June 2018 | Issue #20

THE PERFORMANCE DIGEST

A review of the latest sports performance research

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Welcome to the
PERFORMANCE DIGEST

OWEN WALKER
Founder and Director of
Science for Sport

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

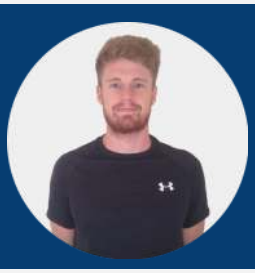
LATEST NEWS

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

1. **Special announcement coming next month!!!**

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

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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Fatigue & Recovery

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

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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.

James de Lacey
MSc

Strength & Conditioning

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

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PhD Candidate

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

Carl Valle
BSc

Technology & Monitoring

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

Dr. Stephanie Allen
PT, DPT, OCS, CFSC

Injury Prevention & Rehab

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

Audio
REVIEW

ACL Injuries

A recap on what we know and hope to find out from future research.
with Dr. Stephanie Allen

WHAT WE DICUSS

In this episode of the Audio Review, Steph and Matt discuss ACL injuries and the rehabilitation process. They also what we would like to see from the research in the near future.

In this episode, they discuss:

- About Dr. Stephanie Allen
- What ACL injuries are
- How they can be reduced but not prevented
- What to do at day 1 of rehab
- What is an appropriate return-to-sport timeline?
- How does waiting 1-month for surgery impact the rehab process?

Episode length = 40-minutes

A bit about **Steph**

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.

Listen Now

The Science of
COACHING

[Abstract]

Coaching youth vs. master athletes

Same coach, different approaches? How the context a coach is working in can influence their behaviour

INTRODUCTION

Research into the different coaching approaches which impact on the learning and development of athletes is becoming much more prevalent. Typically, there are two approaches to this, coaching based on a more 'traditional' perspective (e.g. instructional, technically focused, coach-led) or a more 'contemporary' perspective (e.g. guided discovery, athlete independence). There is some indication though that the type of approach used by the coach depends on the athlete(s) that they are working with. For example, those working with masters athletes may use less instructive behaviour when compared to a coach working with young athletes. This is because the masters' athletes typically have greater experience within a particular sport and, therefore, less time is required instructing the masters athletes on how to play or move. This information is limited though, and it is, therefore, not well understood if coaches do change their behaviours when working with different athletes. As such, this study looked to gain an understanding of the different behaviours for the purpose of learning and development used by a single canoe/kayak coach during training sessions specifically when coaching youth and masters athletes; from the perspective of the athletes.

WHAT THEY FOUND

A number of differences related to the development and learning of athletes appeared between the two groups, particularly regarding the communication between the coach and the athletes, how the athletes age and maturity level impacted the approach to training by the coach, and how the coaches expectations for training influenced athletes perceptions of learning. More specifically though:

⇒ Masters athletes noted a greater emphasis by the coach to be involved in more collaborative interactions (e.g. facilitated conversations with the coach, asked questions about what needed to improve). Youth athletes though suggested that the same coach was very directive and instructive which led to these athletes not asking many questions relating to their performance.

⇒ Youth athletes suggested that the coach provided less opportunity for self-directed learning during training with factors such as attendance and behaviour monitored continuously by the coach. Masters athletes though felt that their maturity levels (compared to the youth athletes) afforded them more self-directed learning opportunities.

⇒ The youth athletes felt that the coach emphasised a competitive training environment to prepare them for future events, mainly with intra-team comparisons. Masters athletes on the other hand highlighted the how the coach encouraged peer support and social interaction during training to emphasise continued learning.

WHAT THIS MEANS

This coach appeared to change their coaching style depending on the ability level of the athletes, particularly in the way they communicated and interacted with their athletes. When coaching the youth athletes, the coach appeared to follow a more 'traditional' coaching approach whereby a more one-way communication style, which was much more authoritative, was followed. This also included a greater reliance on more instructive behaviour limiting the chance for skill retention and transfer. By comparison, the same coach appeared to be more engaging with the maters athletes, specifically being involved in more two-way conversations and provided more opportunity for self-discovery. As the authors suggest, this type of environment may have allowed the masters athletes to become more intrinsically motivated compared to the youth athletes, allowing them to be more appreciative of the learning process.

Practical Takeaways

As athletes from different sports and activities, age groups, and ability levels all learn and develop differently, coaches need to be adaptable. Along with a well-developed training plan, the coach also needs to have a well-developed communication style and the ability to interact with different personalities in a variety of situations.

Regardless of the age or ability, it is ultimately the athletes who take part during match-play, not the coach. In this case, coaches would be best served to allow younger athletes the opportunity to engage in self-discovery and have a greater input into the training session itself, much like the older athletes in the current study. This would not only allow for these younger athletes to further engage with the session and the coach, but also create more decision-making opportunities; a skill vital for long-term athlete development.

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.

BACKWARDS RUNNING: A NEW DIRECTION TO ATHLETIC PERFORMANCE?

Uthoff et al., (2018) Sports Med. 48(5); 1083-1096.

THE EFFECTS OF STRENGTH TRAINING ON MIDDLE- AND LONG-DISTANCE RUNNING PERFORMANCE

Blagrove et al., (2018) Sports Med. 48(5): 1117-1149.

HOW DOES RESISTANCE TRAINING FREQUENCY AFFECT GAINS IN MUSCULAR STRENGTH?

Grgic, J et al., (2018) Sports Med. 48(5): 1207-1220.

[Abstract]

Backwards running: a new direction to athletic performance?

OBJECTIVE
While forward running has received most of the attention, backwards running has been less researched. Backwards running provides the athlete with a strategy to move in a desired direction and maintain a view of the opponent while reducing the strain on the knee joint. Furthermore, elite soccer players spend approximately 3-4% of the match running backwards compared with 0.9-1.4% of the match sprinting forward. Currently, backwards running is a movement used as an injury prevention method and injury rehab technique. Therefore, the purposes of this review were to: 1) explore and compare the acute responses of backwards running (BR) to forwards running (FR); 2) examine the effects of BR training on various aspects of athletic performance; 3) discuss the possible merits of BR as a method to improve athletic performance; and 4) provide future research recommendations into BR.

WHAT THEY DID
The keywords "backward", "retro" "running", and "backpedal" were searched through 7 electronic databases. All human studies conducted on BR that were published in English were included within this review.

WHAT THEY FOUND
Backwards running (BR) places greater energetic and metabolic demands on the body than forward running (FR) at relative and absolute velocities, including oxygen consumption, heart rate, and blood lactate. Research concluded that the greater demands were a result of a 14% increase in average muscle force per unit of ground force, which resulted in 10% more muscle volume being activated. It was suggested the increase in muscle force is due to BR being less reliant on eccentric work and more on concentric work, and therefore, less reliant on the stretch-shortening cycle (SSC).

Ankle ROM is limited during BR compared to FR, with a second plantarflexion during BR compared to a dorsiflexed position during FR. Knee ROM has been reported to be greater during flight and stance phase of FR compared to BR at similar absolute and relative intensities. Greater vertical leg stiffness has also been seen in BR compared to FR, possibly due to the decrease knee ROM. In terms of step kinematics, BR can be characterised by increased contact times and decreased flight times, which manifest as shorter stride lengths and higher stride frequencies across a range of speeds.

BR has been suggested to reduce the mechanical stress on the knee compared to FR, where compressive force is, on average, 24% lower compared to FR at relative and absolute running speeds. In addition, braking forces are shorter in BR compared to FR at constant speeds, while the time to generate propulsive force is longer during BR.

Practical Takeaways

BR may be a method to increase training variability and reduce injury prevalence. Furthermore, a greater energetic demand and lesser compressive forces on the knee can potentially make BR a useful tool to improve energy system development. As mentioned above, the increased energetic demand of BR may come from the fact that it relies heavily on the contractile component, whereas FR is more reliant on the SSC. If increasing the contractile properties of the lower limbs is an objective, then BR may be a method to enhance these qualities. BR may also be an effective method of increasing vertical leg stiffness, due to the knee being less compliant during BR compared to FR. This may translate to greater utilisation of the SSC and reduce deformation of the lower limbs during FR and higher speed tasks. From a performance perspective, exercises such as the start and acceleration phases of a sprint require large isometric and concentric forces, and, as a result, BR may potentially be used to train these phases due to the greater contractile demands on the musculotendinous structures of the legs.

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

James's Comments

"During this current rugby season, I have personally used BR a lot for improving performance and from an injury rehabilitation perspective. Firstly, for performance, the use of multi-directional tempo running is a great way to develop aerobic capabilities in multiple directions of movement (for an example, see the video link below). I have also linked an article below which provides more information on the benefits of BR and how you can organise/implement multi-directional running into your training week. The technical breakdown of BR is also linked in a video below. I've also used BR as a tool to progress into FR for an athlete recovering from a broken foot. Due to the decreased ankle ROM, there is less pain when first starting to run in comparison to FR. In this case, we are able to increase the volume of BR to improve on-feet aerobic conditioning and tolerance to ground impact forces as we progress towards FR. Something as simple as multiple 20 or 30m BR reps is a good place to start when building tolerance back to running load from a foot injury."

[Abstract]

The effects of strength training on middle- and long-distance running performance

OBJECTIVE
VO2max, running economy (RE), and sustainable percentage of VO2max are three main parameters that largely influence endurance performance. Traditionally, chronic periods of running training have been used to enhance RE, however, strength training has also been shown to elicit improvements (see article linked below for more information on RE). In addition, an improvement in force generating capacity would theoretically allow athletes to sustain a lower percentage of maximal strength, thereby reducing anaerobic energy contribution. Hence, the aim of this review was to systematically analyse the use of strength training on distance running parameters.

WHAT THEY DID
Research was included if it met the following inclusion criteria: 1) had participants that were middle- (800-3000m) or long-distance (5000m-ultra distance) runners (triathletes and duathletes were also included), 2) strength training intervention was applied, 3) the intervention lasted 4 weeks or longer, 4) a running-only control group was used, 5) data on one or more physiological parameters, and 6) published in a full peer-reviewed journal. Studies were excluded if: 1) participants were non-runners, 2) running or strength training intervention was poorly controlled or reported, 3) intervention only involved sprint training, 4) participants were reported to be in poor health, and 5) ergogenic aids were used as part of the intervention. 26 studies were included from the initial search of 454.

WHAT THEY FOUND
All but two studies measured at least one strength related parameter. 1RM testing and maximal voluntary contraction (MVC) all improved with the intervention along with jump test performance. Changes in the ability to produce force rapidly showed mixed results, while vertical- or leg-stiffness during running showed improvements at relatively slow speeds and at 3km pace following strength training. Significant improvements (2-8%) in RE were observed for at least one speed in 14 papers, and 4 studies found improvements over multiple speeds. No significant changes were reported in VO2max for any group in most of the studies. Just two papers reported significant improvements in the strength training group. Most studies found no significant change in blood lactate parameters. Performance time-trial improvements were significant for 8 of the 12 studies (middle-distance events = 3-5%; long-distance events up to 10km = 2-4%). Sprint speed showed significant improvements following strength training. No changes were found in anaerobic running performance.

