other training such as aerobic conditioning or sprint training. To further your knowledge, I would highly recommend the attached podcast from JB Morin who is a world-leading expert on sprint performance and force-velocity profiling."

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

Nutrition

This month's top research on nutrition.

ATHLETE FOOD CHOICE DURING INTERNATIONAL COMPETITION: THE IMPORTANCE OF THE COACH/ NUTRITIONIST

Pelly, F.E. et al (2018) Appetite.

CARBOHYDRATE MOUTH RINSE: DOES IT ENHANCE RUNNING PERFORMANCE IN FEMALE ATHLETES?

Chryssathopoulos, C. et al (2018) Journal of Sports Science.

WHICH BEVERAGES ARE BEST FOR FLUID, ENERGY, AND NUTRIENT RECOVERY?

McCartney, D. et al. (2018) Applied Physiology, Nutrition, and Metabolism.

[Abstract]

Athlete food choice during international competition: The importance of the coach/nutritionist

OBJECTIVE
Major sporting competitions such as the Olympic and Commonwealth Games involve athletes living in a village complex for a long period of time. Some athletes are away from home for the first time and may not have previously travelled to another country. These events are hosted in different locations, which, in turn, influences the food environment including beliefs, food availability, and handling practices.

Food provision typically caters for many cultures, religions, ages, and sporting needs, and, therefore, decisions about appropriate food and ultimately dietary intake by an athlete may vary to habitual environment and present many challenges.

Little is known about the influences on athlete's food choice, particularly before and during competition. Therefore, the study aimed to examine the following: 1) the factors that influence food choice of athletes while living in a village at two major international competition events (The Melbourne 2006 and Delhi 2010 Commonwealth Games); and 2) the differences in these factors at each event given the different cultural diversity.

WHAT THEY DID
A previous informed survey was designed and involved 5-point Likert scale with questions of rating food choice included: 1) individual factors of nutrient content, visual appearance, smell, and familiarity; 2) Environmental factor of proximity to entrance; and 3) interpersonal factors, for example, presence of team mates or coach. Athletes who were present in the main dining hall of the athletes' village at the Melbourne (2006) and Delhi (2010) Commonwealth Games were invited to participate in the study. The surveys were distributed at the village dining hall at both events and completed on voluntary basis.

WHAT THEY FOUND
A total of 769 individuals completed the questionnaire with 351 (46%) from Delhi and 418 (54%) from the Melbourne Commonwealth Games. Overall, when making a food choice, athletes rated the following all higher on their scales than sensory factors such as smell and visual appearance:

⇒ nutrient composition of the food
⇒ stage of competition
⇒ time of day
⇒ familiarity of the food

Further, visual appearance, stage of competition, and time of day had significantly greater influence in Delhi than in Melbourne. Interestingly, stage of competition and nutrition composition was rated as very important by the greatest proportion of athletes from weight-making sports (61.9%) and endurance sports (57.9%), respectively. While, there was mixed responses on the influence of the coach, over half of athletes (53.2%) from weight category sports indicated that the coach was an important influence on their food choices.

Practical Takeaways

This study highlights multiple factors (see infographic below) that influence food decisions in athletic populations and the importance of these factors may vary depending on the location of the competition event. For example, while weight-making athletes may be confident with choosing appropriate foods to make weight in their home environment, they appear less confident to make these decisions in a foreign environment with different food options. This explains the finding of the coach being important to athletes from weight-making sports and endurance sports compared to athletes from skill sports. Subsequently, the athlete may trust the coaches' opinion on food choices where there is most risk in terms of eligibility to compete in their event.

Clearly, it remains valuable that the individual athlete or sporting team has a sport nutritionist/dietitian to educate the athletes on travel nutrition, provide an expert review of the menus at major competitions, and collaborate with caterers at the village dining hall for an optimal nutrition support and food provision. A better understanding of the influences on food choices in different sports can assist educational strategies and the provision of a suitable food environment for competition events. A small video around this topic has been made by the Sports Nutrition group from Liverpool John Moores University and can be seen with the attached video link below.

