

August 2019 | Issue #34

THE PERFORMANCE DIGEST

A review of the latest sports performance research



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Audio REVIEW

Agility for Youth Athletes

A recap on what we know and hope to find out from future research *with Tom Green*

WHAT WE DISCUSS

In this episode of the "Audio Review", Tom and Matt discuss agility for youth athletes.

In this episode, you will learn:

- What agility is within a school setting.
- How agility changes throughout stages of maturation.
- What agility is amongst a youth population.

Episode length = 40 min



A bit about Tom

Tom is the Head of Athletic Development at St Peters RC High School. He holds a Masters in S&C and has previously worked with West Bromwich Albion FC, Gloucester Rugby club, and Great Britain Equine. Tom is our youth research reviewer at Science for Sport.



Listen Now

The Science of COACHING

Who'd want to be a coach?

An analysis of coach burnout and the recovery process

[Abstract]

INTRODUCTION

The current day coach (particularly those within a high-performance setting) plays many roles beyond providing technical input to help their athletes develop. It is therefore no surprise that there is an increasing trend of sport coaches developing stress-related illness and burnout, which has seen a large number of coaches leave the profession in recent times. It is therefore in the best interest of any sporting organisation to help coaches avoid and recover from these stressful situations.

The aim of this study, therefore, was to analyse the relationship between burnout and recovery amongst eight professional soccer coaches (Swedish Premier League) over a 10 yr period. These coaches completed a series of questionnaires over this period along with a number of a semi-structured interviews in order to gain insight into each coach's experience with burnout and their recovery process.

WHAT THEY FOUND

The experiences of the coaches in the current study changed continuously.

- ⇒ Coaches levels of emotional exhaustion and depersonalisation fluctuated over the 10 yr period.
- ⇒ The majority of coaches reported lower emotional exhaustion scores at the second data collection point (3 yr). This was due to these coaches significantly changing their approach to their role (e.g. moving to a part-time role, moving to a lower division) or leaving the profession completely.
- ⇒ Only one coach reported unchanged scores between the 3 yr and 7 yr data collection point was the only one still coaching at the elite level (at this time period).
- ⇒ By the end of the 10 yr period, none of the coaches were still coaching in the Swedish Premier League.

WHAT THIS MEANS

The factors that contributed to burnout included:

- ⇒ Working too much.
- ⇒ Having several conflicting roles.
- ⇒ Difficulty in managing external pressures.
- ⇒ Having a perceived lack of control.
- ⇒ The expectation to excel (i.e. performance culture).
- ⇒ Health problems due to stress.

Actions by the coaches to reduce/recover from burnout:

- ⇒ Stop coaching.
- ⇒ Change from full-time to part-time.
- ⇒ Take part in other work (e.g. study, another job).

Practical Takeaways

Regardless of the sport in which a person is involved in, taking some time to step away from your coaching role can reduce their levels of exhaustion, helping them to recover from possible burnout.

An immediate change in circumstances (rather than seeing it through) is possibly the best way to begin the recovery process.

All coaches should look to gain the help of professionals (e.g. sport psychologists) in order to assist them with their recovery from burnout.

With regards to the sport organisations, finding a solution and helping their coaching staff with regards to being over-worked and placed into constant stressful situations is beneficial for all those involved both in the short- and long-term.



Will Vickery

Will is a Lecturer of Sport Coaching at Deakin University, Australia.

Strength & Conditioning

This month's top research in strength & conditioning.

A NEW WAY TO PROGRESSIVELY OVERLOAD STRENGTH TRAINING

La Scala Teixeira, C. V. et al. (2019) *Frontiers in Physiology*.

PRACTICAL RECOMMENDATIONS FOR PRIMING EXERCISE: WHEN, WHAT, AND HOW

Harrison, P. W. et al. (2019) *Sports Medicine*.

CAN COMPRESSION GARMENTS BE USED FOR MORE THAN JUST RECOVERY?

Ballmann, C. et al. (2019) *Sports*.



A new way to progressively overload strength training

OBJECTIVE

Progression of load is most commonly implemented through either increasing volume, intensity, or density in order to create overload so as to constantly stimulate training adaptations. However, there has been an emergence of a more unconventional strategy for progressive overload: complexity. Complexity increases the exercise difficulty without necessarily increasing volume, intensity, or density. For example, going from bilateral to unilateral exercise.

Therefore, the aim of this technical report is to discuss the concept of load progression based on increasing complexity in order to illustrate its characteristics as an evidence-based application.

WHAT THEY DID

Because this is a technical report, there is no methodology to this paper. Rather, the authors demonstrate how complexity can be increased throughout a training program. The main theme of this paper is the rise of "functional training" in the scientific research in the past two decades, where, resistance exercise is applied with the aim of stimulating multiple adaptations.

These could be coordination or balance which are integrated into the resistance exercise. Linked below is an example program from a previous study that emphasises complexity as a progression, rather than the traditional overload approach.

WHAT THEY FOUND

Interestingly, previous research has shown that programmes with higher levels of complexity have demonstrated greater effectiveness in performance outcomes compared to traditional programs in children, adults (trained and untrained), and elderly individuals. For example, performing staggered stance alternating dumbbell presses or 1-arm lat pulldowns.

Some examples of ways to increase complexity that were suggested include:

- ⇒ Increase the velocity of the exercise, which has been shown to increase power output.
- ⇒ Multi-segmental exercises, where the simultaneous movement of several body segments can provide a progression option. An example would be a push press or a clean high pull.
- ⇒ Multiplanar movement can increase the difficulty of the task, such as lateral weight transfer in the squat.
- ⇒ Unilateral or alternating execution of exercises, such as alternating presses and 1-arm presses.
- ⇒ Double task exercises, where the focus is taken away from the physical exercise to the cognitive task.
- ⇒ Non-cyclical movement such as the Olympic Lifts.

» Practical Takeaways

Example load progressions to increase complexity in strength exercises include:

- ⇒ Generic – Specific.
- ⇒ Uni-segmental – Multi-segmental.
- ⇒ Uni-planar or one-dimensional – Multi-planar or three-dimensional.
- ⇒ Slow – Fast.
- ⇒ Stable – Unstable.
- ⇒ Without visual deprivation – With visual deprivation.

Applying complexity to a training program will generally have a positive influence on the idea of creating a robust or adaptable athlete. Complexity as a progression that can be used throughout a competitive season if you didn't want to overload volume, intensity, or density traditionally through specific phases. However, some complexity variations will automatically overload intensity such as going from sitting/kneeling to standing. Here are some examples:

- ⇒ Tall Kneeling Landmine Press – Half Kneeling – Standing.
- ⇒ 1-arm DB Bench Press – 1-arm Offset DB Bench Press (see [HERE](#)).
- ⇒ Back Squat – Back Squat with Band Perturbations.

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



James' Comments

"Complexity as a form of progression is something as coaches we generally do as a way to increase intensity or provide some variation in movement, whilst still achieving the outcome we want. For example, if I'm prescribing the overhead press in the first cycle, the second cycle might use the push press as a progression. While volume might be similar or decrease, intensity will automatically increase due to the multi-segmental nature of the push press.

I often use complexity progressions to increase intensity rather than just load on the bar during the same exercise. An example would be the landmine press. Starting tall or half-kneeling and progressing to standing. It's an easy way to limit intensity through load at the beginning until standing where a greater load can be handled."

Practical recommendations for priming exercise: when, what, and how

OBJECTIVE

Research has identified that low-volume resistance training stimuli may acutely enhance athletic performance (see [HERE](#)). This is often referred to as post-activation potentiation (PAP). However, due to the small window of opportunity that is available prior to competition, PAP is difficult to use when looking to enhance competition performance.

Some research has suggested that there is another window of potentiation up to 48 h following low-volume resistance exercise (see [HERE](#)). Therefore, the aim of this brief review was to assess the current literature that has investigated the acute effects (1-48 h) of low-volume resistance exercise on subsequent exercise performance.

WHAT THEY DID

PubMed, MEDLINE, CINAHL, SPORTDiscus, SCOPUS, Web of Science, and Google Scholar databases were used to search for research that was published up to December 2018. The search strategies included terms such as 'priming,' 'resistance priming,' 'morning priming,' 'pre-competition training,' 'morning exercise,' 'acute response,' 'short term response,' 'neuromuscular performance,' 'resistance training,' 'resistance exercise,' 'strength training,' 'power training,' and 'post activation potentiation.'

Articles were included in the review if the study examined neuromuscular performance measures during the 1-48 h period following resistance exercise compared with control or baseline measures. The exercise intervention had to involve exercises utilising external load or maximal effort unloaded jumping.

WHAT THEY FOUND

Neuromuscular Performance

- ⇒ Potentiation in jumping performance has been observed 6-48 h following low-volume resistance exercise.
- ⇒ Athletes exhibiting high levels of anxiety may have greater benefit to priming exercise.

Resistance Priming Strategies:

- ⇒ Current research suggests exercise should range between 30-95% 1RM to elicit performance improvements up to 48 h after.
- ⇒ 30-40% 1RM seems effective when performing ballistic exercise.
- ⇒ Performance may be maximised when resistance is progressively loaded over multiple sets with low repetitions (<6) and performed at high resistance (>85 1RM).
- ⇒ The training stimulus should remain low between 450-1190 AU (sets x reps x %1RM).
- ⇒ The bench press is effective at eliciting upper-body potentiation.
- ⇒ Resistance priming strategies are most beneficial when performed 6-33 h prior to competition.

