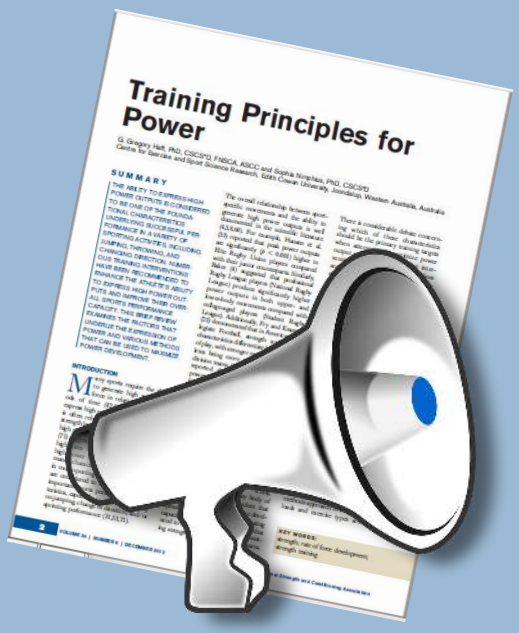
Research Alerts

JUNE EDITION: ISSUE #9

Your monthly roundup of the LATEST RESEARCH across the following topics.

(click a heading to jump straight to the topic)



SCIENCE for SPORT

Foreword

An introductory word from the chief editor.

Issue #9 - June 2017

Welcome to Science for Sport's monthly *Research Alerts*. These monthly issues are a gathering of the latest, and best, research published in that month from peer-reviewed journals. For example, research published within October 2016 will be included within the October 2016 issue - this ensures you're up-to-date with the most recent and talked about research. When there is not enough relevant research published in that month, studies published in the preceding month(s) will be used to supplement the topic. Each new issue will be published on the last day of the month (e.g. July 2017 issue will be published on the 31st July 2017).

With hundreds of studies published every month across the realms of sports science, the primary motivation of the *Research Alerts* is to help students, practitioners, researchers and educators alike keep up-to-date with the latest peer-reviewed research—which otherwise is a seemingly impossible task. The secondary motivation is to facilitate education within the global sports science community by critiquing the studies and displaying the information in a refreshingly digestible format.

With so much positive feedback from the Science for Sport members regarding all the content (i.e. articles, videos, jobs, research and so much more) currently delivered, we felt these *Research Alerts* were a very important addition—and one we hope will be well received.

I would also like to take this opportunity to sincerely thank all the editors for their contributions and reviewing of these documents, as for without them, these would not be so valuable. It is an absolute pleasure working alongside such fantastic practitioners and academics , and I hope to see these relationships continue to develop and prosper.

Last, but by no means least, I hope you find these *Research Alerts* very helpful in your daily practice, and I'm sure you can appreciate just how much work goes into them every month. As a matter of courtesy, though we cannot always prevent you distributing these documents with other professionals, we kindly ask and hope for you to respect our work and refrain from sharing them freely.

Yours Sincerely,

Owen Walker

Owen Walker MSc*D CSCS

Founder, author and director of Science for Sport

SCIENCE for SPORT

Strength & Conditioning

This month's top research in strength & conditioning.

FEATURE

RESISTED SLED SPRINTING: WHICH LOAD IS BEST FOR POWER OUTPUT?

Cross MR, Brughelli M, Samozino P, Brown SR, and Morin JB. International Journal of Sports Physiology and Performance, 2017.