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

James's Comments

"The results of this investigation have a few limitations that should be recognised. Initially, the questionnaire has not been validated to suit an athlete cohort, nor the diversity of cultures represented at major competition events such as Commonwealth Games. Some of these are discussed by Sophie Killer in the podcast below and dining hall issues have been outlined in an attached fact sheet (**HERE**). Secondly, the questionnaire did not include a comprehensive list of factors that could influence food selection, such as athletes attempting to modify body weight and composition (e.g. weight-making sports) and athletes who experience gastrointestinal discomfort (e.g. endurance sports), and, therefore, this cannot be extrapolated to all determinants of food choice.

As proposed by the researchers, future studies could include a more comprehensive list of other factors that have been shown to be relevant to general populations that may play a role in food selection. For example, weight control, mood, general health, and natural foods. It is noteworthy that the participants were a sample of those selected for international squads and, as such, are not necessary representative of the entire athlete cohort for each respective sport. The authors suggested that there is a need for further investigation of the various determinants and motives for food choice of athletes from a range of cultures and sports."

[Abstract]

Carbohydrate mouth rinse: Does it enhance running performance in female athletes?

OBJECTIVE
Many investigators have examined the efficacy of oral carbohydrate (CHO) mouth rinse technique compared to placebo (PLA) on 1-hour endurance performance. Their findings have indicated that such a strategy exerts its effects during high-intensity exercise through a central action mediated by receptors in the mouth or gastrointestinal tract. Therefore, CHO mouth rinse might be an alternative strategy to reduce the incidence of gastrointestinal problems associated with the ingestion of CHO beverages in endurance events lasting less than one hour. However, only 4 studies have used women participants (2-6 participants). Furthermore, most of these studies were conducted under controlled laboratory settings where each participant was tested individually either cycling or on a treadmill ergometer. Interestingly, no study has attempted to examine the effect of CHO vs. PLA on 1-hour running performance in females only.

Therefore, this study wanted to examine the effect of 25ml of either 6.4% carbohydrate (CHO) or a placebo solution (PLA) on 1-hour running performance in recreational female runners during a condition of low ovarian hormones outside the laboratory and under free-running conditions.

WHAT THEY DID
Fifteen female recreational runners on no oral-contraception ran two races of 1-hour duration on an indoor 216m track after an 8-hour fast, with 7-days in-between. In a double-blinded randomised study, participants were given a plastic syringe of 25ml of either 6.4% CHO beverage or placebo solution which they rinsed orally for 5-seconds and expectorated immediately before the race, and again at 15, 30, and 45 minutes during the race.

Blood samples were taken before each race to determine 17β-estradiol (E2) and progesterone (PRG) concentrations. No instructions for high CHO intake the days before each race were given to the participants since this might have masked any possible benefit the CHO mouth rinsing could have on running performance. However, food intake was recorded and replicated for 2 days before the second race. All participants were in the early follicular phase, because this corresponded to the period of the most stable ovarian hormone milieu.

WHAT THEY FOUND
Serum E2 and PGR did not differ between trials. Furthermore, there was no significant difference in distance covered in the 1-hour running performance. Consequently, the present study found that a CHO solution produced no difference in 1-hour track running performance compared with mouth rinsing with a PLA solution in a sample of female recreational runners competing in a low ovarian hormone condition, after an 8-hour fast, and when no fluid was ingested during exercise.

Practical Takeaways

CHO mouth rinsing strategies seem to be a very attractive way to enhance performance of relatively short durations (e.g. up to 1-hour) and has been outlined in an article in the Guardian below and discussed in a Podcast by James Morton from Liverpool John Moore's University (see link below). Given the known impairment in neuromuscular function during morning hours due to the effect of circadian rhythm, the participants in this current study might have responded better to the CHO mouth rinse in morning trials compared to late afternoon trials. The fact that the runners did not race in the morning (race time 18:00), and after an overnight fast could be considered a possible reason for the discrepancy between the finding of the study and previous investigations that employed the overnight approach.

Controlled conditions such as nutritional status and fluid availability may interfere with the practicality of this nutritional approach. Therefore, in reality, an athlete preparing for endurance events should practice this nutrition strategy in training after an appropriate pre-event meal while receiving ad libitum fluids during exercise (as this is likely to be practiced in the real-world) in order to reduce the risks of gastrointestinal discomfort. Specifically, rinsing and expectorating a CHO beverage may be a useful nutritional strategy for individuals undertaking exercise for weight management purposes. Such a strategy would likely result in a lower perception of effort and/or higher exercise intensities without the intake of additional calories (may be appropriate for boxers, lightweight rowers or jockeys), however, performance effects of CHO mouth rinse remain debatable amongst female participants.