Practical Takeaways

Strength training activities can positively affect performance directly and provide benefits to several physiological parameters that are important to distance running. However, inconsistencies exist that can be attributed to differences in methodology and characteristics of the participants. Therefore, practitioners should be cautious when applying generalised recommendations to their athletes. In general, a strength training intervention lasting 6-20 weeks added to a programme of distance running appears to enhance RE by 2-8%. An improvement of this magnitude should theoretically allow a runner to operate at a lower relative intensity and thus improve training and/or race performance. Improvements were observed in moderately-trained, well-trained, and highly-trained runners, suggesting any training status can benefit from strength training. Different modes of strength training were used (i.e. isometric, plyometric, and explosive resistance training) that all elicited improvements in RE to a similar extent.

While strength training does not appear to positively influence VO2max, it also does not appear to hinder aerobic power. Meaning undertaking strength training during an endurance running programme is potentially a way to improve other markers of performance without negatively effecting the body's ability to uptake, transport, and utilise oxygen.

An increase in lactate threshold allows a greater proportion of aerobic capacity to be accessed. However, strength training appears to have little impact on blood lactate markers. An improvement in RE theoretically should result in an enhancement in speed for a fixed blood lactate concentration, suggesting that RE adaptations can occur independently to changes in metabolic markers of performance. An absence of a change in blood lactate implies that strength training does not alter anaerobic energy contribution during running, and assuming aerobic energy cost is reduced following strength training (positive changes in RE), then it could be inferred that total energy cost is also likely to be reduced.

The time-trial performance improvement can be put down to significant enhancements in one or more determinants of performance. One paper found 10km performance improved due to higher speeds in the last 3km. This suggest that greater levels of muscular strength may result in lower levels of relative force production per stride and thus providing a fatigue-resistant effect.

Want to learn more?
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James's Comments

"The greatest impact strength training has to running performance seems to be the positive changes seen in RE. As taken from the article link below, "Running economy is a measure of how much (or little, as the case may be) oxygen the runner uses for a given, sub-maximal speed. In theory, two runners can have the same maximal capacity for oxygen use (called VO2max), and the one who is more economical at the sub-maximal speeds is likely to be the better runner (i.e. less effort is required for a given sub-maximal pace)."

In addition, strength training does not seem to hinder VO2max, meaning it can be performed alongside a running training programme without any 'interference effect'. Furthermore, it seems that all levels of running athletes can benefit from strength training in order to enhance running performance. Additionally, a wide variety of strength training modalities can be used, so what you enjoy doing the most or what best fits into your schedule may be the best option. From my experience in training endurance athletes, most have minimal experience in strength training, even at a world championship level. This means a lot of positive adaptation can be made through low volumes of work, which is especially important when fitting around a high-volume running schedule."

[Abstract]

How does resistance training frequency affect gains in muscular strength?

OBJECTIVE
Muscular strength can be defined as the capacity to exert force under a particular set of biomechanical conditions. Resistance training frequency pertains to the number of training sessions performed per muscle group in a given period. A common timeframe for classifying resistance training frequency is on a weekly basis. The purpose of this study was to: 1) perform a systematic review of the studies that compare different resistance training frequencies while assessing muscular strength outcomes; 2) quantify the findings with a meta-analysis; and 3) to draw evidence-based conclusions guiding exercise programme design.

WHAT THEY DID
A database search was performed with the study inclusion criteria of: 1) the study was published in English as a full-text manuscript, 2) the study compared the effects of different weekly resistance training frequencies with the programme using traditional dynamic exercises, 3) pre- and post-muscular strength assessments were performed, 4) the intervention lasted a minimum of 4 weeks, and 5) the study was conducted among healthy humans. 22 total studies were included from the 1,835 studies found in the initial search. 912 participants were pooled, with only 3 studies including participants with resistance training experience (pooled n = 56) while the rest included untrained individuals. Interventions ranged from 6-24 weeks with 2-3x a week resistance training sessions being the most frequent.

WHAT THEY FOUND
Effect size gradually increased in magnitude with each additional training day per week, with a significant overall effect of training frequency. However, when volume was equated, there was no significant effect. Multi-joint exercises showed a significant effect of training frequency, with effect size increasing with magnitude with each additional training day per week; meanwhile, while single-joint exercises did not. Upper-body strength showed a significant effect, with effect size increasing in magnitude with each additional training day per week. Meanwhile, lower-body strength effect size gradually increased with each additional day per week, but the effect was not significant. Young adults benefited the most from higher-frequency training, with the effect size significantly increasing gradually with each additional day. On the other hand, middle-aged and older adults showed a non-significant increase. Females responded positively with each additional training day, increasing the overall effect significantly, while males showed a non-significant trend.

Practical Takeaways

The main takeaways from this review is that there is a dose-response relationship between resistance training frequency and muscular strength gains. However, when volume is equated, there is no significant effect. It could be suggested that the increased training volume from the additional sessions per week is the reason for improvement in muscular strength, rather than the session frequency itself. Therefore, from a practical standpoint, increasing training frequency may be used as a means to increase total training volume and, in turn, muscular strength.

Higher training frequencies can also allow for volume to be distributed throughout the week, therefore, keeping performance during each session high. When performing high-frequency training, avoiding muscular failure allows for faster recovery, and therefore, allowing multiple sessions a week. Furthermore, younger adults appear to respond more positively to higher training frequencies compared to middle-aged and older adults, which suggests younger adults can make greater gains in muscular strength with more training days per week. Having said that, the small number of studies conducted on trained individuals limits the ability to generalise this to this population.

Want to learn more?
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James's Comments

"Higher-frequency training has its "pros" and "cons" depending on the athletes you work with, your schedule, time of year, facilities, etc. In the podcast linked below, Prof. Mike McGuigan talks about micro-dosing gym-based power elements and touches on some of the pros and cons of doing so, so be sure to check that out. While strength seems to respond positively to higher-frequency training sessions due to the volume increase, guidelines for hypertrophy from a recent review state major muscle groups should be trained at least twice a week (see article and infographic below). Despite this, higher-frequency resistance training can be difficult in some team- and individual-sport environments where players are also juggling other training demands such as skills, conditioning, etc. Sometimes, giving players a day off from training is better than distributing their resistance training volume onto an 'off-day' to try keep the quality of the session high."

Technology & Monitoring

This month's top research on technology and monitoring.

MONITORING FATIGUE: THE BEST METHODS FOR USING THE COUNTERMOVEMENT JUMP

Kennedy R and Drake D. (2018) Journal of Strength and Conditioning Research.

ACCELEROMETER-BASED PLAYER TRACKING DEVICE: WHAT'S THE RELIABILITY AND VALIDITY?

Nicolella D, Saylor K, and Schelling X et al. (2018) PLOS ONE.

CAN SCREENING PREDICT ATHLETES AT RISK OF OBTAINING GROIN INJURIES?

Mosler A, et al., (2018) The American Journal of Sports Medicine.

[Abstract]

Monitoring fatigue: the best methods for using the countermovement jump

OBJECTIVE
Testing vertical jumps and using force analysis has become more popular with sports teams over the past few years, mainly due to the commercial market improving the user experience with force plates. Currently, coaches need to know how to apply countermovement tests better and be educated on what measures are appropriate to determine true fatigue with athletes. The aim of this study was to determine a better statistical approach to scoring countermovement jump performance with rugby union players.

WHAT THEY DID
The two researchers used a single force plate to summarise leg power with 15 male academy players from a UK club. On average, each athlete was slightly under the age of 20, and were approximately 97 kilos in body mass, with a range of about 10 kilo range heavier and lighter. Each subject jumped 8 times and the researchers used excel to analyse the data, addressing for both coefficient of variation and smallest worthwhile change for the group of athletes. The six metrics analysed were Reactive Strength Index Modified, jump height, peak concentric power, peak velocity, peak concentric force, and the ratio of flight time and contact time.

WHAT THEY FOUND
The study found that increasing the amount of jumps reduced the noise, and peak velocity and jump height were the highest rated metrics with countermovement tests. In addition to the types of metrics, the use of best score and average score was compared, and overall the average of multiple trials was better statistically than a single score approach. The researchers were very firm on suggesting that more testing is recommended and the use of jump height may be more practical because it could be estimated by a contact mat or similar technology.

Practical Takeaways

From a coaching perspective, the necessary amount of jumps needs to be higher if the professional needs confidence that the data is actually representing the trend seen. The study reinforces the need for not only more jumps, but also the research explained what metrics have a stronger signal-to-noise ratio. Due to the convenience of tools that estimate jump height from air time, it makes sense to consider tools and protocols that can collect jump height with enough precision and reliability to flag fatigue. The short rest periods used in the study (1-minute) empowers coaches to test quickly, but teams may need to increase the amount of jumping stations to compensate for the increase of trials (i.e. jumps) from each athlete.

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

Carl's Comments

"Many teams and organisations are investing a lot of money into jump testing, and to create sustainable approaches to monitoring fatigue over a season, the challenge of testing athletes weekly is difficult. My only concern with this paper or any paper that mentions biological variability of jumping is the fact that effort and motivation to jump height wasn't really addressed. In the future, more attention to the motivation to produce a maximal effort needs to be factored in, as athletes tend to lose interest into jump performance over time; especially if they're seeing little to no return on investment (i.e. no programme manipulation based on results/data)."

[Abstract]

Accelerometer-based player tracking device: what's the reliability and validity?

OBJECTIVE
The massive adoption of wearable tracking devices is so prevalent that the scientific community has the burden of continuously vetting out the validity and reliability of the instruments. If a new system is available, coaches need to know if the data integrity is high enough to trust in making pragmatic adjustment to both practice and off-the-field or court training. The goal of this study was to see if the units were accurate and reliable under very controlled laboratory tests, focusing on the accelerometer data of the Catapult OptimEye S5 device.

WHAT THEY DID
To ensure the sensors were tested with extreme accuracy, the researchers forgo field-testing the devices and used a shaker table, or a motorised platform that could oscillate the accelerometers at 20 Hz. 19 units were evaluated in very controlled environmental conditions using a gold standard, and then the data from the systems were analysed using simple statistical analysis such as coefficient of variation and for the PlayerLoad metric one-way ANOVA was used.

WHAT THEY FOUND
The findings of the study were very straightforward; the intra-device reliability of the units was excellent. On the other hand, the inter-device reliability was variable enough to factor in best practice. In addition to the hardware evaluation, the calculation (PlayerLoad metric) was found to be biased based on the hardware outputs. This raises concern that the algorithms used in devices are likely to be blind to the limitations of the hardware when compared in team reporting.