2

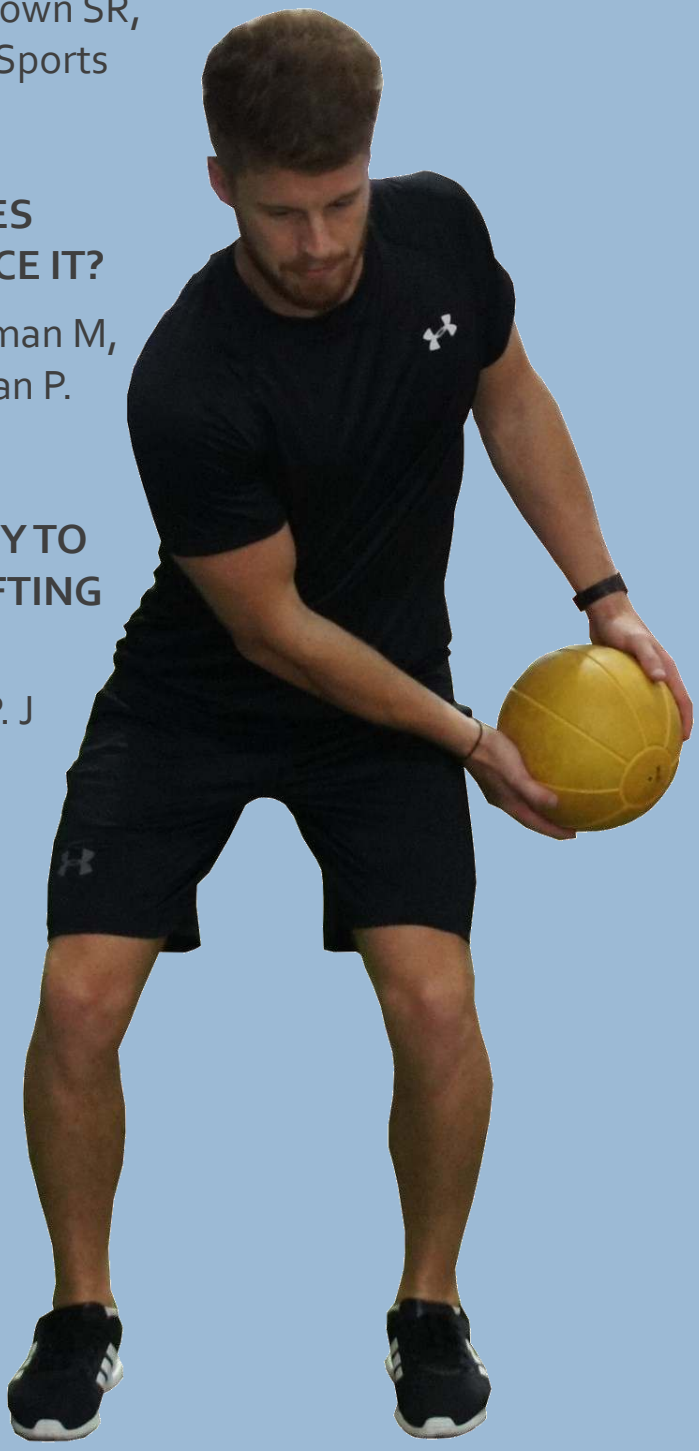
EXERCISE AND CHRONIC PAIN: DOES EXERCISING THROUGH PAIN REDUCE IT?

Smith BE, Hendrick P, Smith TO, Bateman M, Moffatt F, Rathleff MS, Slfe J, and Logan P. Br J Sports Med. 2017.

3

DEVELOPING AN ATHLETE'S ABILITY TO ABSORB FORCE: WHICH WEIGHTLIFTING EXERCISES ARE BEST?

Suchomel, TJ, Lake, JP, and Comfort, P. J Strength Cond Res 31(6): 1644–1652, 2017.



SCIENCE for SPORT

RESISTED SLED SPRINTING: WHICH LOAD IS BEST FOR POWER OUTPUT?

OBJECTIVE: The aim of this study was threefold: 1) to determine the validity and reliability of sled sprinting for force-velocity-power (FvP) profiling; 2) to identify which load optimises power output; and 3) to compare this between mixed-sport athletes and sprinters.

WHAT THEY DID:

27 athletes, consisting of 15 sprinters and 12 recreational mixed-sport athletes with ≥1 year of resisted sprint training experience performed multiple trials of maximal sprints, both unloaded and towing a selection of sled masses (20-120% body-mass). A radar gun was used to collect velocity data, whilst kinetics and peak velocity were measured using friction coefficients and aerodynamic drag. Individual force-velocity and power-velocity relationships were generated using linear and quadratic relationships, respectively. Mechanical variables, including optimal loading, were then calculated and test-retest reliability assessed.