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

James's Comments

"Participants in the current study were a mixture of pre-and post-menopausal women and, therefore, it can be speculated whether pre-menopausal women responded differently to CHO mouth rinse than post-menopausal participants. The post-menopausal participants exhibited a very low level of oestrogens (5pg ml -1) compared to pre-menopausal participants (60-80pg ml-1). Due to participants different working hours, pre-menopausal women had to run on their own or in pairs, and therefore, competition mindset, although similar between CHO and PLA, was kept to a minimum for this group of participants. However, this study reflects a true real-world condition in recreational running performance. Indeed, more research is warranted to determine whether CHO mouth rinsing during different menstrual phases exerts an effect on endurance performance.

Finally, the results may have been more beneficial for CHO mouth rinse if the exercise duration exceeded more than 1 hour. Some may suggest that the nutritional intake leading into the study design may have provided enough energy to complete this 1-hour run, irrespective of intervention group. For the full systematic review and infographic please see the attached links to the left."

[Abstract]

Which beverages are best for fluid, energy, and nutrient recovery?

OBJECTIVE
Researchers at Griffith University in Australia collaborated with the sports nutrition department at the Australian Institute of Sport to better understand how the consumption of 4 different food and beverages differ in their effect on fluid, energy, and nutrient recovery in female athletes after exercise.

WHAT THEY DID
8 female cyclists (age: 33.2 ± 7.4 years; VO2max: 46.3 ± 7.5 mL·kg-1·min-1 99; Peak Power Output: 244 ± 32 W; cycling: 115 ± 60 km·week-1) underwent dehydration (>1.8% body mass loss via sweating) as induced by 10 minutes in a 70°C sauna and continuous cycle ergometer exercise. Once dehydration was reached, cyclists were immediately provided with access to one of four beverages: water (WAT), Powerade® (POW), reduced sugar milk (RSM), or a high protein milk (HPM) and told to drink the beverage Ad Libitum (as much as they wanted) over a 4-hour recovery period. They were also supplied with a variety of food for two 15-minute periods during the recovery period (again, Ad Libitum). Participants also recorded any additional food intake for the remainder of the trial day. Each cyclist completed this protocol 4 times on separate occasions (once for each beverage) in this repeated measures design experiment.

WHAT THEY FOUND
The amount of beverage consumed and, consequently, the amount of water consumed (as a constituent of the beverage), did differ between beverages with highest and lowest levels of water consumption for WAT and RSM, respectively. However, the total amount of water retained did not significantly differ between the four beverages. Due to the nature of the beverages, nutritional intake for each beverage condition did differ. For example, in the HPM condition, the total protein consumed was higher than in the WAT condition and, similarly, more carbohydrate was consumed in POW, RSM, and HPM versus WAT. When accounting for the consumption of food as well as beverage, total energy intake tended to be higher in HPM versus WAT and POW. There were no differences in post-trial (24hrs post) intake of energy, water, carbohydrate, fat, and sodium but dietary protein intake tended to be lower in HPM conditions compared to other beverages.

» **Practical** Takeaways

This research has demonstrated how different beverages can have similar water retention, and thus, rehydration properties regardless of the amount of beverage consumed. A practical guide from cycling weekly can be seen below for a quick look snapshot. Therefore, if the goal of an athlete is to simply replace fluid lost in exercise then water can be deemed sufficient. However, this research did not measure electrolyte balance, and this should not be neglected. For this reason, sport drinks such as Powerade might be more beneficial (than water) for electrolyte replacement. The higher intake of carbohydrate in POW, RSM, and HPM compared to WAT has implications for weight management in athletes and rehydration strategies must be included in nutritional plans to ensure that athletes are meeting macronutrient targets.

Another point of interest is the reduced dietary protein intake in the 24hrs following HPM conditions. More specifically, consuming a huge amount of protein in the 4hr recovery period appears to reduce the protein consumption via food in the following 24hrs. Following muscle damaging exercise, this would be debilitative to muscle recovery as protein consumption should be regular throughout the day rather than in one larger "hit".