» Practical Takeaways

The evidence currently suggests that priming activity must be specific to the neuromuscular pathway of the subsequent task in order to maximise potentiation. For example, upper-body exercise potentiates subsequent upper-body tasks and lower-body exercise potentiates subsequent lower-body tasks. Depending on facilities, travel, and time of competition, priming sessions can look very different. Here are some examples:

Competition Day -1

- A1) Jump Squat 2-3 x 3 @30-40% 1RM
- B1) Half Squat 3-4 x 3-6 @85-95% 1RM
- C1) Bench Press 3-4 x 3-6 @85-95% 1RM

Competition Day 6-10 h Pre-Competition

- A1) Jump Squat 2 x 2-3 @30% 1RM
- B1) Power Clean 2-3 x 3-4 @80-95% 1RM
- C1) Bench Press 2-3 x 3-4 @85-95% 1RM

Competition Day 6-10 h Pre-Competition No Gym or Hotel Gym

- A1) DB Squat Jump 3-4 x 3-5 @30% 1RM or as close to it as possible
- B1) Band Resisted Ankle Pops 2 x 20
- C1) Partner Resisted Overcoming ISO Pushup 3 x 6 sec
- D1) 10 m Sprints x 2-4 w/ 30-60 sec Rest

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



James' Comments

"I have reviewed many original research papers on priming exercise in previous Performance Digests. In order to maximise potentiation, the priming exercise should be similar to the subsequent task in whether it's upper- or lower-body, and generally be velocity specific. This means that lightly loaded jumps generally potentiate reactive strength index and jumping, sprinting potentiates sprinting, and heavy resistance exercise generally potentiates strength and power with some carry over to jumping and sprinting.

This current review only investigated external resistance exercise and unloaded jumps and its effect on potentiation. However, previous research has also shown that sprinting enhances subsequent sprint and jump performance 6 hours later."

Can compression garments be used for more than just recovery?

OBJECTIVE

Various methods to enhance recovery and performance during anaerobic exercise have been studied through passive and active means, such as nutritional supplementation and cryotherapy. Recently, the use of compression garments, specifically lower-body compression (LBC), has gained popularity for use during and after exercise in an effort to aid recovery.

LBC has been shown to be an effective recovery tool from basketball match-play. However, little evidence exists on the efficacy of LBC on anaerobic performance. Thus, the aim of this study was to examine the effects of wearing a LBC garment on anaerobic exercise performance.

WHAT THEY DID

Twelve collegiate Division 1 male basketball players (age = 20.3 ± 1.37 yr) completed two different conditions, LBC or non-compressive control (CON) garment in a counterbalanced, crossover design. LBC garment was full-length with a gradient of compression from 15-20 mmHg at the ankle to 6-10 mmHg at the thigh.

The CON garment group wore shorts which provided no compression. Two Wingate tests were performed (30 sec maximal sprint) on a cycle ergometer with a resistance of 7.5% body mass for each condition during separate sessions with 5 min rest provided between tests. Mean power, peak power, anaerobic capacity, anaerobic power, total work, fatigue index, and RPE were measured at various stages of each test.

WHAT THEY FOUND

The key findings of this study were:

- ⇒ Average mean power was significantly higher while wearing LBC (738.8 ± 155.3 W) compared to CON (684.5 ± 146.3 W).
- ⇒ Average anaerobic capacity was significantly higher while wearing LBC (8.1 ± 1.4 W/kg) compared to CON (7.5 ± 1.3 W/kg).
- ⇒ Average total work completed was higher during LBC ($22,165.4 \pm 4661.3$ J) compared to CON ($20,533.3 \pm 4392.2$ J).
- ⇒ Average peak power was unaffected by LBC compared to CON.
- ⇒ Average anaerobic power and fatigue index were not significantly different between LBC and CON.

» Practical Takeaways

Previous research has shown (see [HERE](#)) that mean power output during the Wingate test has a positive correlation with shuttle-run performance. Furthermore, countermovement jump height also had a moderate positive correlation with the Wingate test in the study linked above. Thus, improved power output with LBC may improve players ability to jump and run during a match. Additionally, lower RPE scores during basketball games have shown improved offensive efficacy and decreases in RPE with LBC could potentially positively impact basketball-specific skills (see [HERE](#)).

Practically, this study gives some support to the use of compression garments for training and match-play. For example, for hard anaerobic conditioning sessions, the use of lower-body compression (if possible) would make sense for all anaerobic conditioning type sessions and matches due to the potential increased mean power, anaerobic capacity, and total work. However, depending on the sport (such as rugby where it's a World Rugby ruling), some don't let you wear full length lower-body compression during matches.

Compression works best when wearing full length garments as shorts don't provide the compression gradient needed to enhance the blood flow. According to the Science for Sport article linked below, there is no specific pressure gradient that allows for optimising recovery, so it seems as long as it goes from a low-pressure gradient at the ankle to a higher-pressure gradient at the thigh. Further uses of compression garments for recovery are during sleep and long travel periods.

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



James' Comments

"There are a couple of limitations to this study:

- ⇒ Physiological variables were not measured, so the mechanisms by which anaerobic performance was enhanced is unclear.
- ⇒ The current study wasn't able to blind treatments as the control garment may not have replicated the compression garment adequately if that were the case.

While LBC may enhance anaerobic performance during a Wingate test, it is difficult to extrapolate to other modalities such as running. Running during basketball and other team-sports involves impact forces and rapid acceleration/decelerations which provide a greater stress to the body compared to cycling. As seen in the infographic posted below, a recent meta-analysis found no positive effect on many running variables."

Technology & Monitoring

This month's top research on technology and monitoring.

CAN ACCELEROMETER-DERIVED METRICS MONITOR FATIGUE?

Beato, M. et al. (2019) *Frontiers in Physiology*.

THE FATIGUE AND FITNESS TEST FOR TEAMS (FFITT): A PRACTICAL METHOD FOR MONITORING FATIGUE?

Starling, L. T. et al. (2019)
European Journal of Sport Science.

IS THE POLAR TEAM PRO SENSOR RELIABLE WHEN USED INDOORS?

Fox, J. L. et al. (2019) *Journal of Science and Medicine in Sport*.



[Abstract]

Can accelerometer-derived metrics monitor fatigue?

OBJECTIVE

Global navigation satellite systems (GNSS) devices use accelerometers to collect data on athlete movement, as well as provide algorithm-based metrics that can be analysed with the hope of optimising performance by quantifying training load (TL) and managing fatigue.

The aim of this study was to assess the sensitivity of these innovative metrics at detecting fatigue in athletes during a standardised exercise protocol.

WHAT THEY DID

Fifteen active university males wore Apex 10 Hz GNSS (STATSports, Northern Ireland) devices and completed a 5 min standardised warm-up, a sub-maximal intermittent recovery test (Sub-IRT), followed by six maximal 20 m sprints with 20 sec rest intervals. To evaluate the TL variations of fatigue, each participant completed the Sub-IRT after the initial protocol.

The dynamic stress load (DSL) and fatigue index (FI) (calculated external metrics based on the accelerations of the players within the GNSS devices) was compared between internal measures (e.g. Heart rate (HR) and RPE) across the two Sub-IRT bouts to assess the validity of the GNSS devices.

WHAT THEY FOUND

Primary findings in the study:

- ⇒ The exercise protocol used appeared to be valid as the external TL variables (e.g. Distance travelled, relative velocity, average metabolic power) were consistent between Sub-IRT bouts, whereas the internal TL variables (e.g. Maximum HR, mean HR, RPE) increased.
- ⇒ GNSS-based metrics (e.g. DSL, $DSL \cdot m^{-1}$, and FI) also increased from the first to the second Sub-IRT, which correlated with an increase in internal TL variables.

» Practical Takeaways

In particular, dynamic stress load may potentially provide greater accuracy than HR response with regards to objectively monitoring and recognizing fatigue. For example, possibly because of the numerous factors that can elicit a change in HR response (e.g. external temperature, mental fatigue, hydration).

Monitoring DSL, $DSL \cdot m^{-1}$, or FI values after a match or training session may provide a gauge as to where the athlete lies on an individualised readiness scale for subsequent activity. This may mitigate injury that is related to fatigue and ultimately increase the opportunity for success and optimal performance in team-sports.

Coaches can watch for trends over the length of a season or important blocks of training and competition, focusing attention not solely on the external outputs of an athlete in managing load, but more on the strategies related to acceleration that can ultimately decide performance and be an indicator of fatigue. The goal of these metrics is to tease out meaningful data, and the results of this study indicate that these equations provide valuable insight and actionable information.

Want to learn more?

Then check these out...



Cody's Comments

"The validity of the DSL or FI value come from the correlations seen with internal and external training variables. As with all monitoring, these values should not be looked at in isolation but appreciated in context and paired with other variables. These values, whether they are absolute or derived from an equation using multiple variables, help to tell a story and clear the fog in making calculated decisions with training prescription.

Ultimately, the technology that coaches and teams utilise and implement should provide information that helps to guide decisions and support the athlete's well-being. A study examining DSL or FI values related to injury incidence would provide further worth to these values in injury mitigation and fatigue management."

[Abstract]

The Fatigue and Fitness Test for Teams (FFITT): A practical method for monitoring fatigue?

OBJECTIVE

Monitoring an athlete's mental and physical state presents challenges related to efficiency, intrusiveness, and actionable insight for coaches. The combination of objective and subjective measures provides a comprehensive showcase of an athlete's psycho-physiological readiness and response to training load.

This study presented rationale for a multi-dimensional testing procedure as a practical athlete monitoring protocol, the Fatigue and Fitness Test for Teams (FFITT) and measured the reliability of its various components.