MEASUREMENTS:

Force-velocity relationship
- Theoretical maximum velocity
- Theoretical maximum force
- Theoretical maximum relative force
- Slope of the linear force-velocity relationship
- Theoretical maximum normal load
- Theoretical maximum normal relative load

Power-velocity relationship
- Peak power
- Relative peak power
- Peak power with equation
- Force at peak power production
- Velocity at peak power production
- Normal loading at peak power
- Normal loading at relative peak power

Unloaded Sprint
- **Peak velocity**

WHAT THEY FOUND:

Using regression modelling, resisted sled sprinting appears to be valid and reliable for developing individual force-velocity and power-velocity relationships.

Loads of 79 and 83% of bodyweight appeared to be most effective for maximising peak power output during resisted sled sprinting in recreational athletes and sprinters, respectively. This is equal to a resistance of 3.4 and 3.6N·kg^{-1} and represents a velocity of 4.2 and 4.9 m·s^{-1}, respectively.

Sprinters appeared to be capable of producing higher power outputs (17-27%) at much greater velocities (17%) than recreational mixed-sport athletes.

WHAT THIS MEANS:

This study demonstrates that force-velocity and power-velocity profiles can be accurately profiled using classical resisted sled training. It also provides greater insight into the loads required to maximise power production (69-96% of body mass [equating in a velocity reduction of approx. 50%]) which are far higher than current recommendations (approx. 7-20% of bodyweight). In summary, this study not only displays optimal loading conditions for sled sprinting, but also demonstrates that practitioners can develop mechanical profiles of their athletes in order to better individualise programming.

To add to this, the study also highlighted the following rough distances required to reach maximum velocity when towing a given load.

Unloaded Sled = 45m; 20% bodyweight = 35m; 40% bodyweight = 30m; 60% bodyweight = 25m; 80% bodyweight = 25m; 100% bodyweight = 20m; 120% bodyweight = 20m.

LIMITATIONS:

A couple of weaknesses of this study include:

1. The sprinters wore spiked trainers, whilst the mixed-sport athletes wore standard running trainers. This may partially explain the better performances observed in sprint athletes.
2. The load of the sled was increased progressively, but in a non-randomised manner.

FUTURE RESEARCH:

Future studies should replicate this study in other athletic populations, for example, rugby and soccer players and perhaps even bobsleigh athletes due to the similarities between their sprint start and common resisted acceleration training protocols (i.e., prowlers).

Research should also investigate whether highly-individualised training using force-velocity-power profiling leads to greater improvements in performance compared to traditional training.

Cross MR, Brughelli M, Samozino P, Brown SR, and Morin JB. Optimal Loading for Maximising Power during Sled-Resisted Sprinting. International Journal of Sports Physiology and Performance, 2017. [Link]

SCIENCE for SPORT

TITLE

EXERCISE AND CHRONIC PAIN: DOES EXERCISING THROUGH PAIN REDUCE IT?

OBJECTIVE:

The aim of this review was to compare the effects of exercises which caused pain compared to non-painful exercises on pain perception, function or disability in patients with chronic musculoskeletal pain.

WHAT THEY DID:

Seven research databases (the Allied and Complimentary Medicine Database, the Cumulative Index to Nursing and Allied Health Literature, the Cochrane Library, Embase, Medline, SPORTDiscus and Web of Science) were searched for relevant studies published up to October 2016. From the search, 9 studies, totalling 385 participants, which met the inclusion-exclusion criteria were used for the review. The Cochrane risk of bias tool was used to evaluate the methodological quality of the studies, and the GRADE method was used to evaluate the quality of evidence.

WHAT THEY FOUND:

For exercises which caused pain, the results showed there was significant short-term reduction in pain with a small effect size (−0.27) and moderate quality evidence. However, there was no significant reduction in pain over medium- and long-term usage of painful exercises.