In conclusion, coaches and athletes should consider what it is they wish to achieve during the immediate recovery period following dehydrating exercise. Furthermore, the subsequent effect of a recovery beverage on dietary intake — both in the recovery period and 24hrs following exercise — must be considered, as a high-protein recovery beverage can decrease voluntary protein intake after exercise.

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

James's Comments

"First of all, it is worth noting that this research was funded by the company that produces the reduced-sugar and high-protein milk. However, the research conducted is of high-quality and published in a reputable journal and the findings do not promote the drinks as superior to water or Powerade. Furthermore, the involvement of the Australian Institute of Sport adds credibility to the research. The experimental design is high in ecological validity as it considers food consumption after exercise as well as the consumption of fluids. As such, this is more realistic than other research investigating rehydration strategies that tend to only allow consumption of the beverage being investigated; limiting any confounding effects of foods. Some applied practical advice can be listened to with the below podcast as well as a simple infographic which can be printed and put up in the athlete's kitchen. The article from which the infographic is based on is also linked for you to read."

Injury Prevention & Rehab

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

PATELLOFEMORAL PAIN IN RUNNERS: WHICH REHAB TOOLS ARE MOST EFFECTIVE?

Esculier J.F. et al., (2018) J Sci Med Sport.

DOES ACL SURGERY INCREASE AN ATHLETE'S ODDS OF OSTEOARTHRITIS?

Cinque M.E. et al (2018) Am J Sports Med.

WHAT IS THE EFFECT OF EXERCISE ON OSTEOARTHRITIS?

Bricca, A. et al. (2018) Br J Sports Med.

[Abstract]

Patellofemoral pain in runners: Which rehab tools are most effective?

OBJECTIVE
The current research suggests that there may be different sub-groups of runners with patellofemoral pain (PFP). The authors of this study performed a randomised control trial prior to this, in which they found that adding exercise or gait retraining to education had no significant additional benefits compared to education alone. Therefore, the objective here was to perform secondary analysis to identify possible predictors of success following rehab programmes that focus on education and management of training loads in runners with PFP.

WHAT THEY DID
Sixty-nine runners were recruited from the running community in Quebec City, Canada. The runners underwent a baseline evaluation that included the following: demographics, symptoms and functional limitations (using the Knee Outcomes Survey - Activities of Daily Living Scale, KOS-ADLS), and maximum isometric strength of knee extensors, hip abductors, external rotators, and extensors. Running kinematics and kinetics were assessed as well, with focus on peak hip adduction and internal rotation (HIR) angles, as well as contralateral pelvic drop. Lastly, radiographs of the patellofemoral joint were taken to screen for osteoarthritis (via the Kellgran & Lawrence scale - see article #1 below) and patellar tendon integrity. Runners were then placed into one of three rehab groups: education-only (Group 1), education + exercise (Group 2), and education + gait retraining (Group 3).

WHAT THEY FOUND
All three groups experienced comparable improvements following each of the rehab programmes. Therefore, all groups were dichotomised together to attempt to find significant predictors of treatment outcomes. Results suggested that 4 potential predictors (with "thresholds" of rehab success established) should be included in the logistic regression model: the KOS-ADLS (indicative of success if <70%), knee extension isometric strength (indicative of success if <70% body weight (BW)), presence of patellar tendinopathy (indicative of success if Grade >0), and VAS for usual pain (indicative of success if >2/10 pain). If all 4 predictors were present at baseline, they predicted treatment outcome with 87.9% accuracy.

Practical Takeaways

The results of this study provide coaches and clinicians with a good idea of initial measurements to take prior to initiating a rehab/training programme, and what to focus on within those programmes. It suggests that we utilise the KOS-ADLS, knee extension isometric strength, presence/diagnosis of patellar tendinopathy, and subjective pain rating (and their respective thresholds) to help predict a patient or athlete's response to rehab/training. It also strongly suggests that proper education regarding load management and acceptable pain levels be the centrefold of the programme.

All of the above lends itself well as a practical tool for coaches and clinicians to confidently put together a plan of care and/or training programme for athletes and patients dealing with PFP. It also provides data for the coach and clinician to confidently explain their treatment or training plan and instill confidence in the individual and credibility for themselves.