» **Practical** Takeaways

The simple need to periodically check the hardware with novel testing was well documented five years ago in a study by Dr. Buchheit (**HERE**). Outside of the intrinsic challenges of hardware not being calibrated properly, simple challenges like firmware upgrades and improvements on algorithms will render historical data incomparable. With less expensive options in player tracking growing, coaches at lower levels in sport are responsible for team monitoring. The need to know if devices must be assigned to the same athlete is to ensure data is accurate and reliability is not a big concern, as most teams label their devices anyway.

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

Carl's Comments

"The study brought up the most important question in modern sport science, "is the data collected from the device trustworthy, and how much precision and reliability is needed to make rational decisions?"

The study performed by the researchers was a great example how to test team systems in a controlled laboratory environment first, before performing more ecological type testing. In the future, it would be beneficial to perform tests that replicate simple sporting actions such as robotic accelerations or change of direction motions."

[Abstract]

Can screening predict athletes at risk of obtaining groin injuries?

OBJECTIVE
Repeated medical screening provides a possible opportunity to identify at risk athletes to specific injuries based on clinical examination and radiographic evaluation. Several screening systems failed to see association between scores and actual injury, but the risk to groin injuries from intrinsic factors may offer a possible avenue for medical staff to ward off potential injury. A cpmprehensive screening process is an intriguing solution to groin injuries, and the aim of the study was to see if it could be done in professional soccer.

WHAT THEY DID
The researchers examined professional soccer players over two years with structural, range of motion, eccentric strength, and pain provocation tests. During the two-year period, injuries were documented and categorised based on location of the injury (type) and the time-loss from practicing and competition. Using hazard ratios and other statistical analysis to tease out relationships, the researchers made conclusions based on the multivariate data.

WHAT THEY FOUND
Not surprisingly, the researchers found that structure and classic clinical evaluation was not strong enough to identify "at risk" individuals. Radiographic information on the hip morphology, isolated strength tests, and medical hip evaluation was not clearly connected to all injury patterns.

Practical Takeaways

Risk factors from the anatomical structure of pelvis of soccer athletes are not associated with groin injuries later in the season. What this means is that while risk factors exist from the bony structure of the hip, they are not strong enough to statistically increase the rate of injuries. This should provide confidence to athletes who have been labelled as "at risk" because of their shape of their hip joint. In addition to structural factors, range of motion and strength should not be seen as direct risk factors either. When screening at the beginning of the season, teams should take note of the information that screens provide, but those data points alone are not enough to determine the fate of soccer athletes.

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

Carl's Comments

"Coaches who are involved with teams that provide comprehensive screening should not toss out risk factors because they don't predict injuries, but should see those risk factors as weak variables which can contribute to injuries.

What is surprising was the eccentric strength testing wasn't seen as a valid risk factor, indicating that other variables might need to be included in new research; such as foot function, aerobic capacity, and global leg strength."

Fatigue & Recovery

This month's top research on fatigue and recovery.

HOW MUCH SLEEP DO ELITE ATHLETES GET AND IS IT AFFECTED BY TRAINING-LOAD?

Knufinke, M. et al. (2017) Journal of Science and Medicine in Sport.

DOES COLD WATER IMMERSION HARM LONG-TERM ADAPTATIONS?

Broatch JR et al. (2018) Sports Med. 48 (6):1369-1387.

A NEW VALID AND RELIABLE SLEEP BEHAVIOR QUESTIONNAIRE FOR ELITE-LEVEL ATHLETES

Driller, M.W. et al. (2018) Sleep Science, 11(1), 37–44.

[Abstract]

How much sleep do elite athletes get and is it affected by training-load?

OBJECTIVE
Sleep is recognised as one of the key pillars for recovery from training. Although sleep is very important for recovery, elite athletes tend to sleep worse in comparison to their non-training counterparts. Moreover, although deep sleep increases following a day of strenuous exercise, some research suggests that in severe cases sleep can actually be affected (i.e. prolonged periods of very high training loads). This study aimed to answer two questions: 1) How long do elite athletes spend on each sleep stage; and 2) Is the time spent on each sleep stage and total sleep duration affected by daily training loads?

WHAT THEY DID
In order to answer these two questions, 98 well-trained athletes were monitor over a 10-day period. After collecting data over a 10-day period, the last 7 days' worth of data was used for the analysis. Sleep duration was measured using wrist actigraphy, while time spent in each sleep stage was measured using a wireless one-channel EEG sensor. Perceived training load was assessed via an evening training load diary with a single question ("How high was today's training load?") rated from 1 to 10.

WHAT THEY FOUND
The variables of interest are presented as means ± SD in the table below:

Sleep characteristics	Sleep duration (hours:minutes)	7:50 ± 1:08
	Sleep onset latencies (minutes)	13 ± 15
	Wake after sleep onset (minutes)	33 ± 17
	Sleep efficiencies (%)	88 ± 5
Sleep stages	Light sleep (%)	51 ± 9
	Deep sleep (%)	21 ± 8
	REM sleep (%)	27 ± 7
	Perceived training load (AU)	5.40 ± 2.50

No alterations in sleep duration or sleep stage distribution were observed from day-to-day, indicating that training load appears to have no effect on sleep.

Practical Takeaways

As highlighted by the authors, although training duration was high (~8h) and with a good amount of time spent in a deep sleep (~21%), the increased wake after sleep onset (~33 minutes) and the average sleep efficiencies (~88%) indicate that the sleep of these athletes is actually fragmented. As a result, it is highly recommended that sleep strategies and education should be implemented to improve sleep quality in these group of athletes.

The fact that deep sleep was considerably high may, in fact, reinforce the increased recovery demands required within an athletic population. However, the lack of changes in sleep duration and sleep stage distribution to changes in training load may indicate that these athletes were not recovering sufficiently (i.e. an increased sleep duration and deep sleep was expected to occur when training load increases).

As previously mentioned, the increased deep sleep observed in this study demonstrates the necessity for athletes to increase the quality and quantity of their recovery process. Moreover, the fact that sleep was fragmented, reinforces the need for appropriate sleep hygiene education. In previous issues of the Performance Digest, I have attached links to two recovery-based infographics which focus on sleep hygiene. So, if you did not see them, I have attached the links again below and highly recommend you check them out and maybe even share them with your athletes.

The fact that sleep variables did not change in conjunction with acute changes in training loads is a novelty. However, practitioners need to be aware that training intensities were low (i.e. RPE <9 AU). It is likely that if athletes were exposed to higher training intensities, changes in sleep characteristics would be more noticeable. Importantly, acute spikes in training loads (e.g. training camps) will also lead to changes in sleep patterns. As a result, coaches must adapt their training and recovery strategies accordingly when placed in these situations.

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

Francisco's Comments

"I think this is a very interesting study, particularly due to the large sample size (n = 98). On the other hand, the fact that the athletes were from different sports and were exposed to different environmental (e.g. sleep hygiene) and training characteristics (e.g. frequency, load, duration, intensity, etc.) needs to be pointed out as a limitation.

The fact that sleep duration and sleep stage distribution did not change with increases in training loads may be explained by various other factors. For example, as most training sessions finished approximately 3 hours before bed time, this allows for the athlete's core temperature, metabolism, and other physiological variables to return to values close to baseline. Also, the fact that deep sleep was high and unchangeable may indicate that there is a "ceiling", and these athletes already hit that ceiling. Another factor that may have affected the results, is the fact that in such a heterogeneous sample, sleep hygiene related factors (e.g. light exposure, lifestyle practices, etc.) may have affected the daily changes in sleep, and therefore counterbalancing sleep changes related to changes in training load. Lastly, the field measurements of sleep obtained may reduce the sensitivity needed to monitor small but important changes in sleep characteristics. Altogether, these factors suggest that these findings need to be interpreted carefully."

[Abstract]

Does cold water immersion harm long-term adaptations?

OBJECTIVE
While cold-water immersion (CWI) is widely implemented to acutely speed-up recovery (e.g. 24-48 hours after exercise), a growing body of research suggests that it may influence protein synthesis, therefore affecting long-term adaptation to training. As a result, this study reviews how CWI influences responses and adaptations to exercise.

WHAT THEY DID
After briefly reviewing the rationale for the implementation of CWI, the authors looked for the influence of CWI in the adaptive responses to a single exercise session (i.e. the molecular responses and the responses to endurance exercise and resistance exercise). The authors then reviewed how CWI can influence long-term adaptations to endurance and resistance training exercise.

WHAT THEY FOUND
With regards to the use of CWI after endurance training, some of the literature, but not all, has found that markers of mitochondrial biogenesis are increased after a single endurance session. Nevertheless, regular implementation of CWI seems to have no effect on long-term adaptations.

The effects of CWI on the physiological responses and adaptations to resistance training are also not conclusive. Findings from molecular studies suggest that CWI either has no effect, or at least no negative effects, on physiological adaptations from resistance exercise.

Importantly, these findings were obtained from untrained or recreationally-trained athletes. Research investigating the influence of CWI on the same physiological responses and adaptations from both resistance- and endurance-based training in elite-level athletes is scarce.

Practical Takeaways

The findings from this study suggest that CWI provides little to no benefit on long-term adaptations to both endurance- and resistance-based exercise. This is, however, somewhat surprising, as acute increases in mitochondrial biogenesis following endurance training have been observed in literature. As these results seem to be contradictory to current believe, please make sure you read my "editors comments" as well.

When looking at the results from this study, apparently practitioners should reconsider using CWI. However, as previously mentioned, care must be taken when interpreting results from studies investigating non-athletic populations, as athletes training characteristics are likely to be different from those implemented in the generality of the randomised control trials used for this review. This also emphasizes the importance of critiquing the study you have just read and to not simply read the abstract and take the findings as gospel. Furthermore, it is for this reason that the Performance Digest exists - to help you better understand what all of the research is saying and not just one single study.

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

Francisco's Comments

"From an acute standpoint, post-exercise CWI has been repeatedly demonstrated to speed-up recovery, however, less is known about the long-term (i.e. chronic) effects. By investigating the acute responses to CWI, researchers and physiologists are trying to understand the impact of regular CWI. Unfortunately, however, acute changes in one, or some, markers of mitochondrial biogenesis or protein synthesis are far from representing of the entire adaptive phenomenon (i.e. one or two markers don't explain the whole picture). This study aimed to review how CWI affects the adaptive mechanisms following resistance- and endurance-based exercise, and as mentioned by the authors, some of the molecular responses that are described are speculative.

The findings from this study seem to suggest that CWI brings no benefit, or may, in fact, be harmful for adaptations following endurance- and resistance-based exercise. Despite this statement, and as I previously wrote, the amount of literature investigating molecular responses and adaptation to CWI in elite-level athletes is scarce. In fact, to the best of my knowledge, only one study has ever been conducted using professional athletes (see article #1 below).