In summary, exercising into pain can offer small, but significant, short-term benefit over pain-free exercises for reducing chronic pain.

Reference:

Smith BE, Hendrick P, Smith TO, Bateman M, Moffatt F, Rathleff MS, Slfe J, and Logan P. Should exercises be painful in the management of chronic musculoskeletal pain? A systematic review and meta-analysis. Br J Sports Med. 2017. [Link]

EDITORS COMMENTS:

"Anyone who works with, or has worked with, an abundance of athletes/clients will be all-to-familiar with certain individuals who experience symptoms of chronic pain (i.e., an old injury but still get symptoms of pain). If you're reading this thinking "yes, I know exactly what you're talking about" , you not doubt would've asked yourself this question before: If the exercise causes pain, shall I do it or not, and will it make it better or worse?

Well, research (this study in particular) is beginning to show us that exercising through that pain is beneficial for reducing chronic pain. So the answer is yes, you should exercise through it, providing the pain is below approx. 4/10 on the visual analogue scale of pain."

Owen Walker

TITLE

DEVELOPING AN ATHLETE'S ABILITY TO ABSORB FORCE: WHICH WEIGHTLIFTING EXERCISES ARE BEST?

OBJECTIVE:

The aim of this study was to examine and compare the load absorption characteristics of certain weightlifting derivatives.

WHAT THEY DID:

12 resistance-trained NCAA Division III track and field male athletes with > 2 years' experience training with weightlifting derivatives participated in this study. Participants performed the hang power clean (HPC), jump shrug (JS), and the hang high pull (HHP) on a force platform with loads representing 30, 45, 65, and 80% of their 1RM HPC. The duration (ms), average force (N), and work (J) were all calculated using the force -time data.

WHAT THEY FOUND:

With regards to the duration of the load absorption phase, the HHP was significantly longer than the HPC ($p < 0.001$) and JS ($p < 0.001$), with no difference observed between the HPC and JS. In terms of average force absorption, the JS was significantly higher compared to the HPC ($p < 0.001$) and the HHP ($p < 0.001$), with no difference between the HPC and HHP observed. In terms of work completed, the JS demonstrated significantly more load absorption in comparison to the HPC ($p < 0.001$) and the HHP ($p < 0.001$). Also, the load absorption of the HHP was significantly greater than for the HPC ($p < 0.001$). Lastly, the external load (30, 45, 65, or 85% of 1RM) appeared to have no effect on the duration, average force, or work completed during the load absorption phase.

In summary, the results from this study suggest that the weightlifting pulling derivatives (JS and HHP) produced greater load absorption demands than the catching derivative (HPC). It also suggests that the external load has no effect on the magnitude of the load absorption. As such, the JS and HHP may be more beneficial than the HPC for developing the load absorption capacity of the athlete.

Reference:

Suchomel, TJ, Lake, JP, and Comfort, P. Load absorption forcetime characteristics following the second pull of weightlifting derivatives. J Strength Cond Res 31(6): 1644–1652, 2017. [Link]

EDITORS COMMENTS:

"To be honest, I love studies like this because the results were a surprise to me, but once you give it good thought it does seem to add up correctly. My previous 'train of thought' had me believing that catching derivatives may be better for developing an athlete's load absorption capacity over the pulling derivatives—but apparently not.

Also, the fact that a 30% 1RM load produces the same stimulus as a 80% 1RM is most likely because the decrease in load is accompanied with an increase in displacement, meaning gravity will do its thing and increase the downward acceleration of the total load (barbell and athlete). Interesting huh!

Because of the historical debate between using weightlifting derivatives vs. loaded jumps (e.g., loaded jump squats), what I'd really like to see is the load absorption characteristics of these exercises compared against one another. And if loaded jumps produces higher load absorption characteristics, then would it be another reason to not bother using weightlifting exercises and their derivatives?"