Importantly, the authors acknowledge that the baseline measures that demonstrated the strongest ability to predict treatment outcomes could all have been positively impacted by proper education alone (see supporting article #2 below). This is potentially a controversial declaration, though may spur productive conversations and new directions of research in the future.

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

Steph's Comments

"The rehab programmes implemented in this study had a clear focus on patient education regarding load management. In the education-only group, participants were informed that anything up to a 2/10 in pain during running which returns to a pre-running level within 60-min following their run was okay (see infographic link). They were given the autonomy to self-modify training according to symptoms, and instructed to increase the frequency of weekly runs, while decreasing speed and duration of each session, and avoiding downhill and stairs running. This is hugely important, especially for insidious onset or persistent tendon or joint pain in individuals that have little leeway to alter sport or training volumes. This approach removes the fear of loading, places the control in the hands of the patient, and sets them up for long-term successful management of their issue. I think it is no coincidence that in a study that makes education such a strong focal piece, all 3 groups improved equally."

[Abstract]

Does ACL surgery increase an athlete's odds of osteoarthritis?

OBJECTIVE
Osteoarthritis (OA) is extremely prevalent in the US, and an estimated 12% of cases are considered post-traumatic osteoarthritis (PTOA) following ACL tear (see articles 1-3 linked below). This study performed a meta-analysis of high-quality publications to determine the prevalence of OA after ACL repair (ACLR), and to look into the effects of time after surgery, length of pre-operative time from injury to surgery, and age at the time of surgery.

WHAT THEY DID
Authors conducted a literature search of high-quality studies (Level 1-3), determined using the modified Coleman methodology scale (mCMS). First, a meta-analysis was performed in order to estimate the overall rate of PTOA. Then, a meta-regression was done to determine the effects of mean length of follow-up, mean patient age at time of surgery, and mean time from injury to surgery on the log-odds (log of the odds ratio) of PTOA. Thirty-eight studies were selected utilising inclusion and exclusion criteria: 9 level 1, 21 level 2, and 8 level 3 studies (average mCMS score of 65.82).

WHAT THEY FOUND
From the meta-analysis, the overall weighted rate of PTOA was 21.1%, though a significant amount of heterogeneity (i.e. variance) between studies was noted. The meta-regression investigating the linear association between three individual variables and the log-odds of developing PTOA produced the following results: a greater number of years post-operatively was associated with development of PTOA, a greater mean time from injury to surgery was associated with higher likelihood of PTOA, and greater patient age at time of surgery was associated with development of PTOA. Also of note, the likelihood of developing PTOA at 5, 10, and 20 years post-operatively increases from 11.3%, to 20.6%, to 51.6%, respectively.

Practical Takeaways

These results highlight the importance of early injury detection, and an expedited time frame between injury and surgery in order to mitigate the potential progression of PTOA. The authors also mention the fact that meniscal tears and chondral pathology are common in the ACL reconstructed knee in the chronic phase (years' post-op). Not surprisingly, this rate is higher in those who do not opt to have the ACL repaired. As a result, this is something to consider when deciding whether or not to have surgery.

As coaches and clinicians, we need to make sure we are diligent with following up after injuries. We need to properly educate individuals in the process of deciding whether or not to have surgery, as well as on the short- and long-term implications of taking either route. On an even larger scale, it is our duty to push for the continued development of injury prevention/risk reduction programmes and ensuring that they are implemented at a young age in order to (hopefully) decrease the rates of injury in general.

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

Steph's Comments

"This meta-analysis and meta-regression provides a pretty clear and convincing argument for surgical vs. non-surgical management. It does not address the fact that there is a much smaller percentage of this population that may actually be appropriate for non-surgical management and possible return-to-sport ("copers" - someone who is able to return to function without the need for surgery).

Without an ACL and/or with meniscal pathology, it is both intuitive and backed by evidence that the knee joint is inherently less stable and is more prone to joint surface and chondral degeneration - there is no getting around that. However, with the current understanding of pain and how tissue damage does not correlate well with the subjective experience of pain/symptoms, it is important to consider this small percentage of the population that may very well function fine without surgical repair. There is also evidence that suggests that ongoing knee instability following ACL repair may be, in part, due to persistent poor neuromuscular control (see supplemental study links below that explains non-surgical management). Each individual case is unique, though it is important to weigh all options."

[Abstract]

What is the effect of exercise on osteoarthritis?