In that study, the authors found that CWI after exercise actually had a beneficial effect on adaptation from endurance training. As I have also written in a few previous issues of the Performance Digest, the rationale to implement CWI exists when the training frequency and/or training loads are high in such a way that the athletes cannot naturally recovery before the next training session. In the majority of the research studies used in this review, the subjects only trained 2-3 times per week with 48-hours' worth of recovery between training sessions, limiting the necessity for CWI. Therefore, this study reinforces that when an athlete has sufficient time to recover, the implementation of CWI should be reconsidered."

[Abstract]

A new valid and reliable sleep behavior questionnaire for elite-level athletes

OBJECTIVE
Together with nutrition and hydration, sleep is one of the key pillars for recovery and adaptation for athletes. In order to determine sleep behaviors, sport scientists commonly implement sleep questionnaires. Although different questionnaires to monitor sleep have been validated in the literature, these questionnaires may not focus on measures specifically related to athletes. The goal of this study was, therefore, to develop a questionnaire that can be implemented to identify maladaptive practices in elite-level athletes.

WHAT THEY DID
564 male and female participants were surveyed for this study. Of these participants, 242 were athletes and 322 were non-athletes. The participants completed four different sleep questionnaires:

⇒ The athlete sleep behaviour questionnaire (ASBQ)
⇒ The sleep hygiene index (SHI)
⇒ Epworth Sleepiness Scale (ESS)
⇒ The Pittsburgh Sleep Quality Index (PSQI)

The ASBQ was the questionnaire that was designed by the authors. In order to determine test-retest reliability of ASBQ, 50 participants of the athlete cohort completed the questionnaire twice, each separated by 7 days. The same group of 50 athletes wore a wrist activity monitor to evaluate their sleeping patterns (total time in bed, total sleep time, sleep efficiency, and sleep latency).

WHAT THEY FOUND
Athletes and non-athletes had a significantly different global score on the ASBQ, including significant differences in 10 of the 18 items. There were no differences between athletes vs. non-athletes for the SHI and ESS scores. For the PSQI, differences were observed between athletes vs. non-athletes. Moderate to Large correlations were observed between ASBQ and the other 3 previously validated questionnaires. The ASBQ showed a small relationship for total time in bed and sleep efficiency and a moderate relationship for total sleep time and sleep quality. Moreover, the ASBQ presented acceptable levels of test-retest reliability.

Practical Takeaways

The fact that ASBQ presented acceptable levels of reliability, high correlations with previous validated sleep questionnaires, and small to moderate relationships with objective markers of sleep, supports the use of this questionnaire to monitor sleep behaviours in elite-level athletes. Importantly, in contrast to other questionnaires (e.g. SHI and ESS), the ASBQ demonstrated to be sensitive to the training status of the subject (i.e. athletes vs. non-athletes).

As mentioned by the authors, the ASBQ is a fast (<2 mins), easy-to-administer, valid, and reliable tool that can help to identify the maladaptive sleep practices within athletes. The implementation of ASBQ on a regular basis (e.g. every 4-8 weeks) may help practitioners to identify athletes with sleeping disorders and interfere and monitor these athletes over time.

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

Francisco's Comments

"As a practitioner working with a large number of athletes, I believe these types of monitoring tools are very useful. I think this study was well conducted, with the authors investigating the reliability of the purposed tool, comparing it to previous validated questionnaires, and testing its validity against objective markers of sleep. The fact that the ASBQ is able to distinguish between athletes vs. non-athletes really attracts me to this questionnaire as it demonstrates the specificity that practitioners look for.

I can see this questionnaire being implemented during early stages of the season to identify and arrange athletes in different score groups based on sleep behaviours (e.g. low scores, moderate scores, and high scores). This way, a higher level of sleep hygiene education can be provided to those with low to moderate scores. Moreover, the athletes in the lower groups can be surveyed more frequently (e.g. every 4 weeks) in order for practitioners to understand if the interventions are having a beneficial effect or not.

I think it would be very interesting to use the ASBQ before and after a period of intentionally increased training loads (e.g. training camp or pre-season phase aimed to achieved functional over-reaching) in order to see its sensitivity to detect changes in training loads.

Just to conclude, I left a link to a video talking about Z-scores. Z-scores allow for the coach to account for the individual variability and perception. For example, an athlete with low standard deviation on his or her sleep ratings, a change of 1 AU is a greater change in comparison to an athlete with a higher variability on his or her sleep ratings."

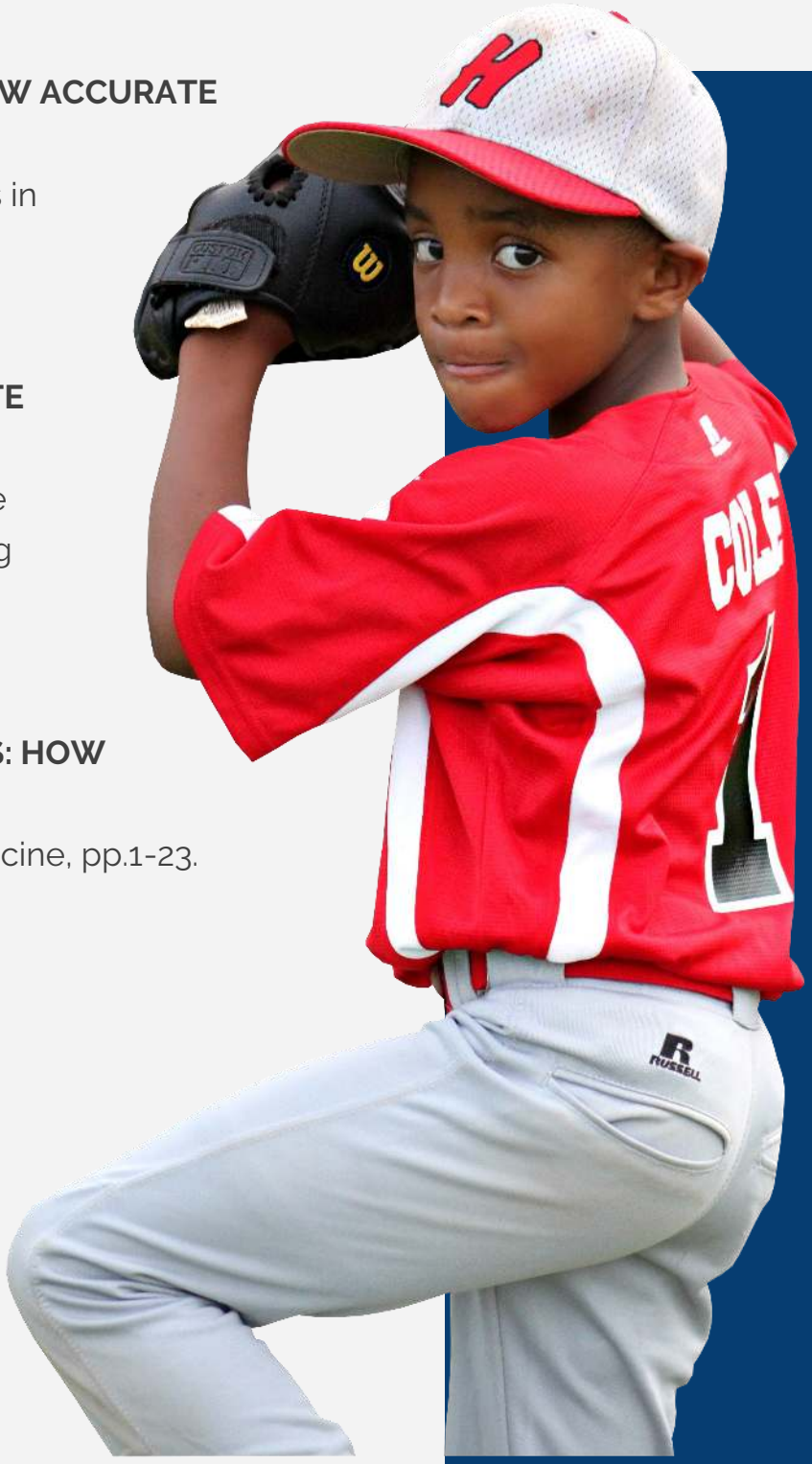
Youth Development

This month's top research on youth development.

TESTING YOUNG ATHLETES: HOW ACCURATE CAN WE BE?
Zemková, E. et al., (2018) Frontiers in Physiology, 9, p.264.

BATTLE-ROPE TRAINING FOR YOUNG ATHLETES: APPROPRIATE AND EFFECTIVE?
Faigenbaum, A.D. et al., (2018) The Journal of Strength & Conditioning Research, 32(5), pp.1197-1206.

BALANCE TRAINING FOR PERFORMANCE IMPROVEMENTS: HOW MUCH AND HOW OFTEN?
Gebel, A. et al., (2018) Sports Medicine, pp.1-23.



[Abstract]

Testing young athletes: how accurate can we be?

OBJECTIVE
Strength and conditioning is a relatively new discipline to sports science, schools, and colleges. To justify our position and worth to the industry, we must have adequate and reliable methods to collect pre- vs. post-intervention data (e.g. performance testing results from before and after a training programme) that can be reported to key partners in order to secure commitment and belief.

Of the qualities that a child should develop, adequate neuromuscular (NM) control is important due to its ability to reduce injuries and because of the high-levels of transfer to sport and everyday tasks. Many tests exist for measuring neuromuscular function, with some demonstrating low reliability or validity in practice. In accordance to this, the authors wish to find the optimal methods for measuring a training response in young athletes and introduce the reader to the Sport Longlife Diagnostic Model (SLDM) which was designed to support athletes past adolescence. The benefits of resistance training for adults has been discussed in detail by Mark Rippetoe (see attached podcast).

WHAT THEY DID
With the aim of answering two primary questions, this study was structured in a literature review format. Literature reviews allow the researchers to understand the current state of the research topic, identify the world-leading experts in the field, and further, identify specific topics that they wish to investigate. The two questions that these researchers wished to answer were: 1) Can existing testing methods effectively measure change in youth athletes; and 2) which could be implemented into the SLDM? The initial search focused on key terms such as 'neuromuscular', 'resistance training', 'strength', 'plyometric training', and 'power training'. The authors then analysed these studies, evaluating their effectiveness in practice, and both their validity and reliability. All studies that could not demonstrate strong scientific rigour were eliminated from the study review list.

WHAT THEY FOUND
This study found that tests performed before, during, and after peak height velocity (PHV) were inadequate to reveal any measurable change. The authors suggested that this may be due to a low testing sensitivity between ages/abilities. In addition, it was proposed that most of the tests used lacked specificity to the demands of the sport, namely soccer and basketball. Finally, few of the studies tested their interventions against other variables (i.e. plyometric training vs. Olympic lifting to improve power), which would deem most of these studies to difficult to quantify in terms of effectiveness.