WHAT THEY DID

Twenty-four physically active males from a variety of sports completed the FFITT on five consecutive days under consistent conditions. At each session, participants completed a subjective readiness-to-train questionnaire (RTT-Q), as well as, a heart rate recovery test (HRR60s), and standing long jump (SLJ) for objective measurement. Each test was specifically designed to provide a holistic state of athlete readiness, showcasing psychological, autonomic, and neuromuscular function.

The trials were analysed for consistency and reliability, examining typical error and variance. Further comparison of error to sensitivity was used to determine the significance that was necessary to detect a meaningful change between the various measures.

WHAT THEY FOUND

Primary findings in the study:

- ⇒ Each testing component of the FFITT (i.e. RTT-Q, HRR60s, and SLJ) displayed high reliability across the five days of testing.
- ⇒ HRR60s and SLJ were able to detect medium to large changes in fatigue and fitness.
- ⇒ Changes in HRR60s greater than 5 beats and changes in SLJ greater than 13 cm were considered meaningful.
- ⇒ The RTT-Q displayed high internal consistency across the five days of testing.
- ⇒ The test proved to be time-efficient, only taking 8 min to complete.
- ⇒ The FFITT caused no residual fatigue, as measurements were constant or improved across the testing period.

» Practical Takeaways

An athlete is a biological system that is composed of numerous functional systems that interact with one another to create performance and adapt to environmental and training stressors. The FITT's multi-compartmental approach is necessary to appreciate the readiness and interaction of these various systems.

When making decisions and analysing data, it is important to not focus attention on one specific measure, but rather the combination of at least three measurements. Multiple measurements take more time but the FITT is arranged appropriately to fit the time constraints and budgets of any team and level.

Combining the information is applicable for any athlete relying on both power and capacity and provides assurance in the holistic performance ability. Putting an athlete on the field that is mentally and physically ready to perform at the highest level possible.

Want to learn more?

Then check these out...



Cody's Comments

"Rather than simply using one measurement, be it subjective or objective, the combination of measurements creates a holistic picture of the athlete's true readiness for match-play. Just as the most reliable body composition measurement is multi-compartmental, the most actionable monitoring information combines multiple measurements of information that include physical performance and psychological perception.

This study does an excellent job of attacking the hurdles associated with athlete monitoring in the team setting. Creating a monitoring strategy that does not interfere with daily operation and fits seamlessly into the process is necessary. Likewise, with numerous and expensive technology options on the market today, this approach allows the opportunity for coaches to get valuable information, quickly, that can be tracked over a season or period of time to provide insight to an athlete's response to the environment they are in. The results help to create conversation with the athletes, encourage opportunities to educate and impact performance or recovery within an important training or competition block."

[Abstract]

Is the Polar Team Pro Sensor reliable when used indoors?

OBJECTIVE

Indoor sports cannot utilise global positioning systems (GPS) to quantify external workloads because of signal interference. To overcome this issue, microsensors are an alternative to measuring movement indoors since they work through accelerometers.

The aim of this study was to determine the validity of the Polar Team Pro Sensor to measure locomotive tasks indoors, as well as, compare the device positioning (back- or chest-mounted) and potential influences on validity.

WHAT THEY DID

Twenty-six participants were outfitted to randomly selected sensors (Polar Team Pro Sensor, Polar Electro, Kempele, Finland), one back-mounted between the scapulae and one chest-mounted at the xiphoid process, worn in accordance with manufacturer's design and instruction.

Participants completed both continuous locomotion at various intensity (i.e. low, medium, and high) and a change-of-direction (COD) test (i.e. agility T-test) in a randomised order. Distances and speeds were referenced using a trundle wheel and electronic timing light. Agreement in speed and distance between reference measures and the two mounted microsensors was performed to determine validity.

WHAT THEY FOUND

The key findings of the study were:

- ⇒ Consistent results between the back- and chest-mounted sensors, but both placements compared poorly to the reference measures for speed and distance.
- ⇒ Typical error in speed and distance was 11-50% when comparing sensors with reference distance and times.
- ⇒ Speeds and distances were underestimated by as much as 2.76 km h⁻¹ and 32.6 m and overestimated by as much as 4.52 km h⁻¹ and 59.6 m, respectively, across tasks and intensity.
- ⇒ There was a correlation with wider limits of agreement at higher intensity, suggesting a greater margin of error as movement speed increases.

» Practical Takeaways

The results of this study do not support the use of the Polar Team Pro Sensor for use as a monitoring tool to measure the speeds experienced and distances travelled during training or competition. Furthermore, use of these microsensors and the algorithms used are not accurate for measuring speed or distance. A motion capture system remains the criterion measure for indoor activity measurement and use of alternative approaches using local positioning systems such as ultra-wide band or radiofrequency identification systems may provide a valid alternative.

Simply collecting data for the sake of numbers provides no value to the coach and is not worth the time and efforts of the athletes and staff. It is important to collect data that provides an accurate showcase of what the athlete is doing during competition or training. With the large range of over- and under-estimation in speed and distance, this system should be used with extreme caution.

Want to learn more?

Then check these out...



Cody's Comments

"The Polar Team system at one time was a leader and pioneer in live team-sport monitoring, with the ability to showcase heart rate response information, used to understand the athlete's output during a given session. In efforts to keep up with the ever-advancing technology allowed through GPS monitoring and the need for an indoor solution in measuring outputs, it appears Polar's algorithms for measuring movement through the use of an accelerometer, gyroscope, and digital compass have fallen short.

For the time being, if there is a financial opportunity and a practical fit for video-based time-motion analysis or local position systems (e.g. KINEXON or Catapult), practitioners should explore opportunities available in those areas, as there is greater evidence for valid and reliable speed and distance measurements with indoor use. Although these devices have limits, one of the first requisites of technology and monitoring is collecting and using data that is repeatable and reliable."

Fatigue & Recovery

This month's top research on fatigue and recovery.

GPS MEASURES OBTAINED DURING FOOTBALL ARE ASSOCIATED WITH POST-MATCH FATIGUE

Wiig, H. et al. (2019) *Frontiers in Physiology*.

WHAT LOAD MEASURES ARE RELATED TO CHANGES IN CARDIOVASCULAR FITNESS AMONGST ELITE FOOTBALLERS?

Rago, V. et al. (2019) *Journal of Sports Sciences*.

SLEEP EXTENSION THROUGH NAPPING MAY EFFECT PERFORMANCE

Boukhris, O. et al. (2019) *Frontiers in Physiology*.



[Abstract]

GPS measures obtained during football are associated with post-match fatigue

OBJECTIVE

Training load is frequently monitored using GPS devices and whilst practitioners collect a different number of measures, the knowledge of how different GPS measures affect different markers of fatigue is scarce. Understanding how different running loads (e.g. accelerations, total distance) effect fatigue may help practitioners planning recovery strategies and weekly schedules.

This study aimed to explore the relationship between GPS measures obtained during football matches and different fatigue markers obtained after the matches.

WHAT THEY DID

During three matches (one match each per the following measures) were collected from players from six semi-professional football teams :

- ⇒ Physical measures: total distance (TD), PlayerLoad™ (PL), high-intensity running (HIR), and high-intensity events (HIE).
 - ⇒ Fatigue markers: Creatine kinase (CK) and myoglobin (MYO).
 - ⇒ Performance measures: Yo-Yo Intermittent Recovery test level 1 (YOYO), countermovement jump (CMJ) and 30-m sprint (SP30).
- The timing of each measure was as such:
- ⇒ 72 h before each match: CMJ.
 - ⇒ 1 h before each match: CK, MYO, CMJ, and YOYO.
 - ⇒ 1-, 24-, 48 h after each match: CK, MYO, and CMJ.
 - ⇒ 72 h after each match: CK, MYO, CMJ, SP30, and YOYO.

WHAT THEY FOUND

The main findings of this study were:

- ⇒ CK was elevated from baseline values for up to 72 h and peaked 24 h after a match, and the increase in CK was associated with higher HIR.
- ⇒ MYO was elevated from baseline values for 24 h and peaked 1 h after a match, and was affected essentially by increases in HIR.
- ⇒ CMJ was decreased from baseline values for up to 72 h after a match and was decreased on the 1, 24 and 48 h after. CMJ decreases couldn't be explained by any of the GPS measures.
- ⇒ YOYO returned to baseline 72 h after a match. SP30 was still compromised 72 h after a match and was affected by player load and total distance.

» Practical Takeaways

The findings of this study demonstrate that fatigue is affected according to the characteristics of the game (i.e. different makers), therefore, practitioners are recommended to collect a variety of metrics (e.g. TD, HIR, PL) during training and competition. Understanding how different loads affect fatigue can help practitioners designing recovery strategies and adjusting training loads. For example, if a player has a higher than usual volume of HIR and TD during a match, he or she may benefit from cold recovery modalities.

The fact that sprint, CMJ, and CK were still affected at 72 h reinforces the need for appropriate recovery (i.e. nutrition, sleep, and management of training loads) on the subsequent days following a match. It is, however, important to reinforce that in most team-sports it is very unlikely that there are no residual effects of fatigue from the match during the first training day(s) of the week.

Want to learn more?

Then check these out...



Francisco's Comments

"This is a very interesting study demonstrating that fatigue is affected differentially according to the volume and/or frequency of different actions during football matches. At 72 h there were still some residual fatigue, demonstrating that training loads need to be managed throughout the week in order to avoid cumulative effects of fatigue. **HERE** you can see one example of the organisations of training loads typically utilised in football. Using this example and imagining that players were exposed to higher HIR distance than usual, practitioners can increase the post-match recovery strategies (e.g. cold-water immersion, anti-oxidants). If players demonstrate higher fatigue levels than usual during the MD-4, monitoring, management of training loads (e.g. decrease of the training duration) can be contemplated.