OBJECTIVE
Knee osteoarthritis (OA) is extremely common and is a major contributor to chronic pain and disability. Therapeutic exercise is often used as the main treatment as it is safe and has been shown to result in decreased pain, increased function, and potentially slow down cartilage degeneration. The purpose of this review was to investigate the impact of knee joint loading exercise on articular cartilage in people either "at risk" or with existing knee OA.

WHAT THEY DID
A database search was conducted, and 9 studies were included in final analysis. The authors developed a customised data extraction form that included information on morphometry (thickness and volume), morphology (defects), and composition (collagen or glycoaminoglycan/GAG content) of articular cartilage.

The effects of knee joint loading were designated as positive (+), negative (-), or no effect (=) depending on whether a significant improvement or decline in one of the outcomes assessed occurred. Negative effects included increased T2 weighted MRI values (indicative of collagen deterioration), decreased hydration, and decreased cartilage thickness, whereas positive effects were decreased T2 weighted MRI values, increased hydration, and increased thickness.

WHAT THEY FOUND
The total number of participants in the 9 studies included was 702, with a mean age of 57.7 years. Due to the variability among studies in the exercise programmes implemented, the authors performed a narrative synthesis of the results vs. a meta-analysis (see the slideshow link below for more information on the narrative synthesis).

Between-group analyses showed mixed results, with a range of mostly (+) and (=) effects, and few (-) effects. Within-group analyses comparing pre- and post-exercise intervention showed increased cartilage volume, improvement in cartilage defects, improvement in GAG composition, and improvement in patellar cartilage. Only one negative finding in a total of 14 within-group comparisons was found.

Practical Takeaways

There appeared to be a point of diminishing returns with knee joint loading, in that once it reached high-impact/jumping activities, it was associated with cartilage deformation and radiograph evidence of OA. However, inadequate or lack of loading was associated with detrimental cartilage changes as well. There seems to be a happy medium on this loading spectrum but, as this review acknowledged, the high degree of variability among the studies' exercise programmes made it difficult to specify which type and amount of exercise loads produced the best outcomes. Despite this, this is encouraging because coaches and physios are in a great position to work on appropriately and progressively loading these patients/athletes in order to reap the benefits of loading without crossing the loading threshold, and potentially contributing to the onset or progression of OA.

The authors also highlighted the finding that GAG and collagen composition that were assessed via MRI were the only two outcomes that showed a response to the exercise intervention. This supports that these measurements are potentially helpful in demonstrating treatment effects in those with early or established OA.

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

Steph's Comments

"These findings clearly support the contention that appropriate exercise loading has a positive effect on the overall health of articular cartilage. Having said this, there was a large amount of heterogeneity in the specific exercise programmes, making it difficult to state the ideal loading dose and type. The authors also mentioned that compliance rates were low among the studies appraised, which could easily have contributed to the difficulty in quantifying the optimal level of loading.

Despite this uncertainty, I found this to be exciting news for the coach or physio, as this is our area of interest and experience. Knowing that perhaps jumping and full sports participation in "at risk" individuals may be exceeding that happy medium, we have many strengthening tools that are both safe and likely beneficial for the cartilage itself. In addition, we can have a significant impact on the compliance piece of the puzzle, as we are experienced with motivating patients and athletes and holding them accountable in their individual exercise or training programmes.

There is absolutely a need for further research that delineates type and dose of exercise and its effects on cartilage, though this is a great start in terms of reassuring patients, athletes, and coaches/clinicians, in general, that exercise is safe and, in fact, an important part of recovery and ongoing joint health."

Infographics

A round-up of our monthly research infographics.

MASSAGE

Solomon, M. (2018) Science for Sport.

FOAM ROLLING

Solomon, M. (2018) Science for Sport.

@ScienceforSport

MASSAGE

SCIENCE for SPORT

Definition

"Mechanical manipulation of body tissues with rhythmical pressure and stroking for the purpose of promoting health and well-being."

Physiological

There is no strong evidence to suggest that massage can significantly influence muscle temperature (deeper than 2.5cm), blood flow, blood lactate removal, or cortisol levels.

Biomechanical

Multiple studies have shown the efficacy of massage in enhancing joint range of movement, however there is a lack of evidence to suggest that massage is an effective tool for reducing passive stiffness.