Owen Walker

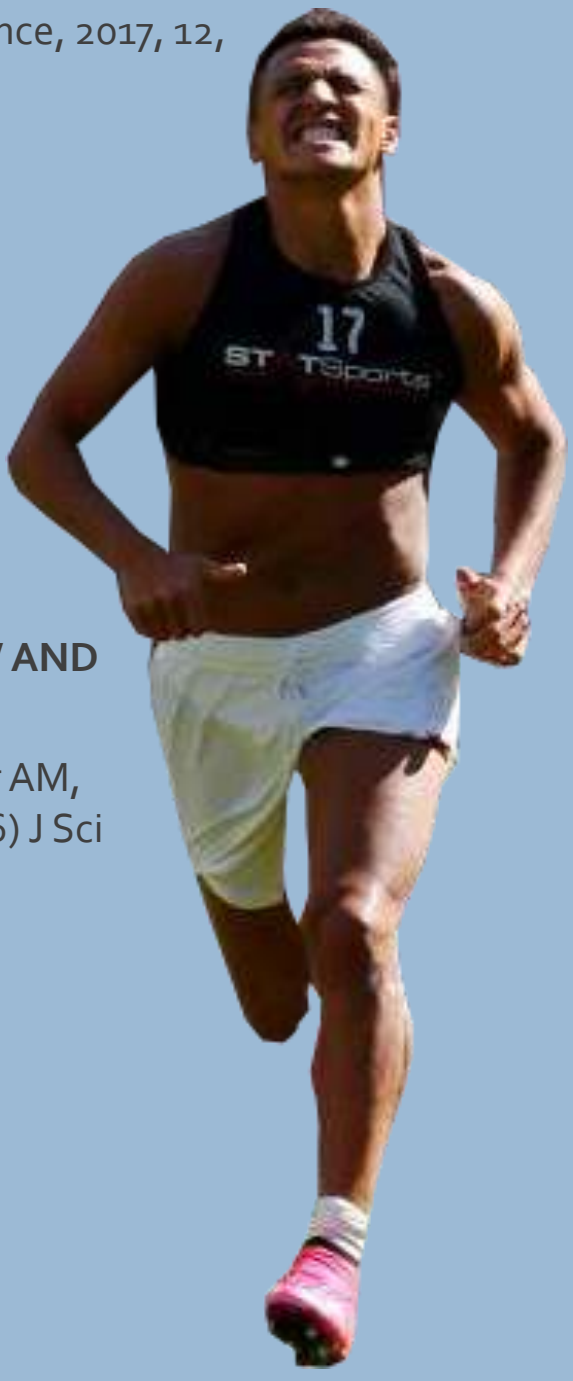
Technology & Monitoring

This month's top sports science research on technology and monitoring.

FEATURE

MONITORING TRAINING-LOADS: WHICH VARIABLES MATTER?

Williams S, Trewartha G, Cross MJ, Kemp SPT, and Stokes KA. International Journal of Sports Physiology and Performance, 2017, 12, S2-101 -S2-106.



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GPS TECHNOLOGY: HAVE WE BEEN MEASURING THE WRONG THINGS?

Buchheit M and Simpson BM. International Journal of Sports Physiology and Performance, 2017, 12, S2-35 -S2-41.

3

FITBIT ACTIVITY MONITORS: ALL SHOW AND NO GO?

Reid RER, Insogna JA, Carver TE, Comptour AM, Bewski NA, Sciortino C, Andersen RE. (2016) J Sci Med Sport.

SCIENCE for SPORT

MONITORING TRAINING-LOADS: WHICH VARIABLES MATTER?

OBJECTIVE: The purpose of this study was to outline a systematic process of data reduction and variable selection by monitoring multiple variables and relating them to the occurrence of injuries.

WHAT THEY DID:

Over the 2013-14 English Premiership season, the training-loads of 173 professional Rugby union players were monitored using the session rating of perceived exertion (sRPE; modified BORG 1-10 scale) method, with injuries reported via an established surveillance system. 10 derivative measures of sRPE training-load were identified from existing literature and subjected to principal-component analysis. A representative measure from each component was selected by identifying the variable that explained the largest amount of variance in injury risk from univariate generalized linear mixed-effects models.