It is however important to mention that the effects of load (e.g. different metrics obtained from GPS, perceived exertion) on fatigue is highly dictated by the training background and chronic loads that players have been exposed to. Therefore, it is my personal thought that we should find ways to overload the players in order to make them capable to tolerate higher loads rather than raise "red-flags" because of some residual levels of fatigue 72 h after a match."

[Abstract]

What load measures are related to changes in cardiovascular fitness amongst elite footballers?

OBJECTIVE

Cardiorespiratory fitness is a determinant of football, and to determine each player's level of cardiorespiratory fitness practitioners typically use maximal fitness tests (e.g. Yo-Yo intermittent recovery test). Given the dense competitive schedules of football, it is difficult to continuously monitor cardiorespiratory fitness using these maximal tests and, for this reason, submaximal tests have been gaining the attention of practitioners and researchers.

This study was the first study investigating changes on fitness in elite footballers using a submaximal test.

WHAT THEY DID

Training loads and cardiorespiratory fitness of seventeen elite Spanish football players from the same team were monitored throughout a 3-month period. Cardiorespiratory fitness was monitored by measuring the mean heart rate (HR) of the last 30 sec during a submaximal version of the Yo-Yo intermittent recovery test (YOYO). This test required players to complete the test as they typically would during the level 1 of the YOYO. However in this instance, players stopped once they had reached 800-m (i.e. 6:51 min:sec). The test was performed four times in total (every ~30 days).

Training and competition internal load were calculated using mean HR, whereas external training load was calculated from the measures obtained from the GPS devices (training) or cameras (competition). These included: total distance, high-speed running distance, sprint distance, and the number of accelerations and decelerations.

WHAT THEY FOUND

Cardiorespiratory fitness improved over the 3-month period, as demonstrated by the significant decrease in mean HR during the YOYO from the last two tests in comparison to the first.

From the different load measures obtained, total distance completed during training and competition was the only measure associated with differences in cardiorespiratory fitness status (i.e. cardiorespiratory fitness negatively correlated with the mean HR of the YOYO).

» Practical Takeaways

- ⇒ HR obtained during a submaximal intermittent can be a simple way for practitioners to monitor changes in fitness without exposing athletes to a maximal effort.
- ⇒ It is important to monitor total distance as it predicts fitness to a certain extent.
- ⇒ Load and changes need to be measured individually (e.g. in this study, two players out of the seventeen did not show any change cardiorespiratory fitness over the 8-week period).
- ⇒ Although mean HR did not show an association with fitness changes, this should not discourage practitioners from using HR to track internal load. For example, time spent above 85-90% of the maximal HR has been demonstrated to have a greater association with changes in cardiorespiratory fitness than mean HR).



Francisco's Comments

"This study aimed to understand what measures of load are linked with cardiorespiratory fitness status within elite football players. While assessing cardiorespiratory fitness is traditionally done with a maximal test, this study demonstrates for the first time in elite footballers that this can be done with an intermittent submaximal test. This is great news for practitioners as: 1) Cardiorespiratory fitness is one of the most important physical qualities for football players, and 2) At the elite level, it is impossible to continuously monitor fitness throughout the season due to the density of the competition schedules. Furthermore, in addition to changes in fitness status, HR during submaximal exercise can also provide some information about the readiness of the players.

A submaximal test that I particularly like as it can easily be performed as a warm-up is a 4-min jogging test at 12 km.h-1 pace. For this test, the players run back and forward on a 100 m field with cones placed every 20 m to set the pace (i.e. 6 sec to run every 20 m). As in this study, the average HR of the last 30 sec is calculated. More information about this test can be found [HERE](#)."

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



[Abstract]

Sleep extension through napping may effect performance

OBJECTIVE

Day napping is a strategy frequently used by athletes to increase sleep duration and readiness to perform. Although, there seems to be little scientific evidence about the effects of naps aiding athletic performance and the effects of different napping durations on subsequent performance.

This study aimed to investigate whether or not different nap durations aided an athlete's readiness to perform on the same day.

WHAT THEY DID

Seventeen physically active men performed a shuttle test under four conditions with 72-h between each condition:
25-, 35- or 45-min nap opportunity (NAP25, NAP35, NAP45, respectively). No nap opportunity (CON).

The shuttle test consisted of six sets of 30 sec maximal shuttle sprints over 5-, 10-, 15- and 20 m with 35 sec between sets. Total distance over the 6 x 30 sec (TD), best distance (BD) and fatigue index (FI; FI (%)) were obtained. For specific information on how FI was calculated refer to the abstract link above.

WHAT THEY FOUND

The main findings of this study were:

- ⇒ NAP25 and NAP45 had a beneficial effect on BD in comparison to CON.
- ⇒ All napping conditions were beneficial on TD in comparison to CON.
- ⇒ No effects of any condition on FI.
- ⇒ RPE was lower in NAP45 in comparison to CON and NAP25.
- ⇒ No effects of any conditions on sleep quality during the nap opportunities or preceding nights.

» Practical Takeaways

- ⇒ The main practical takeaway of this study is that athletes may benefit from a nap during the day-time before practice or competition.
- ⇒ Some points must be considered when allocating a time for naps to occur in the training schedule:
- ⇒ Naps should occur early in the afternoon (~13:30-16:00) in order for future sleep to not be affected.
- ⇒ Naps should not be long (~20-30 min) so night sleep is not affected.
- ⇒ If napping is to be included in athlete's routine, practitioners need to ensure that athletes have the facilities to allow for this.

Want to learn more?

Then check these out...



Francisco's Comments

"Although the participants of this study weren't athletes, the conclusions from this study still provide us some guidance in terms of the effects of napping in performance. More precisely, this study demonstrates that napping during the day may provide benefits in terms of athletic performance.

In previous issues, I have talked about the importance of providing group (Performance Digest Issue #28) and individual education about sleep hygiene and strategies to enhance sleep time and sleep quality (Performance Digest Issue #32). Increasing total sleep duration by adding naps can be a powerful tool to be used in athletes revealing bad sleep duration and quality. These athletes can trial day napping and understand how it effects their fatigue levels and night sleep. Practitioners need to be aware that for some individual's day napping may negatively impact on night sleep and, therefore, effect their overall sleep duration/quality."

Youth Development

This month's top research on youth development.

THE IMPACT OF SOCIOECONOMIC STATUS ON PHYSICAL LITERACY

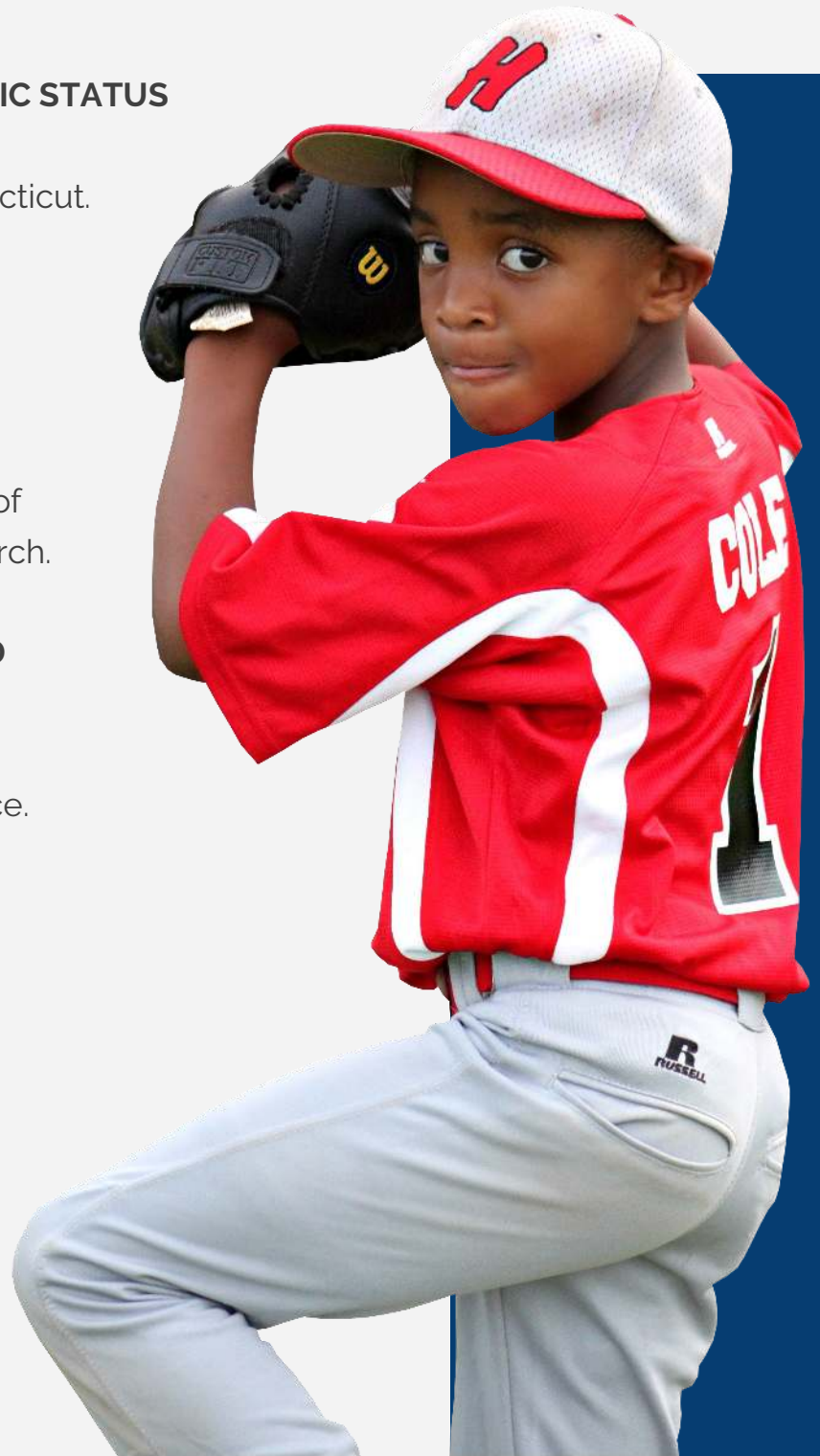
Zuk, E. (2019) University of Connecticut.