Neurological

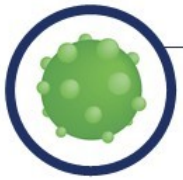
Massage can reduce neuromuscular excitability and pain perception, while increasing levels of serotonin and dopamine. This may provide some mechanistic support for the use of massage in pain reduction.

Why is it important?

Massage is widely used as a post exercise recovery modality, and various mechanisms thought to be responsible for this.

Psychological

Massage has been shown to reduce anxiety in the short term, and enhance the perception of recovery.



Immunological

Given the disparity in the research and the limited number of immune function parameters measured, at this point it is unclear as to whether massage can modulate immune function.

Lack of research

There is a tremendous lack of research into massage within athletic performance.

Our Summary

There are many claims with regards to the application of massage which are not supported by scientific evidence. The current scarcity in research means regulations on claims should be tightened until further knowledge is obtained.

For the full article check out the Science for Sport website

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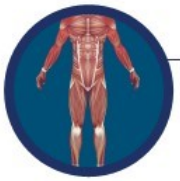
FOAM ROLLING

SCIENCE for SPORT

What is it?

Foam rolling is a simple self-manual therapy technique often used to improve flexibility, recovery, and athletic performance.



Physiology

Research into the physiology underpinning foam rolling is still growing.

Myofascial release

Foam rolling aims to reduce myofascial tightness. It is thought that this tightness reduces range of movement and blood flow.

Mechanoreceptors

Both muscles and fascia contain mechanoreceptors, it is therefore theorised that applying pressure to these tissues could stimulate mechanoreceptors to alter muscle activity via the central nervous system.

Application

3-5 sets of 20-30 second repetitions, 3-5 times per week, performed on a consistent basis.

Effects

Empirical evidence on the effects of foam rolling recently has grown.

Flexibility

Foam rolling can acutely (up to 10 minutes) and chronically improve flexibility

Performance

Foam rolling has no negative impact on performance, and may enhance some physical characteristics, such as speed and power if used as part of a well planned warm up.

Recovery

Foam rolling has been shown to reduce the sensation of delayed onset of muscle soreness (DOMS) after exercise.

Our Summary

Foam rolling is proving to be a beneficial addition to training programmes by providing positive improvements in a variety athletic qualities. More research is required in order to determine how foam rolling truly works.

For the full article check out the Science for Sport website

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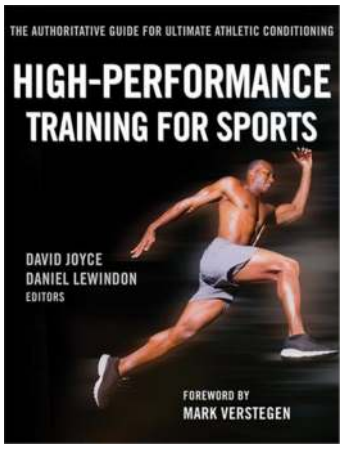