Practical Takeaways

Sports testing and monitoring are a heavily debated topic, with this study finding that current practitioners are not able to detect measurable change using their selected testing methods. These concerns could be explained by inadequate strength and conditioning support, poor statistical analysis and evaluation, or a fluctuation in data as a result of maturation. To read more regarding the influence of maturation on monitoring, the attached article should guide the reader on 'how' and 'what' to change.

To evolve as a discipline, coaches should obtain variables that are directly linked to particular sports by assessing common movement tasks, understanding the force demands of the sport, or testing the energy system utilisation that can complement training and assists coaches. For example, in a sport such as Basketball, it may be of use to collect reactive strength index data which would educate the coach on an athlete's ability to produce and absorb force in jumping tasks. This, in turn, could influence plyometric jump heights, leading to improved vertical force production which is a required trait of basketball players. However, in a sport such as horse racing, such a test may be seen as a waste of resources (time and money). In light of this, the coach may consider other tests, such as an anthropometric test (i.e. skinfold test) that may prove valuable in a weight-categorised sport and improve the athlete's performance. Inevitably, all of these considerations will be influenced by your budget, resources, and access to equipment, with a special mention to the quality of data-evaluation at the forefront of evaluating and justifying success.

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

Tom's Comments

"Baseline or movement skill testing are a great way for S&C coaches to show their impact, particularly in environments where they are not used to working (Schools and on a one-to-one level with children). However, these can be time-consuming, especially when children are in large groups. I think the long-term sports diagnostic model is a great idea for supporting athletes through and past adolescence. At times, some S&C studies that focus on youth samples are often to idealistic in nature, assuming that after PHV an athlete has a "complete" set of sporting-skills; some examples of this can be seen in the attached video. This model negotiates this, treating greater age brackets with focused training with the aim to support adults in their athletic development."

[Abstract]

Battle-rope training for young athletes: appropriate and effective?

OBJECTIVE
As strength and conditioning (S&C) for young athletes becomes a more welcome and pursued endeavour, researchers must explore the variety of exercise modalities that are available to create a physiological adaptation that the youngsters enjoy. Of these, the coach may wish to use battle-ropes, which unlike skipping ropes, are thicker and heavier. This, therefore, brings about an exciting array of potential adaptations, such as strength, power, and strength-endurance in multiple planes and positions. Some examples of the battle-rope variations can be seen in the attached video.

WHAT THEY DID
Fifteen boys between aged 7.7 and 11.9 years (± SD mean age 10.6 ± 1.4 years, height 142.5 ± 8.4; body mass 37.4 ± 6 8.0 kg) from local sport teams volunteered to take part in this study. Before and after the rope-resistance training intervention, all participants were asked to attend a Maximal Aerobic Capacity Test, comprising of a V02 test (Fitkids treadmill test protocol) and a metabolic system test (Med- Graphics ULTIMA Metabolic System). These were analysed using a Tukey's post-Hoc test to confirm any differences. The battle-rope training protocol consisted of five exercises performed over 2 sets for 30-seconds with a 30-second rest between. The exercises were:

1. Standing side-to-side waves
2. Seated alternating waves
3. Standing alternating waves
4. Jumping jacks
5. Double-arm slams

WHAT THEY FOUND
This study found that a 10-minute battle-rope programme comprising of a 30-second working set with 30-seconds of passive rest can enhance cardiovascular and metabolic adaptations in youth athletes. This study is one of the first to investigate battle-rope training protocols, with other studies focusing on resistance training or aerobic-based sprint training; therefore offering the S&C practitioner with a new avenue for exploration.

After observing the V02 data, Faigenbaum and colleagues reported that movement complexity, intensity, and muscle mass involvement were the main protagonist for oxygen consumption in the battle-rope exercises. The double-arm slam was perceived as the most intense exercise because each repetition required the athlete to slam the ropes against the ground at high velocities and force. From this, it may be suggested that more forceful movements with larger muscle recruitment patterns would be more beneficial when looking to create a cardiometabolic stimulus.

Practical Takeaways

From this study, it could be suggested that battle-rope training is a great way to improve both aerobic and anaerobic properties in young children. More importantly, this training is fun, relatively inexpensive, and easy to set-up in a variety of settings.

Practitioners may wish to think about when to programme certain battle-rope exercises. For example, as mentioned in the "What they found" section, larger muscle groups can pose a stronger cardiometabolic stimulus than less taxing battle-rope exercises (e.g. standing side-to-side waves or seated variations). These may require more rest before competition, or may be programmed in a contrast set/rep configuration to improve stress-tolerance and training quality in short periods of time. Contrast training is the coupling of a heavy-load and lighter ballistic movement to create adaptation. For a more in-depth explanation of this, the attached article should prove useful.

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

Tom's Comments

"This study makes several attempts to discuss the benefits of S&C in schools, with particular reference to the inclusion of battle-rope resistance training in sessions. Whilst there is no doubt that such an initiative would prove useful for school-aged children, it is important that the programme is ran by a qualified practitioner who understands load, volume, variety, and rest intervals to reach the desired performance outcome. Having said that, this is a very positive step for youth-based S&C.

In my training, I would much rather do conditioning sessions that focussed on some form of aggressive cardio, which developed other facets of performance at the same time. For example, during the double-arm slams, there are many additional benefits to the athlete than just cardiometabolic adaptations; such as anti-rotation, bracing, repeated shoulder/arm muscle activation, co-contractions, and glute/quad work to name just a few. In addition, the attached podcast offers some useful ideas for improving V02 during everyday activities, which may be ideal to combine with fast, intense sessions."

[Abstract]

Balance training for performance improvements: how much and how often?

OBJECTIVE
Balance is key to all functional movements, where posture, joint stability, neuromuscular efficiency, and symmetry are all supported by an athlete's ability to sustain the balance of these systems. In young and old adults, the benefits of balance in sport and everyday life are well understood. With regards to young athletes, however, there are few systematic studies that exist to report the dose-response and training requirements when looking to develop balance. This study aims to support current coaches in delivering balance training that is effective and developmental.

WHAT THEY DID
The authors of this study conducted a thorough literature search, focussing on studies that investigated balance, neuromuscular training, proprioception, and both static and dynamic balance in a youth sample. All studies were carefully selected, consisting of children with a mean age of 6-19 years old. Other factors such as gender, training age, and training setting were also considered. The literature searches identified 198 potentially relevant studies and were coded according to various physical and physiological measures.

WHAT THEY FOUND
This study found that balance training, irrespective of age, gender, and training method was an effective method when looking to improve both static and dynamic balance. With respect to training duration, this study found that 12-weeks of training provided the largest effect size for improvements. In terms of frequency, two sessions a week lasting roughly 4-15 minutes were beneficial, with the largest effects experienced in adolescents. Furthermore, additional findings of this study suggested that balance training sessions that are tailored to the individual age brackets (6-7, 11-12, and 14-15) were much more effective than those that did not consider chronological age and ability. Lastly, all forms of balance training proved effective.

Practical Takeaways

Balance training may prove to be an "easy win" for practitioners as it can be incorporated into resistance sessions, warm-ups, or even rest periods. Furthermore, with a small amount of time (twice a week for 4-15 minutes), coaches should consider how improved balance may contribute to other athletic qualities such as posture, strength production, and improved speed. A thorough breakdown of the monitoring strategies, programming, and set/rep schemes can be seen in the attached article, making this easy to implement almost instantly. I would also like to remind you of the need to make balance training appropriate for the athlete's age, which is why a fun game has been attached in the video for younger children. I would recommend you take a look through the channel as many developmental and enjoyable games have been included.

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

Tom's Comments

"Both static and dynamic balance can be developed differently, whereby the coach may wish to use different exercises, cues, or constraints to train an athlete more specifically for their sport. For example, a sprinter could be considered as 'balanced' during foot placement in the swing-phase using a fast ground-contact time to move forward. However, in the absence of balance, the hips and upper-body may rotate, limiting forward momentum. Other sports, such as rugby, may require dynamic balance for longer ground-contact times, therefore requiring a different training approach to target the specific movement demands. In a rugby player, the athlete may have to overcome excessive lateral forces to remain upright during a step. Sport-specific factors such as these should be considered and have been discussed in more detail by Mike Robertson (attached audio) in his work in professional soccer."

Nutrition

This month's top research on nutrition.

HOW MUCH DO ATHLETES KNOW ABOUT THE WADA PROHIBITED SUBSTANCES LIST?

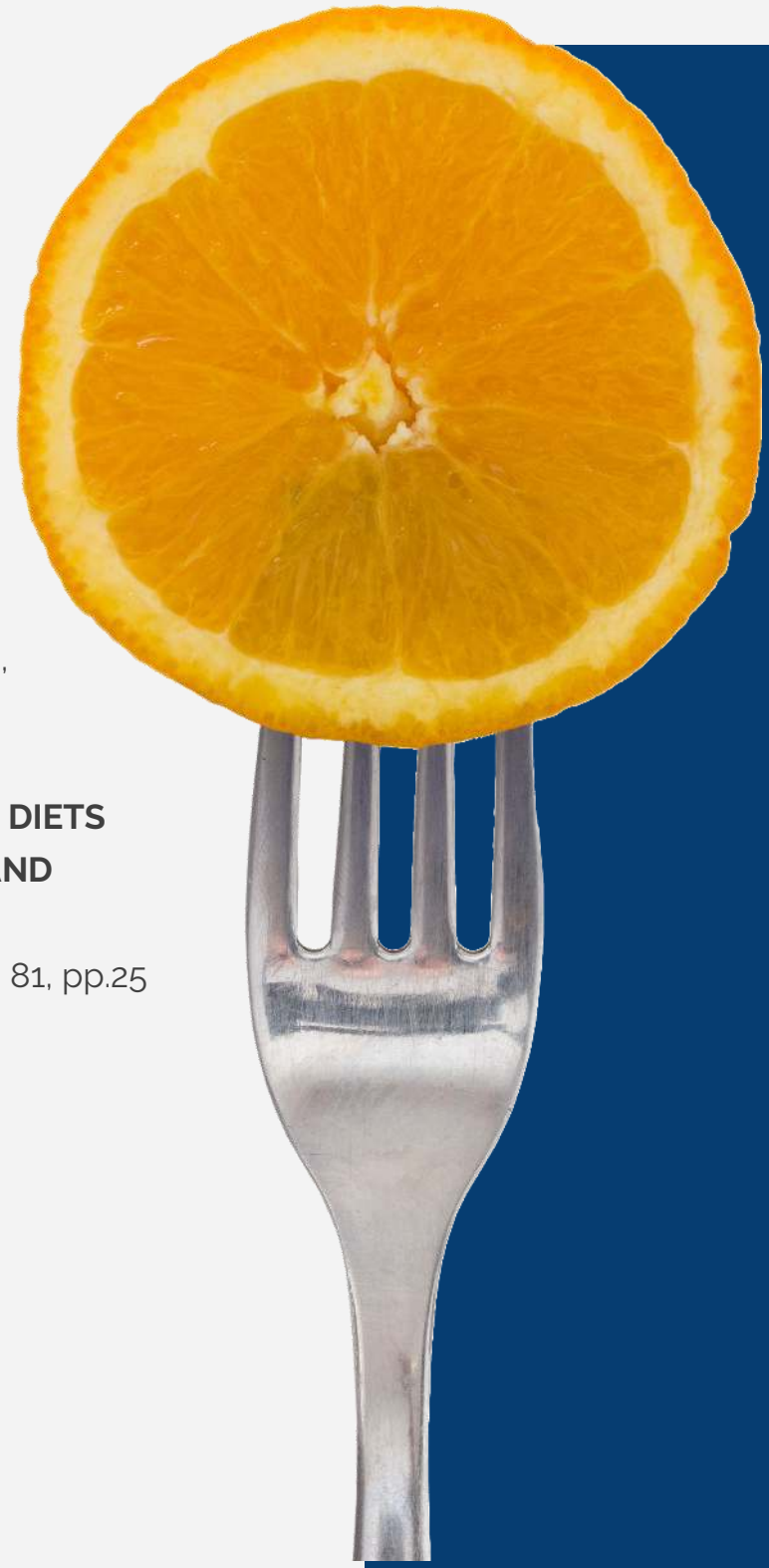
Orr, R. et al., (2018) International Journal of Drug Policy, 56.