THE ROLE OF ELASTIC BAND TRAINING ON PERFORMANCE VARIABLES IN MALE YOUTH HANDBALL PLAYERS

Aloui, G. et al. (2019) The Journal of
Strength and Conditioning Research.

GROWING UP: THE ASSOCIATED RISK IN FOOTBALL

Johnson, D. M. et al. (2019)
European Journal of Sport Science.



The impact of socioeconomic status on physical literacy

OBJECTIVE

In order to be physically active, children must have a degree of "physical literacy", defined in the attached article as "the motivation, confidence, physical competence, understanding, and knowledge to maintain physical activity at an individually appropriate level, throughout life". Many factors, such as socioeconomic status, have been suggested as barriers to sports participation.

The purpose of this study was to evaluate physical literacy competency and landing strategies in youth between those of a high and low socioeconomic status.

WHAT THEY DID

This study adopted a cross-sectional study design to compare children from high-resourced (HIGH), and low-resourced (LOW) communities (LOW: >50% free/reduced lunch; HIGH <49% free/reduced lunch) on fundamental movement skills (FMS) and jumping and landing abilities from nine schools.

Physical competency during FMS task were assessed and measured by the PLAYfun assessment tool, whilst landing technique was assessed using the Landing Error Scoring System (LESS) over three trials. Once collected, two-way analysis was used to compare physical literacy (locomotor, balance, upper extremity object control, lower extremity object control, and running) and LESS scores between high- and low-resourced schools.

WHAT THEY FOUND

It was reported that those who were from low-resourced schools performed the locomotor ($p = 0.001$), balance ($p = 0.002$), upper extremity object control ($p = 0.002$), lower extremity object control ($p < 0.01$) and running ($p = 0.04$) tasks with lower competency scores than those from higher resourced schools.

Regardless of socioeconomic status, LESS scores were lower in all participants in early school compared to middle school and this was believed to be as a result of increased exercise exposure.

» Practical Takeaways

- ⇒ Children in low-resourced environments, particularly those in elementary school, may not have the neuromuscular control or fundamental movement skills to be active for life, placing them at a high risk of diseases such as obesity, stroke, cardiovascular, and cancer caused by inactivity.
- ⇒ The decrease in FMS and LESS scores in children in low-resourced environments could be due to the lack of opportunity to participate in organised youth sport, and places them at a greater risk of injury.
- ⇒ Barriers to sports participation include safety concerns in public parks, financial commitments, travel cost, and a lack of input from parents in the household. This has been discussed in greater detail in the attached podcast.



Tom's Comments

"This study makes a notable effort to reveal what is a very common issue when working with youth. Interventions and initiatives designed to prevent low FMS in children are often time-consuming or financially non-viable. Unfortunately, this leads to issues whereby those in low-income households are at risk of health impairments later down the line. In the podcast below, Dr Ann Morning describes how inequality is created and contributes to issues such as; poor health knowledge, quality coaching, and opportunities to perform.

With regards to the methods in this study, the LESS and PLAYfun assessment are both valid and reliable measures to assess FMS and to detect jumping errors. As someone who works in a school, it can be really hard to manage behaviour whilst trying to test large groups of children. To do this effectively, numerous members of staff must be involved in the testing, analysis, and pupil-management process. Again, this can be limited by resources, however, I've found it extremely useful to set up a mini-tournament, whereby the 'resting' team are with me. This must be a low-intensity game though, so that the results are not affected."

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



The role of elastic band training on performance variables in male youth handball players

OBJECTIVE

Handball is an intermittent sport, requiring players to make continuous changes in their pace, acceleration, and direction whilst simultaneously juggling all of the technical aspects of the game. Strength underlies many of these qualities, with elastic band training lending itself to youth strength development due to the practicality, safety, and variation in exercise selection.

The aim of this study was to evaluate the effects of elastic band training on performance-related abilities.

WHAT THEY DID

This study was conducted over eight weeks of bi-weekly training in thirty elite male players (aged 18.7 ± 0.8 years). Participants volunteered for random assignment to either an elastic band training group ($n=15$), or a control group who maintained their normal training ($n=15$). The following tests were conducted prior to training:

- ⇒ Force-velocity test.
- ⇒ Squat and countermovement jump (CMJ).
- ⇒ Sprint times (5 and 30 m).
- ⇒ Repeated change-of-direction test (RCOD).
- ⇒ T-Test (COD).
- ⇒ Half back squat (1RM).
- ⇒ Anthropometric test.

Participants then performed both knee and hip extension exercises using a progressive resistance training programme which increased in both repetitions and band difficulty with black (special heavy), silver (super heavy), and gold (maximum heavy) bands used.

WHAT THEY FOUND

Small to trivial improvements were found for peak power ($p = 0.001$), 1RM strength measures ($p = 0.01$), sprint times ($p = 0.001$ for 5 m; $p = 0.05$ for 30 m), COD ($p = 0.01$), and RCOD parameters ($p = 0.05$).

However, vertical jump parameters (measured by the squat and CMJ jump) and limb volumes calculated through the breadth of knee condyles were found to be no different to the control group.

» Practical Takeaways

- ⇒ By replacing more conventional training with elastic band training, well-trained handball players can make further athletic improvements over eight weeks.
- ⇒ Bands are an affordable and versatile piece of kit (see article below), which can be used in a gym or from home.
- ⇒ Although small, positive changes in power, strength, sprint speed, RCOD, and COD performance were all measurably developed. This should not be overlooked in a sport such as handball, as these qualities can be the difference between winning and losing.



Tom's Comments

"In any role I've undertaken, ensuring that resistance bands are available in all shapes and sizes are a must in my opinion. Restoring the function of a joint, supporting mobility, or increasing strength (see video below) is key when working with youth. In addition to this, bands are an affordable and versatile piece of equipment which lends itself to multiple movements and exercises. From this study, it would seem that band training is a very time-efficient method of training which is essential when working with youth due to limited contact time, high academic schedules, and high levels of focus on sport, rather than training. To have an influence on vertical jump parameters, the combination of plyometric training may be a good solution for coaches.

In the future, I'd like to see a study that compared the use of bands vs. free weights vs. control. However, other factors such as affordability, practicality, and the ability to train in and away from a facility should be considered and are partly addressed in the podcast. Furthermore, I would like to see some research conducted around band-strength, and in particular the "cut-off" point where the band may be providing too much support for the participant."

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



Growing up: the associated risk in football

OBJECTIVE

The objective of football academies is to find and develop youth players to compete at the highest level in adult football. To ensure that this happens, a considerable amount of time must be spent with the individual to ensure that an athlete is available and injury free so that they do not miss out on their technical, tactical, and physical development.

The aim of this study is to examine the variance of maturity status and timing on injury risk in academy football players.

WHAT THEY DID

In total, seventy-six young football players from U11-U16 were analysed over two competitive seasons, exposing them to 3693 matches with a mean exposure of 48 (\pm 23) of games per player.

To calculate each player's maturation, cut-off points were defined as a percentage of their predicted adult height taken from Khamis-Roche equations. Circa-Peak Height Velocity (PHV) (see [HERE](#) for more details) was defined as being at 88-95% of predicted adult height. Subsequently, anything over 95% was deemed post PHV. Time-loss injuries were recorded by the Academy medical staff and accounted for time-loss through non-contact and overuse injuries, which prevented a player from participating in full training or matches.

WHAT THEY FOUND

The U13 and U14 age groups had the highest number of injuries per 1000 h of playing (24.5 injuries per 1000 h) compared to those pre-PHV (11.5 injuries per 1000 h). This supported the notion that there is an increased vulnerability during adolescence.

Maturity appears to be a factor associated with increased injury incidence and burden and is particularly prominent during periods of growth. Other factors such as maturity timing were found to have no significant effect on injury.

» Practical Takeaways

- ⇒ Schools, organisations, and sports clubs should regularly assess the maturity status of athletes using either the Khamis-Roche method or Mirwald equations. The attached document addresses the protocol in great detail.
- ⇒ During PHV, players are extremely susceptible to injury. More specifically, players during PHV had an increase of 115% of injury incidence and a 225% greater injury burden.
- ⇒ The authors suggested that the increased risk of injury may be due to changes in muscle-tendon junctions, bone-tendon junctions, ligaments, growth cartilage and bone density. The attached podcast discusses this in greater detail.
- ⇒ Ensuring that athletes are programmed for individually by taking into account their stage of growth and altering training volume and load accordingly should reduce the risk of injury.

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



Tom's Comments

"From this study, it is evident that maturation brings about certain challenges, such as increased injury risk and time away from training. In my own practice, I've always made an attempt to monitor load during maturation. However, in the future, I may need to adapt the programme for those going through their PHV to a greater degree. To achieve this, I will look to spend more time working in motor-skill development (i.e. throwing and catching), balance activities, core strength (see video below), and reducing load and volume around these sensitive periods.