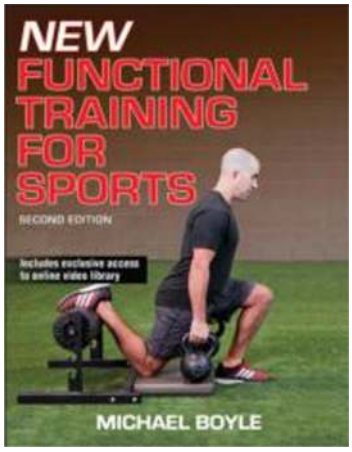

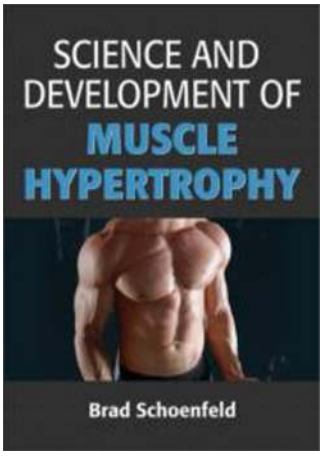

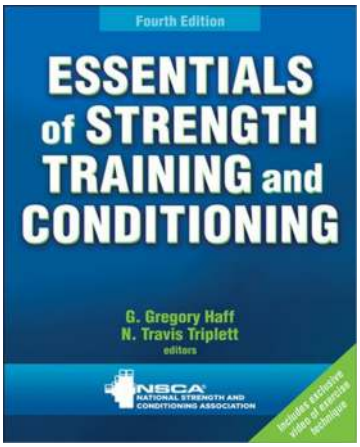

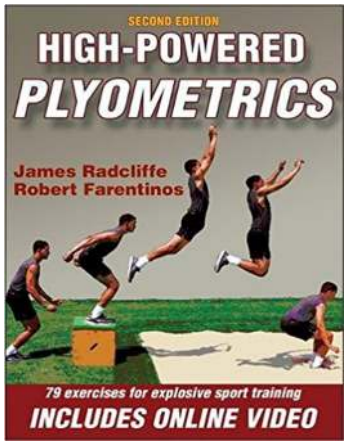

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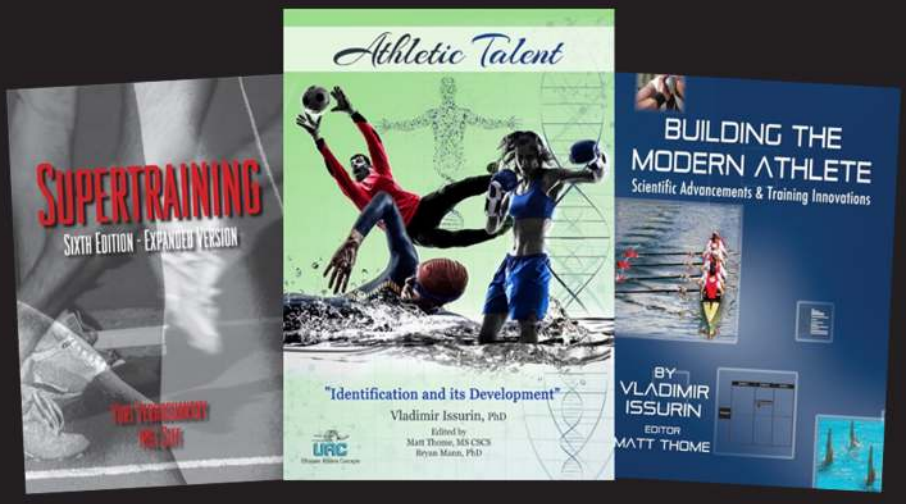

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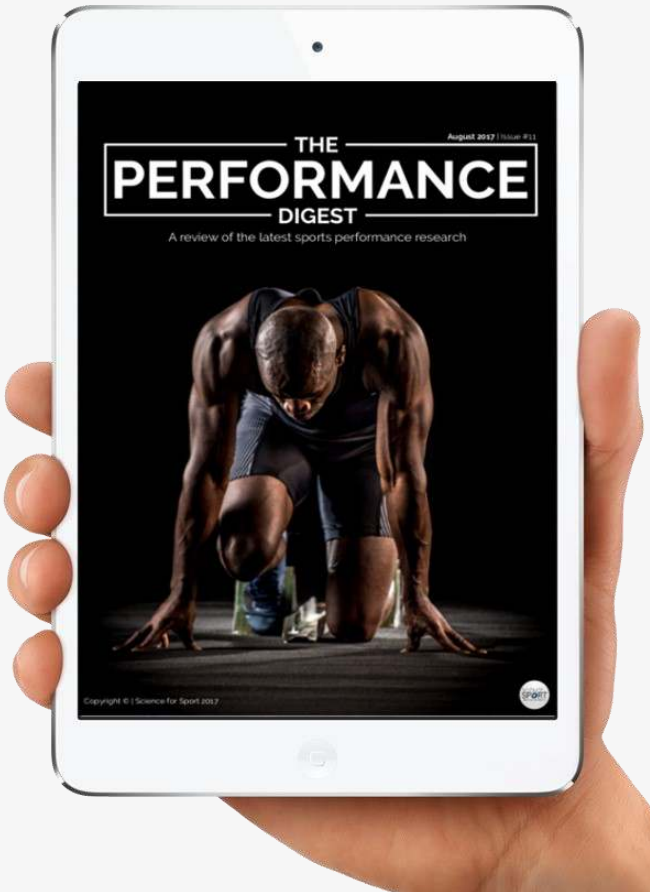

Thanks for Reading!

The next issue will be published on
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Warm Regards
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