DO PRE-WORKOUT SUPPLEMENTS AFFECT RESTING VASCULAR FUNCTION?

Robinson, A.T. et al., (2018) International Journal of Sport Nutrition and Exercise Metabolism, 0 (0), pp. 1-27.

DOES KETO-ADAPTATION FROM LCHF DIETS ENHANCE EXERCISE PERFORMANCE AND BODY COMPOSITION?

McSwiney, F.T. et al., (2018) Metabolism, 81, pp.25 -34.



[Abstract]

How much do athletes know about the WADA prohibited substances list?

OBJECTIVE
Despite implementation of the World Anti-Doping Agency (WADA) code in 1999 and national anti-doping agencies to regulate doping control and education programmes, some athletes continue to engage in doping behaviours. Unintentional/accidental violations with over-the-counter (OTC) medications, including nutritional supplements, have caused concern given they are easily accessible. Such violations may be due to a lack of knowledge of current drug education programmes. It is unclear how many cases occur with adequate knowledge and how many cases are unintentional as new substances have been added to the WADA Prohibited Substances List and established substances have changed status. Previous studies have been limited to small sample sizes and the use of inappropriate instruments. Therefore, the aims of this study were to identify athletes' knowledge on a range of prohibited, recreational, nutritional, and therapeutic substances with respect to the WADA prohibited substances list and the effects of four well-known performance enhancing substances in Australian athletes.

WHAT THEY DID
In a cross-sectional, single time-point study, a self-report validated questionnaire was used to examine athletes' knowledge on the status of 30 substances/methods and the effects of amphetamines, anabolic steroids, growth hormone, and erythropoietin. Following pilot testing of the questionnaire (test-retest reliability), a sample of 1925 participants (775 females, and 1148 males) completed the survey from National and State/Territory sport governing bodies, institutes, academies of sport, universities, talent/development squads, and sports high schools in Australia between 2009-2010.

WHAT THEY FOUND
Athletes showed limited knowledge of the WADA Prohibited Substances List scoring just 32.2% correct, despite athletes believing they were moderately well-informed about the current banned substances. Indeed, 31.4% indicated that they did not know the status of these 30 different substances provided in the questionnaire. Knowledge of the therapeutic medications on the WADA List ranged from 6% to 40%. Age, gender, ethnicity, and competition level were significant predictors of the number of correct responses. Subsequently, the 19-22 years old males at professional and international levels were more likely to provide correct responses.

Practical Takeaways

These findings are most relevant to sports organisations, coaches, health professionals, and sports nutritionists in order to establish specific, relevant educational curricular based on the athletes current understanding of the WADA codes. The study highlights that while substances are added to WADA Prohibited List and status of established substances are changed, ongoing communication to athletes appears to be ineffective and outdated. Positive tests to doping may result from poor knowledge and unawareness of recent changes, and therefore re-evaluation of anti-doping education programmes across various sporting bodies, delivery of anti-doping information and appraisal of knowledge retention may be beneficial to ensure a clean sport without confusion. With limited understanding of therapeutic knowledge, it is possible that less emphasis is placed on therapeutic substances in drug education and therefore may be the cause of reduced awareness of these medications unless they have been prescribed, possibly leaving the responsibility to coaches and health professionals to advise them.

In particular, younger and non-professional athletic populations should receive an ongoing education programme of current prohibited substances in relation to the WADA List, including the importance of sport supplements registration with Third Party accredited supplement testing parties for avoidance of potential contamination (i.e. batch-tested supplements). This will allow them to make informed decisions and avoid the problem of accidental violations.

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

James's Comments

"Rhonda and colleagues have assessed the athletes' knowledge on an extensive range of banned substances, whether that be in competition only, or at all times, as well as the understanding of the effects of common performance enhancing substances. Certainly, they show there is still a lack of knowledge that should be educated using appropriate programmes. As a result, up-to-date information and prevention are necessary and should be provided to athletes and associated athlete support personal. This will maintain correct attitudes towards unintentional doping.

Despite this, this study has identified gaps in the current drug education system and should therefore inform the design and delivery of future programmes; however, the methods used should be interpreted with caution due to expected limitations of self-reporting information.

It is also worth considering that the answers may be intentionally false as the respondents may not wish to reveal the use of drugs, even if anonymity and confidentially are guaranteed by investigators. This also suggests the need for an improved research study design which uses interviews and questionnaires in order to combine both qualitative and quantitative measurements. Finally, it is important to understand that one of the core principles of the WADA Code is 'strict liability', meaning that when it comes down to it, athletes are responsible for what they put into their body, whilst we, as practitioners, are simply here to assist and educate them with these decisions.

Moral of the story? If you work with athletes who are subject to testing, you should be doing all you can to ensure their knowledge is up to scratch."

[Abstract]

Do pre-workout supplements affect resting vascular function?

OBJECTIVE
The use of dietary sport supplements to enhance performance and body composition has recently been popular among active individuals, especially pre-workout supplements. Pre-workout supplements have gained attention with a purpose of augmenting physiological improvements associated with resistance training, for example, increasing lean muscle mass, while maintaining or improving perceived energy, concentration, strength, and power. However, some of the effects of these supplements on the cardiovascular function remains understudied. With regards to pre-workout supplementation, the authors suggest there is a critical need to determine the effects on vascular function following acute resistance exercise given that events of temporary reduced flow-mediated dilation in the post-exercise period has previously been reported.

Therefore, the purpose of this study was to assess the effects of a multi-ingredient dietary pre-workout supplement on cardiovascular function at rest, and immediately following an acute leg press resistance exercise in healthy recreational active individuals.

WHAT THEY DID
12 participants (9 males, 3 females) volunteered to a double-blind, randomised, cross-over study design. Following familiarisation, participants were randomly placed to either a placebo (PLA) or pre-workout supplement (SUP) group. Participants were instructed to consume one serving of the supplement (Iron Pump, Arnold Schwarzenegger series MusclePharm Corp) or the PLA every day at preferred time for one week preceding the experimental tests. There was a two-week washout period for men and one-month for the women. Females were tested within the first days of the follicular phase of their menstrual cycle (self-reported information). In the tests, participants completed measures of vascular function. This involved peripheral measures of blood pressure and branchial artery flow mediated dilation followed by measures of arterial stiffness via pulse wave analysis and pulse wave velocity. These measurements were taken at both rest, and immediately following eight sets of 10 repetitions at ~80% 1RM of bilateral leg press with two-minute rest in between the sets.

WHAT THEY FOUND
Findings showed no significant differences in resting and post-exercise blood pressure, and in brachial artery flow mediated dilation and arterial stiffness between PLA and SUP. This study, therefore, concluded that one week of multi-ingredient pre-workout supplement did not adversely affect cardiovascular responses at rest or to an acute bout of resistance exercise in young, healthy recreational individuals.

Practical Takeaways

It is well-known that sport supplements are prevalent in the athletic populations in order to peak performance. Whilst pre-workout supplements are common in recreationally active individuals (i.e. engage in exercise multiple times per week), this supplement may not be appropriate to professional athletes. Given that Iron Pump, Arnold Schwarzenegger series MusclePharm Corp suggests many benefits to users, there may also be a risk of harm for the athlete if an anti-doping rule violation surfaces. This is likely to occur if supplements contain traces of banned substances due to contamination, and therefore, it is extremely important that athletes only use supplements that are trusted by registered testing facilities to avoid an anti-doping violation (i.e. batch-tested supplements).

Athlete support personnel and SENr nutritionists should be consulted before professional athletes implement such a supplement into their regime. It is also important that the practitioner encourages a "food first" policy at all times, with multi-ingredient pre-workout supplement with additional micronutrients (e.g. caffeine and nitrates) only utilised if completely necessary to support the athlete during intense training regimens. This multi-ingredient pre-workout appears to have no negative impact on cardiovascular function at rest or post-exercise in recreational athletes, however, it is advised that the professional athlete should use other types of provision of energy (e.g. a strong coffee, if needed). Inadvertent consumption of prohibited substances under the anti-doping codes that govern elite sport is a known risk of taking supplements (see attached video).

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

James's Comments

"The study has provided preliminary evidence that acute consumption (one week) of a multi-ingredient pre-workout does not alter vascular function at resting or post-acute resistance exercise; however, this study is not without its limitations. First, the results cannot be generalised to all multi-ingredient dietary pre-workout supplements on the market due to different content and dosages. Second, a small sample size (3 females and 9 males) was used despite power calculations being made, thus the study was limited to explore potential gender differences.

It is crucial for the professional athlete to be aware that this supplement is not registered with Informed Sport, and therefore, before any consumption of such supplement an expert professional, sport nutritionist, or anti-doping professional must be asked. It is important to highlight that responses may vary a lot between individuals because of different factors, including habitual diets and genetics. Other considerations include age, maturity, and experience of the athlete before considering nutritional aids for performance enhancement."

[Abstract]

Does Keto-adaptation from LCHF diets enhance exercise performance and body composition?