Reducing the work-load during this time may also support athletes through movement awkwardness whilst providing a training stimulus. As coaches, we have a responsibility to factor in the external load experienced by the athlete through training, which their club/organisation isn't going to do. The challenge then becomes finding activities that do not provide too much or too little stimulus for development. This is very relevant in football, where professional training and high physical bouts of exercise may be unduly loading a system (youth athlete), who possess a decreased load-capacity capability which could lead to injury."

Nutrition

This month's top research on nutrition.

NUTRITIONAL STRATEGIES TO ENHANCE PERFORMANCE OF STRENGTH AND POWER ATHLETES

Mota, J. A. et al. (2019) Strength and Conditioning Journal .

THE SEVERE DETRIMENTAL EFFECTS OF MAKING WEIGHT THE WRONG WAY

Kasper, A. M. et al. (2019) International Journal of Sport Nutrition and Exercise Metabolism.

CAN MILK REALLY HELP WITH ADAPTATIONS FOLLOWING RESISTANCE TRAINING?

Born, K. A. et al. (2019) Journal of the International Society of Sports.



Nutritional strategies to enhance performance of strength and power athletes

OBJECTIVE

Periodisation is a concept most athlete support staff will use to shape exercise programmes. However, in recent years, "nutritional" periodisation has become a popular strategy, to support and optimise exercise performance and body composition throughout athlete training sessions and competitions.

This review synthesised the current available literature regarding nutritional strategies for strength and power athletes.

WHAT THEY DID

For the purpose of this review, strength and power athletes were classified as those for whom performance is strictly defined by measures of strength and power, for example, powerlifting, weightlifting, and shot put.

In review of the available literature, the authors firstly classified four main themes relating to basic nutrition for strength and power athletes: calories, carbohydrate, protein, and fat.

Secondly, the authors discussed seven key variables that need to be considered when developing a periodised nutrition plan:

- 1) Increases in training load.
- 2) Decreases in training load.
- 3) Increases in body mass.
- 4) Decreases in body mass.
- 5) Competition.
- 6) Cutting weight.
- 7) Multi-event competitions.

WHAT THEY FOUND

The authors provide a great table which I have re-drawn and included as an attached document (see [HERE](#)). In summary, the table provides evidence-based recommendations for nutrition modifications geared to accommodate alterations in training load and different body mass-based goals of the athlete.

Competition: Competition strategies will differ dependant on the sport (e.g. weight-making sports vs. strong man). If acute weight loss strategies have been employed, then rehydration and increased glycogen strategies should be followed. Similarly, events that run the whole day or over multiple days should implement carbohydrate supplementation strategies to increase energy availability during the event.

Cutting weight: Carbohydrate depletion, creatine cessation, and water loading are three strategies the authors discuss. Switching to a very low carbohydrate diet during the last few days of competition can help deplete total muscle glycogen stores. 1 g of carbohydrate binding to 3 g of water when stored in the muscle can be an effective strategy. A brilliant manuscript outlining acute weight loss strategies is provided below.

» Practical Takeaways

This review provides a strong case for the requirement of nutrition plans that match the individual athletes training load, body composition goals, and competition goals. These three key variables are fundamentally important for the practitioner to fully understand from both the coach and athlete point of view and cannot be overlooked by any practitioner. A thorough understanding of these goals will then aid practitioners to then align particular nutritional strategies to achieve such goals. I would recommend that a meeting is scheduled to discuss these goals with both the coach and athlete.

For example, if you were unaware that your athlete was trying to reach a particular weight for competition day, but had them consuming creatine and 7-8 g/kg body mass⁻¹ of carbohydrates, clearly the nutritional plan and goals of the athletes will not align. Likewise, if your athletes are trying to increase body mass during a pre-season period but they are not eating sufficient protein on heavy training days, then muscle hypertrophy will be impaired and thus so will an increase in body mass.



James' Comments

"For practitioners working with strength and power athletes, this paper provides a great starting framework to now work your own nutritional strategies from. Another resource would be the podcast below by Sophie Killer discussing fuelling track and field athletes.

I say your own strategies because, as an example, and referring to the table above, I have rarely seen any athlete that I personally work with consume 6-7 g/kg body mass⁻¹ of carbohydrates on a training day that has no change in training volume. Although this maybe the target, it is simply very hard to physically implement this amount of food for the athlete, especially when they are maybe living on their own and having to cook for themselves. As an example, a 75 kg athlete who needs to consume 7 g/kg body mass⁻¹ would require 525 g of carbs that day, that's almost the same as 11 jacket potato's on top of protein, vegetables, and fluids! This is where the use of solids, liquids, and gels maybe required instead of just food on its own.

With this in mind, know the targets that need to be hit, but understand that they may not always be possible especially for a travelling athlete and work with the individual athlete to see what is possible for their lifestyle. The importance of working on an individual basis is outlined below in the video."

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



The severe detrimental effects of making weight the wrong way

OBJECTIVE

Weight making-sports require athletes to reach a certain body mass on a scale before they can qualify to then compete in the respective weight category. The pressure to reach certain weights to gain a competitive advantage over opponents is reaching new extremes, so much so that certain weight making strategies are resulting in athlete deaths as recent as June this year (see [HERE](#)) and is discussed by one of the authors of this case-study in the video and podcast below.

With this in mind, the weight-making research group at Liverpool John Moores University aimed to describe the strategies of an individual male athlete as he made weight before competition and quantify the physiological and metabolic impact of the extreme weight cut.

WHAT THEY DID

The athlete presented was a 22-year-old professional male MMA fighter, with the contest under investigation for the case study being the defence of his featherweight championship. At the beginning of the camp he weighed 80.2 kg and was required to make weight at 65.7 kg over an 8-week period.

They assessed the athlete at regular periods before and after the contest for body composition using DXA and skinfolds, resting metabolic rate, and peak oxygen uptake with blood samples taken and analysed at a local hospital.

The protocol of the 8-week weight-making period included the following phases:

- 1) 7-week energy restriction period.
- 2) 6-day water loading period.
- 3) An acute weight cut strategy.
- 4) Rehydration and refuel strategy
- 5) Ad libitum recovery period following the fight.

WHAT THEY FOUND

During phase 1, the athlete lost 4.4kg. During the "cut", the athlete exhibited clear symptoms of the relative energy deficiency in sport syndrome, reductions in resting metabolic rate, the inability to complete the maximal oxygen uptake test and perturbations to endocrine status and hypercholesterolemia (high cholesterol).

In phase 3 during the cut to make-weight (weight-loss of 7.3 kg), the athlete experienced a significant stress response:

- ⇒ 3-fold increase in plasma cortisol
- ⇒ Elevations in serum proteins
- ⇒ Elevations in plasma osmolality
- ⇒ Elevations in plasma sodium concentrations

The plasma sodium observed (148 mmol.L⁻¹) was near to severe levels of hypernatremia (>150 mmol.L⁻¹) where mortality may occur. Similarly, the relative and absolute changes in serum creatinine levels during the final phase of the weight cut are consistent with acute kidney injury.

Finally, following the 32-h rehydration and refueling strategy, the athlete gained 10.6 kg in absolute mass and 2 weeks after the competition, resting metabolic rate, markers of endocrine status, lipid profile, hydrations status and kidney function had all returned towards normative ranges.

» Practical Takeaways

For practitioners and coaches working with athletes that are required to make-weight for competition, this case-study provides clear data showing the potentially harming effects of making weight poorly (specific to this individual). The athlete showed clear signs of relative energy deficiency, evidenced by:

- ⇒ Reduced metabolic rate.
- ⇒ Inability to complete performance tests.
- ⇒ Alterations to endocrine hormones.
- ⇒ High cholesterol.
- ⇒ Dehydration induced hypernatremia.
- ⇒ Acute kidney injury.

Although based on one individual, this case study shows the harmful (and potentially fatal) effects of extreme weight cutting in MMA athletes and represents a call for action to governing bodies to safeguard the welfare of MMA athletes. Similar habits of making weight are reported elsewhere (refer to the article below).

Practically, athletes and coaches should seek help and advice from qualified dietitians and sport nutritionists before attempting to make weight. A list of accredited sport nutritionists can be seen [HERE](#).

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



James' Comments

"Personally, working with professional boxers and Olympic level Judo athletes, I know how important it is for them to make weight safely and allow them to perform to the best of their ability. For me, the data presented from this research group is alarming, and shows just how close the athlete was to potentially fatal outcomes, in particular to the acute kidney damage.

Although more and more research is now being performed on these athletes who are required to make weight for competition, it worries me that the people who can control the rules and regulations of such weigh in's are not willing to listen and thus change the rules around weight categories for the better. Will we see another fatal outcome this year like the one mentioned above?"

Can milk really help with adaptations following resistance training?

OBJECTIVE

It is well established in adult laboratory trials which exert resistance exercise programmes (see [HERE](#)), that the ingestion of carbohydrate and carbohydrate + protein combined, exerts beneficial effects on improving the adaptative response (strength) of muscle during the recovery period.

Similar studies in the applied setting and with adolescent participants are currently limited and thus the ability to translate previous work into practice with high-school aged athletes is difficult. Therefore, the aim of this study was to test the effects of a carbohydrate and carbohydrate + protein drink on strength changes in male and female high-school athletes.

WHAT THEY DID

Overall, 103 students were recruited from a 7-week summer strength and speed camp. Baseline and post-test measures included height, body weight, and strength assessments (bench press, squat, and power clean).

Athletes were placed into three training groups:

- ⇒ Group 1: junior varsity and varsity females grade 9 to 12 (n = 30).
- ⇒ Group 2: varsity males' grade 11 and 12 (n = 43).
- ⇒ Group 3: junior varsity males' grade 9 and 10 (n = 30).

The camp was held four days per week (Monday to Thursday) and each day consisted of:

- ⇒ 1-h free weight resistance training.
- ⇒ 1-h of on-field agility drills and conditioning sprints.

This was followed by ingestion of one dose of the assigned commercially available drink outlined below:

- ⇒ Carbohydrate: 709.7 ml, carbohydrate 42g, protein 0g, fat 0g, sodium 320, kcal 160.
- ⇒ Carbohydrate + protein: 473.1ml, carbohydrate 44g, protein 16g, fat 5g, sodium 360, kcal 300.

WHAT THEY FOUND

Overall, there was no change in body weight across the training programme and no effect of age, race, or ethnicity on group differences.

However, strength showed a significant effect on time across the 7 weeks and group. In particular, the chocolate milk group had a greater improvement in their overall strength score from pre-test to post-test (166.8 ± 73.5 kg to 187.3 ± 75.6 kg) compared to the carbohydrate group pre-test to post-test (179.7 ± 89.5 kg to 184.5 ± 85.5 kg).

Interestingly, further analysis of the results showed the chocolate milk group increasing their bench score from pre- to post-test whilst the carbohydrate group decreased their bench from pre-test to post-test.

» Practical Takeaways

This work builds on previous studies that have been reviewed in the Performance Digest, showing the beneficial effects of milk on strength adaptations. Practically, milk is a drink that can be added into lunchboxes, back-packs, and on the road to ensure young athletes have a good source of protein which can be drunk when required.

Further, the results from this study show the importance of working with commercial partners of high schools as well as key stake holders including coaches. In particular, during the planning stages of training programmes to ensure developments and adaptations from resistance-based training programmes are nutritionally supported. Overall, the benefits of consuming dairy should be well considered for any training programme and is discussed in depth in the podcast below.

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



James' Comments

"I really like this paper for a number of reasons.

Firstly, the study has taken traditional laboratory-based studies into the applied setting to re-test the hypothesis. For any coaches working with young athletes who are trying to develop physical qualities over summer breaks, then the implementation of a chocolate-based milk into the recovery strategy has to be performed.

Secondly, the study uses a drink that is globally available for consumption by adolescent athletes of all ages, can be purchased relatively cheaply in most shops, and service stations when on the road – a real practical advantage.

Finally, chocolate milk is something I have used for years with rugby players, football players, and boxers. Milk is one of the most nutritionally complete beverages and, in my opinion, is one of the go-to drinks for recovery following exercise or overnight - the farmers in the video below feel the same too."

Injury Prevention & Rehab

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

IMPLEMENTATION OF AN ADDUCTOR STRENGTHENING PROGRAM IN SUB-ELITE FOOTBALL PLAYERS

Haroy, J. et al. (2019) Scandinavian Journal of Medicine and Science in Sports.

WHAT ARE THE CLINICAL RISK FACTORS FOR ACHILLES TENDINOPATHY?

Van der Vlist, A.C. et al. (2019) British Journal of Sports Medicine.

ORTHOPAEDIC INJURIES IN THE ELITE ADOLESCENT ATHLETE

Strempler, M. E. et al. (2019) Frontiers in Physiology.



Implementation of an adductor strengthening program in sub-elite football players

OBJECTIVE

Groin-related injuries represent a significant problem in male football, accounting for 4-19% of all time-loss injuries. At the elite level, groin-related injuries occur in 14-17% of all players. The most recent preventative measure to help reduce the reoccurrence of groin-related injuries, the Adductor Strengthening program consists of a single exercise program based on the Copenhagen Adduction exercise which has shown to reduce the risk of groin problems among male football players by 41%.

This study looked at the implementation of the Adductor Strengthening Programme and what player's beliefs were towards groin injury prevention.

WHAT THEY DID

During the last weeks of the 2016 season, all 34 teams (632 players) from the Norwegian semi-professional football league were invited to complete a survey which focused on the implementation and effect of the Adductor Strengthening programme, based on the different dimensions of RE-AIM framework (this included Reach, Efficacy, Adoption, Implementation, and Maintenance).

WHAT THEY FOUND

The key findings of the survey were:

- ⇒ Prevention of groin injuries was considered at least moderately important by 95.5% of the players. However, when asked about their attitude towards preventative measures, only 50.1% of the players were positive.
- ⇒ Strengthening of the adductor muscles was considered important in reducing groin problems by 90.6% of the players in the intervention group. Of the players in the intervention group, 72.5% reported that they spent less than 5 min to complete the programme, 64.7% of players confirmed they would perform the programme the following season, while 52.2% reported they would perform the program less frequently.
- ⇒ Of the players in the control group, 53.3% reported that they had performed the program or other exercises to prevent groin injuries during the season.

» Practical Takeaways

Groin-related injuries are very prevalent in the sport of football, with many players missing time due to them. Players and coaches should consider the addition of an injury-prevention programme as single exercises have been shown to significantly reduce the risk of injury. Therefore, teams should prioritise the importance of strength training and its role in injury prevention.

Most players thought that a preventative program with strengthening exercises would reduce the prevalence of groin injuries. The majority of the players reported it took less than 5 min to complete the programme and very few wanted additional exercises. This shows us that players do understand the importance of injury prevention, however, there lies a barrier in implementation.



Jordan's Comments

"This study shows us that the addition of an injury-prevention program is needed in football and the implementation of the adductor strengthening programme is both time-efficient and effective in reducing groin-related injuries as reported by male football players.

It was interesting that although athletes believed there was a high incidence of groin-related injuries in football and that there is a need for preventative training, more than half reported that even though they would perform the programme in the following season, they would perform the programme less frequently and not abide by the current protocol. This relates to my own practice, as I have found that the more in-depth and time-consuming a programme is, the less likely the athlete is going to adhere to it.

We should be choosing specific exercises that offer the most benefit and are the most time-efficient."

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



What are the clinical risk factors for Achilles tendinopathy?

OBJECTIVE

The Achilles Tendon is one of the largest and strongest tendons in the body however, it can be subject to tendinopathy which could cause disabling effects for months. Achilles Tendinopathy is a common problem that is mostly seen in runners but is also seen in up to 1/3 of the sedentary population. Achilles tendinopathy has been reported in more than half of all Achilles tendon injuries, although the aetiology remains unclear.

The objective of this study was to evaluate the association between potential clinical risk factors and Achilles tendinopathy.

WHAT THEY DID

A search of cohort studies was conducted investigating the clinical risk factors for Achilles tendinopathy from five databases: Embase, MEDLINE Ovid, Web of Science, Cochrane Library, and Google Scholar. Sample sizes of the included cohort studies ranged from 69 to 80, with 106 participants (age range: 18-59 yr). After excluding duplicate studies and ones that did not meet the inclusion criteria, ten cohort studies were included from 5111 publications.

WHAT THEY FOUND

The nine clinical risk factors found that may increase the risk of Achilles tendinopathy include:

- 1) Prior lower-limb tendinopathy or fracture.
- 2) Use of ofloxacin (quinolone).
- 3) An increased time between heart transplantation and initiation of quinolone treatment for infectious disease.
- 4) Moderate alcohol use.
- 5) Training during cold weather.
- 6) Decreased isokinetic plantar flexor strength.
- 7) Abnormal gait pattern with decreased forward progression of propulsion.
- 8) More lateral foot roll-over at the forefoot flat phase.
- 9) Creatinine clearance of $<60 \text{ mL}\cdot\text{min}^{-1}$ in heart transplant patients.

» Practical Takeaways

For Achilles tendinopathy prevention and treatment, the advice to patients includes:

- ⇒ Reduce the use of alcohol to less than 7 units per week for men and less than 4 units for women.
- ⇒ Avoid the use of ofloxacin antibiotics if alternatives are available. Fluoroquinolones as a group demonstrate increased risk for Achilles tendonitis/rupture.
- ⇒ Improve plantar flexor strength by performing strengthening exercises of the calf muscles. Two exercise regimens include eccentric training and Heavy-slow resistance training (HSR).
- ⇒ Future studies should differentiate between mid-substance and insertional Achilles tendinopathy, as these both present and are treated differently.



Jordan's Comments

"This study shows us that although very prevalent across different populations, conclusive evidence for clinical risk factors for Achilles tendinopathy is limited. It was interesting to see that there was also limited evidence for the association between physical activity levels and Achilles tendinopathy.

Current research supports a gradual strengthening and loading progression involving principles of intensity, volume, and frequency for tendon adaptation and resiliency as the first line of treatment.

Two strengthening regimens, eccentric training and heavy-slow resistance training (HSR), have both yielded positive outcomes in patients with Achilles tendinopathy, however, more research needs to be done to further examine predisposing factors."

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



Orthopaedic injuries in the elite adolescent athlete

OBJECTIVE

Adolescence is an important time for the athlete as they undergo vast musculoskeletal growth, however, this can also make them at an increased risk of specific injuries.

The aim of this study was to look at the common types of orthopaedic injuries in elite adolescent athletes taking age, sex, and body mass index into consideration.

WHAT THEY DID

A retrospective injury analysis was performed on 381 adolescent elite athletes in the elite schools of sport in Germany between August 2009 and March 2015. The students were split into two age groups (11-14 yr and 15-17 yr) and represented sixteen different sports.

Data was recorded from a history and clinical examination of each student which included body part, as well as the cause and structure of the acute and overuse injuries. Injury events were analysed in the whole cohort and stratified by age and sex.