OBJECTIVE
Traditional sports nutritional guidelines recommend consumption of high-carbohydrate diets for endurance performance. In recent years, however, more athletes have adopted a low-carbohydrate, high-fat (LCHF) diet approach in an attempt to increase the oxidation of endogenous fat stores, and therefore, lessen their body's dependency on glucose. Previous research has focused on short- (7-14 days) to medium-term adaptation periods (14-35 days) in athletes, but has failed to test the long-term keto-adaptation and exercise performance; possibly due to the difficulties of a long-term dietary intervention. Previous research has shown that when well-formulated ketogenic diets are implemented for a minimum of four weeks, increased fat oxidation is observed with no negative impact on aerobic capacity; however, what happens beyond 4 weeks of keto-adaptation remains unclear. The aim of the current study was to therefore investigate the long-term (12-week) performance implications of consuming a LCHF diet on endurance performance and body composition in trained male athletes.

WHAT THEY DID
In a non-randomised controlled study design, twenty endurance-trained athletes met the inclusion criteria to be included in this study (e.g. habitually consumed a carbohydrate-based diet [> 50% Kcal] and completed the study). Participants self-selected into a high-carbohydrate (HC) diet % carbohydrate: protein: fat (65:14:20) or a low-carbohydrate (LCHF) diet (6:17:77). Following baseline testing, both groups started a 12-week dietary and training intervention (endurance, strength, and High-Intensity Interval Training [HIIT]). Participants returned at the end of week 12 and repeated the testing protocol.

Endurance athletes in this investigation were defined as an athlete who competed in endurance events, completed >7 hrs per week of training, and who had more than 2-years of training experience. Both groups performed the same training intervention (endurance, strength, and HIIT) to encourage mitochondrial biogenesis. Participants received nutritional counselling pre-intervention and continuous weekly support to ensure dietary adherence. Beta -hydroxybutyrate concentrations were determined at baseline and after exercise. During the post-exercise period, the HC group consumed 30-60g.hr-1 whereas the LCHF group consumed water and electrolytes. Body composition, a 100-km time-trial, 6-second sprint, and a critical power test were assessed prior and following the 12-week intervention.

WHAT THEY FOUND
The LCHF group experienced a significantly greater decrease in body mass, with a loss of 5.9kg compared to 0.8kg in the HC group supported by body fat percentage changes of -5.2% loss compared to 0.7% loss, respectively. Serum beta-hydroxybutyrate significantly increased from 0.1 at baseline to 0.5 mmol.L in the LCHF group in week 12. However, no significant difference between the groups in the time-trials, lactate, or VO2max was observed. There was a significant difference in the sprint peak power between groups with significant increase in the LCHF group, but no changes to the average power to participants.

Practical Takeaways

This study examined the effects of consuming a 12-week low-carbohydrate, high-fat (LCHF) diet versus a high-carbohydrate (HC) diet combined with a training intervention on exercise performance and body composition. Interestingly, the authors wanted to investigate whether a habitual HC user could improve/maintain endurance performance when keto-adapted (i.e. LCHF).

The findings suggest endurance performance can be maintained, and in some cases improved, when compared to a HC diet. This was particularly seen in the time-trials of 3 participants in this study from the LCHF group. Indeed, the researchers showed that a 12-week keto-adaptation is associated with greater improvements in body composition, fat oxidation, and peak power in endurance performance, but not time-trials nor average power output. However, the LCHF participants did report a fall in energy levels, in addition to an increase in fatigue and tiredness during initial adaptation period. Furthermore, 5 LCHF participants dropped out due to the difficulties with a restricted carbohydrate diet and perceived effort, suggesting that this type of diet may not be for every athlete.

Given the observed decrease in body weight and body fat percentage while maintaining lean muscle mass, it is possible that a LCHF diet may be a useful tool for achieving weight loss in athletes who struggle to maintain competitive race weight or athletes required to make competitive weight; such as horseracing, rowing, bodybuilding, and combat sport athletes. However, such implementation or avoidance of this dietary protocol should be based on an individuals own dietary preference. Although this keto-adapted diet has potential broad applications, athlete compliance is typically low due to the restrictive nature of the diet.

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

James's Comments

"Despite this study showing a significant improvement in body composition and fat oxidation during exercise and specific measures of performance variables, the short- and long-term benefits of LCHF diets on performance remain debatable in competitive athletes among worldwide researchers. These findings suggest that in certain events like long-distance running, where some athletes may find it difficult to ingest carbohydrates during performance, being fat-adapted may prove to be beneficial.

Although the training programmes in this study were designed to promote mitochondrial biogenesis, there was no measures of mitochondrial adaptations or muscle glycogen presented. This is particularly important given the fact that long-term keto-adaptation may result in an increased lipid metabolism, and as such, it may potentially explain the performance effects seen from these participants.

Furthermore, it should be considered that the nutritional intakes and training between the two testing time-points were not controlled, but rather instructed and monitored. The understanding of LCHF diets are still very much in the early stages, however, keto-adaptation may be one approach worth considering in specific scenarios."

Injury Prevention & Rehab

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

RETURN TO THROWING AFTER A SHOULDER OR ELBOW INJURY

Sgroi TA, and Zajac JM. (2018) Curr Rev Musculoskelet Med. 11(1):12-18.

INJURY RISK AFTER CONCUSSION: WHAT'S THE RISK AND HOW DO WE REDUCE IT?

Howell D.R. et al., (2018) Sports Med. 48 (5):1097-1115.

CORE STABILITY PROGRAMMES: CAN THEY IMPROVE CUTTING MANEUVERS AND REDUCE INJURY RISK?

Whyte E.F. et al., (2018) Scand J Med Sci Sports. 28(2):452-462.

[Abstract]

Return to throwing after a shoulder or elbow injury

OBJECTIVE
Research demonstrates high return-to-sport rates in baseball following elbow and shoulder injuries, but a much lower percentage of return to pre-injury performance levels. Therefore, something may be missing in the return-to-sport rehab in this population.

Throwing requires significant force and dynamic interplay across multiple joints, it is not solely an upper-extremity (UE) task, but rather a whole-body, coordinated movement. The purpose of this review was to establish a criterion-based rehab progression that assists elite baseball players in returning to pre-injury level of play.

WHAT THEY DID
The authors performed an organised literature search including, but not limited to, keywords of "return-to-throw," "return-to-play," and "plyometrics." After a detailed review, they created and proposed a return-to-play (RTP) algorithm for elite baseball players. Prior to initiating the interval throwing programme, the authors advocate for restoring normal ROM and strength, then focusing on monitoring scapular mechanics during the strength phase progressions and initiation of plyometrics.

WHAT THEY FOUND
First normalising ROM and strength, and then properly training the 3 phases of plyometrics (eccentric, amortization, and concentric) sets the athlete up for success in generating the speed required for throwing and pitching without exceeding tissue tolerance (see attached article #1 for more info on this topic).

The throwing programme should be be centered around individualised baseline workloads and should utilise a simple acute:chronic (ACWR) workload ratio to ultimately lower re-injury risk. An acute workload typically refers to a 7-day work period, and chronic refers to a 28-day period. It is important that the acute workload does not far exceed the chronic workload (weekly training spikes) during training. For more on this, read the Science for Sport article on ACWR (see article #2 attached below). The other important aspect is the distance the athletes are throwing. As longer distance throws result in greater shoulder and elbow torques, they should be delayed in the throwing progression process.

Practical Takeaways

This review is helpful to both physical therapists and S&C coaches in their planning for safe return-to-sport with elite-level athletes. It provides an example of specific progressions in the Appendix, but also provides "things to consider" in individualising each athlete's RTP journey. For example, utilising the ACWR throughout the interval throwing programme is an easy and objective way to keep track of tissue loading and ensure that you are minimising the athlete's risk of over-training and re-injury.

Of great value, particularly for those clinicians and coaches who may not be as familiar with throwing mechanics, is the mention of "flaws" that can contribute to increased stress on the arm. These include: open foot position, too little or too much shoulder external rotation, poor hip and shoulder dissociation and timing, and shoulder abduction angle far greater or less than 90 degrees.

Most importantly, however, this review acknowledges that the strengthening phase of rehab and the RTP progression is the foundation upon which to build up tolerance for plyometrics and eventual return to throwing. This means that S&C coaches are an integral part of the process, and the authors offer further guidance by mentioning what the force-velocity curve is, and what ranges to keep the athlete in during different phases of rehab.

Weaknesses of this study were that it was not a systematic review or meta -analysis, there was no randomisation or specific inclusion and exclusion criteria, and it pertains only to elite-level throwing athletes.

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

Steph's Comments

"This review provided actionable takeaways - via an algorithm - for coaches and clinicians working with elite-level throwing athletes. Namely, the ACWR, the guidelines of where to keep athletes on the force-velocity curve, and how training the different phases of plyometrics individually can help safely and effectively prepare them for full capacity plyometrics and the throwing programme.

There were two concepts they mentioned that I would respectfully challenge and that require clarification. First, the authors mention that ROM needs to be normalised. In many cases, "normal" ROM for overhead athletes is not the same as it is in the general population. Instead, it may be more important for the athlete to have a total arc of motion near 180 degrees.

Secondly, the authors stress normalising scapular position and assessing it during a "slow, simulated" overhead throw by the athlete. Past research and experience suggest that overhead athletes tend to have some level of dyskinesis. Although we want to ensure it is not to the point of instability, we may or may not need to "correct" it if it is not contributing to symptoms."

[Abstract]

Injury risk after concussion: what's the risk and how do we reduce it?

OBJECTIVE
Problems with attention, dual-task completion, and neuromuscular control have all been associated with an increased risk of injury, independent of a history of concussion. Adding to this, computerised tests have revealed that concussion negatively affects dual-task and attentional distribution abilities, which are both important in unpredictable game situations. The objectives of this review were to investigate musculoskeletal injury risk following concussion, the ongoing neuromuscular control and attentional deficits, and the possible associations between concussion and these deficits.

WHAT THEY DID
Authors conducted two separate literature reviews using PubMed, Web of Science, and Academic Search Premier. The two search topics were (1) musculoskeletal injury risk and concussion, and (2) dual-task gait deficits after concussion. Each topic had specific inclusion and exclusion criteria, and ultimately 22 total articles were reviewed. They described findings on the relationship between musculoskeletal injury and concussion in 3 sub-groups (collegiate, professional, and recreational athletes), and on the relationship between concussion and dual-task neuromuscular control deficits in 4 sub-groups (return to play and dual-tasks gait deficits, cognitive task completion during gait, post-concussion gait across the age spectrum, and post-concussion dual-task gait with portable sensors).

WHAT THEY FOUND
In all 3 sub-groups of professional, collegiate, and recreational athletes, they found a significant increase in risk and incidence of injury following a concussion, particularly within the first year. For example, one study reported a 60% higher incidence of injury in the first 9 months following concussion compared to those who did not sustain a concussion. On dual-task neuromuscular control deficits, the following was concluded: there were issues with dynamic gait stability while performing both physical and cognitive dual-task exercises, up to 2 months following concussion and after being cleared by a physician to return to play. This was consistent across several age groups, though it was greater in adolescents than in young adults/adults.