WHAT THEY FOUND

Key findings in this study were:

- ⇒ Most injuries were found in female athletes (60%) and athletes of the older age group 15-17 yr (66%),
- ⇒ Injuries were mostly localised to the lower-extremity (47%), followed by the spine (30.5%), and the upper-extremity (12.5%),
- ⇒ Acute injuries were predominantly located at the lower-extremity (73.5%), whereas, overuse injuries were equally observed at the lower extremity (41%) and spine (36.5%).
- ⇒ Overuse injuries were 3-to-6 fold more frequent than acute injuries, with the highest proportion occurring in endurance sports.
- ⇒ For acute injuries, the top three diagnoses were contusion (25%), capsular-ligament lesion (19%), and sprain (17%).
- ⇒ BMI had a significant influence on both the structure and the area of injuries in female athletes

» Practical Takeaways

The results of this study highlight that overuse injuries in the adolescent athlete are very common, with the most at risk being older female adolescents. The influence of age plays an important factor in the type of injury sustained, as older kids were more likely to sustain ligament pathology than younger kids (who were more likely to experience bony pathology).

The most common body part affected was the lower-extremity and spine, so injury-prevention programmes and strategies should not only be implemented, but designed to emphasise these specific injury trends in regards to age, sex, and body mass index.



Jordan's Comments

"This study shows us that we should be careful of youth sport specialisation as this can pose an increased risk of sports-related injuries. If athletes are practicing their respective sport more hours per week than their age, the risk of getting injured increases.

Knowing that the body is still growing in the adolescent athlete, we need to be mindful of this and monitor how much they are being pushed, as well encourage them to play multiple sports. Development of injury-prevention programmes starting with the youth athlete can help to decrease the risk and trends seen in this study."

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Infographics

A round-up of our monthly research infographics.

GPS MONITORING (PART 1)

Solomon, M. (2019) Science for Sport.

GPS MONITORING (PART 2)

Solomon, M. (2019) Science for Sport.





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GPS MONITORING (PART 1)

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What is it?

Global positioning systems (GPS) track the locomotive movements of athletes during both training and competition.



Importance

GPS devices can enable coaches to determine an athlete's; velocity, acceleration, deceleration, change of direction, distance covered during a training session.



How they work

The GPS device communicates with satellites to determine the athlete's current position in space and time.



Valid & Reliable

There is still an abundance of concern regarding the validity and reliability of GPS devices.

Frequency

GPS devices which sample at 10 or 15Hz (10-15x per second) have both been repeatedly proven to be more reliable at monitoring performance than 1 and 5Hz models.



Our summary

GPS devices are highly popular in team sports. Devices appear moderately reliable for measuring player locomotion but struggle during high-speeds, and during short and fast changes in direction. Part 2 will cover metrics and data use.

Movement speed

Reliability is reduced at speeds over 20km/h, with additional concerns over short distance movements. Practitioners should take caution when analysing data derived from short-distance, high-speed movements (e.g. small-sided games).



Signal interferences

Some GPS devices are able to connect to more satellites and obtain stronger connections. These units can typically provide more accurate data. The strength of these signals can often be affected by the surroundings such as; heavy tree cover, tall buildings, and stadiums.



Additional concerns

Reliability may also be affected by; location precision, software calculations, and/or hardware reliability, for example, reliability of the accelerometer.



For the full article check out the Science for Sport website

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GPS MONITORING (PART 2)

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Importance

The use of wearable technology in professional sports is common practice and can supplement the physical development department's ability to monitor athletic performance and readiness.



Metrics

There are numerous useful metrics, the sports scientist will often only monitor the ones they deem most important, useful, or reliable.

Distance

Total distance measures the "volume" of work in kilometres while relative distance is the average distance an athlete travels per minute. Scientists must understand how the way that these metrics are accumulated may alter the athletes level of fatigue.

Number of high-speed sprints

This metric is typically classified and reported using a 'work-rate zone'. It must be noted that the magnitude and volume of these is sport and athlete specific.

Accelerations

The extremely high energetic demand of accelerating and the disruptive effects on tissue from decelerating make these metrics important. However the poor accuracy of GPS units to measure accelerations and decelerations is well documented.

Metabolic Power

This metric aims to provide an overall estimate of total internal energy expenditure during a performance. Unfortunately there are concerns regarding the validity and reliability of this metric during sport-specific tasks.

Player Load

Player load is the "arbitrary measure of the total external mechanical stress as a result of accelerations, decelerations, changes of direction and impacts". There is currently a lack of transparency as to the algorithms which calculate this metric.

Our summary

Reliability issues associated with the micro-sensors are inherently passed onto the metrics, thus raising concerns with the variables used to monitor athletic performance. It is suggested that time is spent researching and identifying which metrics are most reliable, and appropriate for monitoring purposes.

For the full article check out the Science for Sport website

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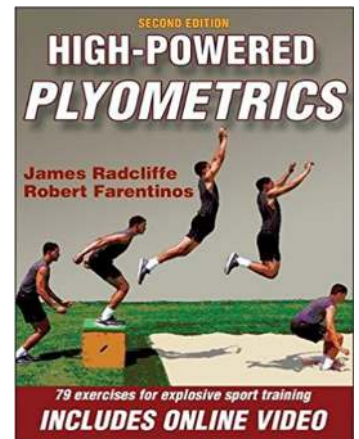
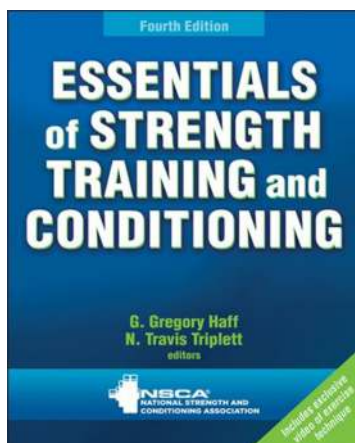
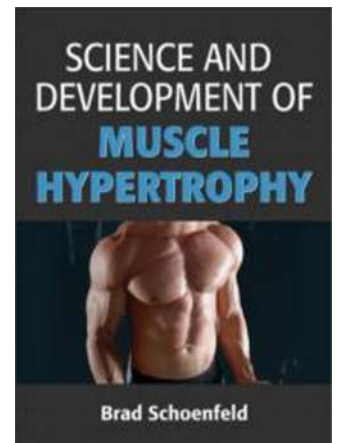
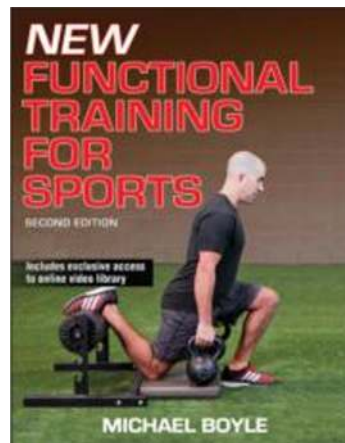
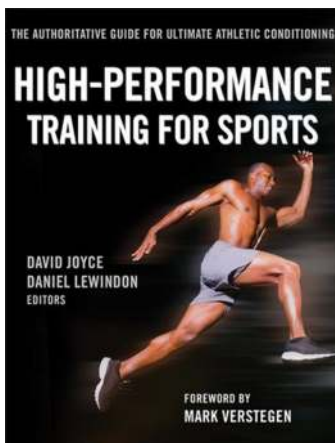




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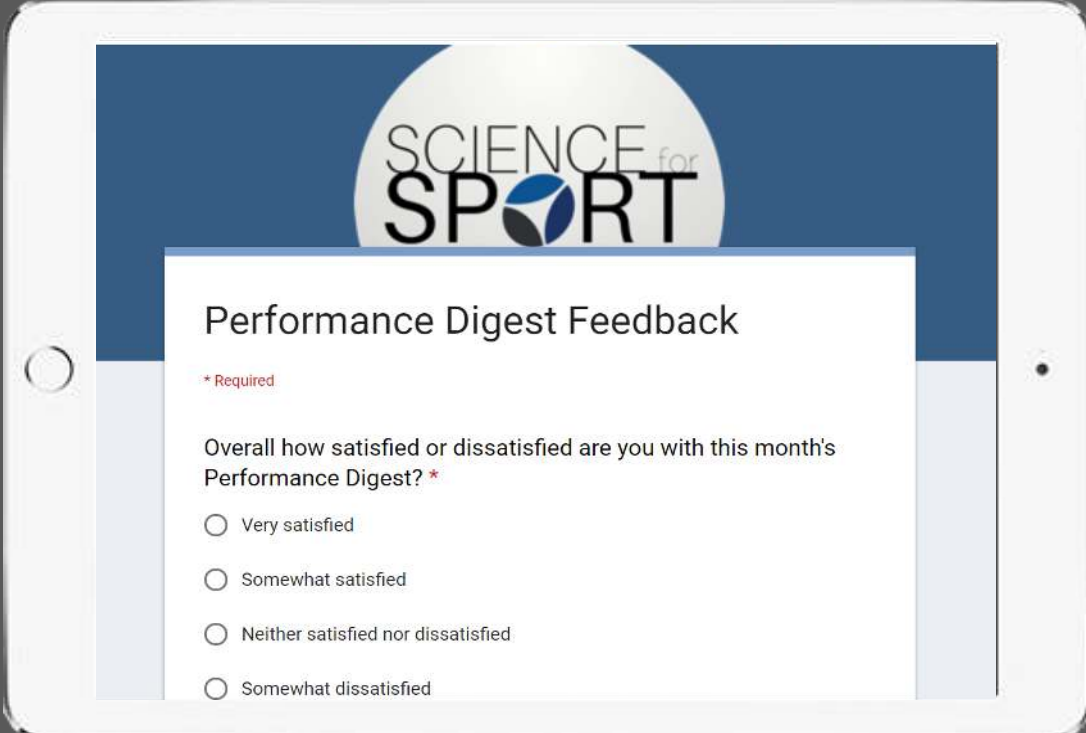
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