Practical Takeaways

Despite some inconsistencies among studies, this literature review suggests that athletes are at greater risk of musculoskeletal injury after sustaining a concussion than they are prior to. It also suggests that lingering neuromuscular control deficits while performing divided attention tasks, as many athletes are required to perform on the field or court, is a significant driver behind this increased risk.

One study investigated a jump and land task after concussion and found that subjects demonstrated increased hip stiffness, but decreased knee and leg stiffness 50 days after the concussion. This draws a parallel to the same lower extremity alignment that is known to be a risk factor for ACL injury (dynamic knee valgus).

Collectively, these findings demonstrate an important point for coaches and clinicians. That being that these deficits in dual-tasking and executive functioning may require a longer time to recover than previously thought, and may impact the athlete's physical performance (namely, neuromuscular control) as a byproduct. That being said, it might not mean that these athletes need to "sit out" for longer, but may need and/or benefit more from incorporating dual-tasking and intermittent cognitive exercises in their training (see video link #1 for some great examples of these).

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

Steph's Comments

"I found this study to be unique in the sense that it demonstrates how some of the cognitive, attentional deficits that may linger after concussion can impact the physical, neuromuscular performance that is so crucial to most sports. This mental-physical link is not frequently touched upon, though it seems so intuitive when considering its carryover to the multi-tasking demands of team-sports.

I felt that the information presented was also reassuring, in that it provides alternatives to testing dual-task abilities when more expensive instrumented tests are not available. One of the suggestions was to use the tandem gait test as an accurate means of measuring dual-task ability in the clinic or gym (see video link below). I would also argue that this same test can be used as an exercise to improve dual-task skill. For example, having the athlete perform cognitive tasks while tandem walking, either intra-set during a training session, or as part of a rehab session, all with the intent to improve the person's ability to handle multiple cognitive and neuromuscular demands simultaneously. This would ideally mimic the mental and physical game-time atmosphere."

[Abstract]

Core stability programmes: can they improve cutting maneuvers and reduce injury risk?

OBJECTIVE
Despite the increase in ACL injury prevention programmes (IPP's), there has not been any significant decrease in ACL injuries over the past decade. Correlations have been found between trunk control and some of the known biomechanical risk factors for non-contact ACL injury. However, the current research on trunk kinematics and how they relate to these risk factors is lacking. This study investigated the effect of a 6-week dynamic core stability programme (DCS) on trunk and lower-extremity (LE) biomechanics during both anticipated and unanticipated cutting tasks.

WHAT THEY DID
Participants were 31 male, collegiate-level football players, at least 18 years old, and were randomised to either the DCS (15) or control group (16). The DCS group performed 3 sessions per week for 6 weeks, in addition to their normal team activities. Each session consisted of 8-10 exercises, 3 sets of 20 reps each, and lasted 10-14 minutes. The exercises were largely static core exercises, though were performed in 3 phases. Phase 1 focused on controlled movements of the trunk, hips, and arms in the cardinal planes. Phase 2 focused on performing the exercises on unstable surfaces (e.g. wobble board or exercise ball). Phase 3 added perturbations to the unstable surfaces, requiring increased dynamic trunk control.

WHAT THEY FOUND
The following variables were analysed and compared between groups during anticipated and unanticipated side and crossover cutting drills: kinematics of the trunk, hip, knee, and ankle, internal moments of the hip, knee, and ankle, and ground reaction forces (GRFs). When analysing the between-group differences of the side cutting maneuvers (anticipated), the authors found greater internal hip extensor moments, lower knee valgus and external rotator moments, and lower posterior GRFs in the DCS group vs. the control group. When analysing the crossover cutting maneuver, they found lower posterior GRFs during both anticipated and unanticipated tasks, as well as greater ankle DF during stance phase in the DCS group after the intervention.

Practical Takeaways

Unfortunately, this study concluded that a DCS programme did not have any significant effect on trunk kinematics. It did, however, demonstrate significant improvement in LE kinematics in anticipated cutting tasks, which can reduce the risk of ACL injury in more predictable situations on the field.

Previous research performed on trunk mechanics during cutting and its correlation with ACL injury risk demonstrates that trunk side bend and rotation in the direction towards which the athlete plans to cut is associated with increased knee valgus and increased risk of ACL injury. Therefore, it may be more beneficial to investigate the utility of a programme that directly targets trunk mechanics vs. just dynamic core control exercises.

It must also be remembered that the cohort studied here was both small and relatively homogenous, in that it was all young, male, elite football players. This group of athletes may very well have had sufficient dynamic core control prior to the study.

These results do not mean that coaches and clinicians should not include dynamic core stability exercises in their training. In fact, the findings of decreased posterior GRFs, increased internal hip extensor moments, decreased internal knee valgus, and external rotator moments all serve to reduce stress on the ACL. Though these were found in anticipated cutting only, there are still a good amount of predicted cutting movements that occur during sport along with the unanticipated movements. Therefore, this training is not futile.

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

Steph's Comments

"I feel that the potential benefits of this training may be somewhat undermined in this study due to its homogenous cohort, as well as the possibility that the exercises included may not have been challenging enough for these athletes. Dynamic core stability, particularly while jumping and cutting, are extremely important in maintaining good LE alignment and good landing technique, both of which are critical for reducing non-contact ACL injury risk. Knowing this, it is appropriate and important to include this type of training with your athletes and patients, as there will surely be carry over into game-time situations.

Perhaps where the research can go further is by investigating the additional impact of perturbations to the athlete while he/she is both in the air during a jump or in the midst of cutting/changing direction. Similar data could be collected, but the challenge and carry over to high-level sport may be greater. Overall, I think the message to coaches and clinicians is to meet your patient or athlete where they are, and challenge them appropriately by utilising dynamic core stability drills and ideally incorporating those movements into sport-specific activities."

Infographics

A round-up of our monthly research infographics.

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

Koral J, et al., (2018) JSCR

WARM-UPS

Walker, O. (2016) Science for Sport.

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

SCIENCE for SPORT

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WHAT THEY DID

16 TRAINED TRAIL RUNNERS

30s SPRINT INTERVAL TRAINING

6 SESSIONS IN 2 WEEKS

MEASURES

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

WHAT THEY FOUND

INCREASED PERFORMANCE...

42% Time to exhaustion at 90% MAS

2.8% MAS

5.7% 3000m time trial

WHAT THIS MEANS

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

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

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WARM UPS

SCIENCE for SPORT

Key information

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

RAMP protocol

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

Raise

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

Activate & Mobilise

Activate key muscles, mobilise key joints.

Potentiate

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

Time in warm up

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

Warm up effects

Include but are not limited to:

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

Our Summary

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

For the full article check out the Science for Sport website

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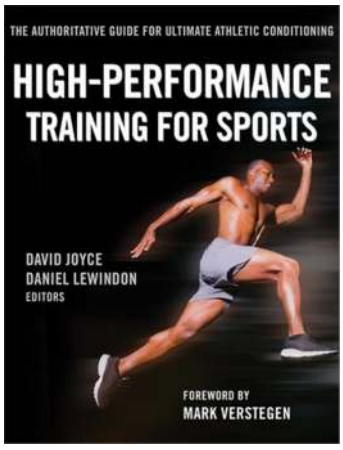

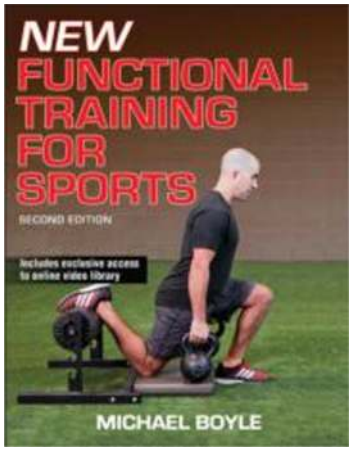

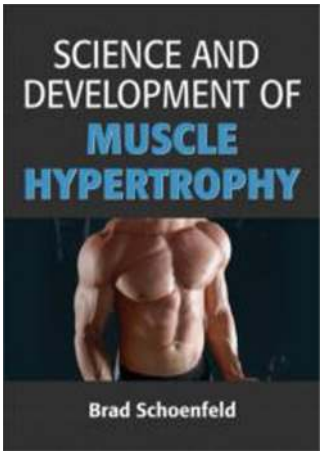

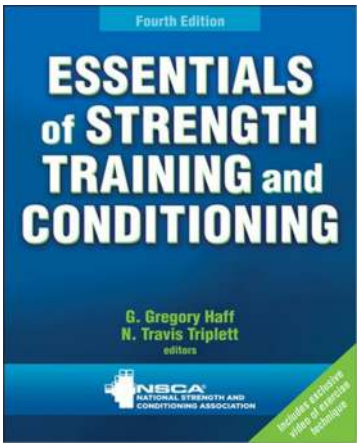

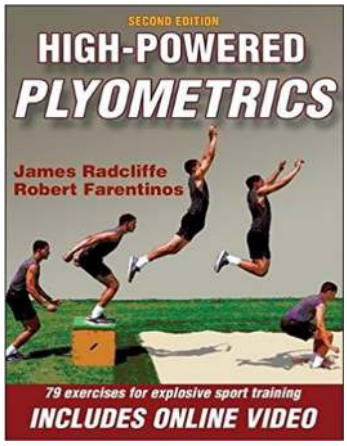

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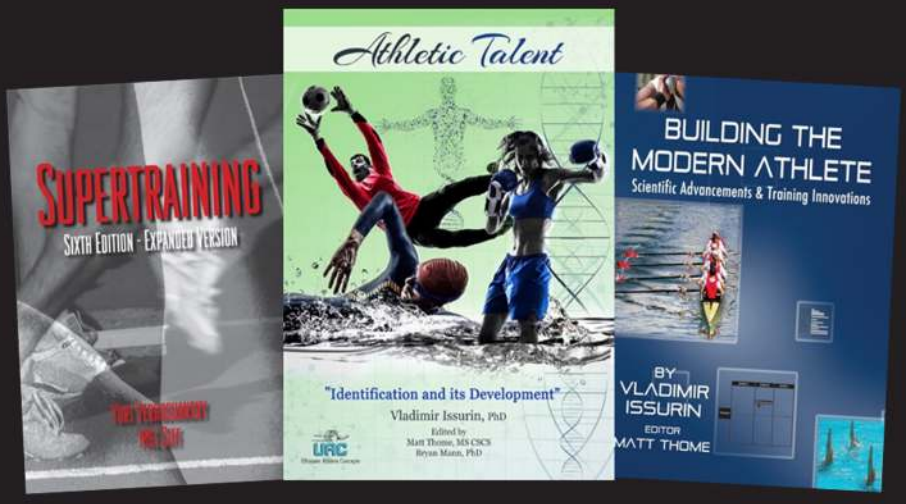

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Warm Regards
Science for Sport