MEASUREMENTS

- Daily training load (AU)
- 1-wk cumulative load (AU)
- 2-wk cumulative load (AU)
- 3-wk cumulative load (AU)
- 4-wk cumulative load (AU)
- Week-to-week change (AU)
- Training monotony (AU)
- Training strain (AU)
- Acute:chronic workload (%)
- Exponentially weighted moving average (AU)

WHAT THEY FOUND:

Over the course of the season, 173 players provided 32 ± 8 training weeks' worth of data (totalling 8027 individual training weeks), mean weekly training-loads were 1706 ± 239 AU, and a total of 465 time-loss injuries (303 match, 162 training; 391 contact, 74 noncontact) were reported. From this, the following variables were deemed to be the most useful for monitoring injury risk:

1) Daily training load (AU)
2) 4-wk cumulative load (AU)
3) Acute:chronic workload (%)

WHAT THIS MEANS:

The results from this study showed that these three variables were most useful for predicting injury risk in comparison to all the other variables measured. However, it is important to understand that these results are likely to be unique to the athletes and data within this study, so it may not transfer to your own cohort.

Having said that, what is just as important with this study, is the fact that the authors demonstrated a systematic process of data reduction which can be applied by sports science and medicine practitioners in order to establish which variables are most applicable and useful for their cohort of athletes.

LIMITATIONS:

A couple of key limitations to this study are:

- Due to the use of a single study group (Rugby union players), the results may only be applicable to this cohort.
- The participants understanding of the BORG 1-10 scale was not clearly stated, meaning players from some teams may have under– or over-estimated RPE more so than others. This would obviously cause issues with regards to calculating training-load and having consistency amongst the data.

FUTURE RESEARCH:

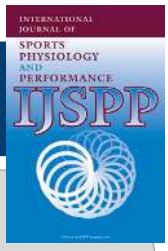
Future research should replicate this study, using the same data reduction methods, and apply it into other sports (e.g., football, Australian Rules Football). After this, they should then attempt to investigate other external load monitoring variables, such as GPS.

Williams S, Trewartha G, Cross MJ, Kemp SPT, and Stokes KA. Monitoring What Matters: A Systematic Process for Selecting Training-Load Measures. International Journal of Sports Physiology and Performance, 2017, 12, S2-101 -S2-106. [Link]

SCIENCE for SPORT

TITLE

GPS TECHNOLOGY: HAVE WE BEEN MEASURING THE WRONG THINGS?



OBJECTIVE:

The objective of this study was to discuss the current trends in player-tracking technology (e.g., GPS) and highlight its primary pitfalls and provide some solutions.

WHAT THEY DID:

Drawing upon the research and their own experiences, the authors discuss issues regarding the validity and reliability of some of the commonly used metrics, and with coach implementation.

WHAT THEY FOUND:

The authors highlight and discuss how some of the most commonly used metrics, and those often deemed most useful (e.g., high-speed running, accelerations/ decelerations, and metabolic power) are actually some of the most useless due to issues with accuracy. The issues with these metrics can come from various sources, for example, software/firmware updates, geometric dilution of precision, Doppler versus local coordinates, and even the time-intervals used in the algorithms to calculate acceleration instead of distance (i.e., 1-m).

Instead, the authors provide some solutions to ensure quality data capturing and trustworthiness in the information. Some of recommended metrics include: force load (different to Player/Body Load), force load in relation to velocity or distance, and stride characteristics.

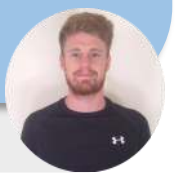
Reference:

Buchheit M and Simpson BM. Player-Tracking Technology: Half-Full or Half-Empty Glass? Brief Review. International Journal of Sports Physiology and Performance, 2017, 12, S2-35 -S2-41. [Link]

EDITORS COMMENTS:

"For anyone working with GPS or RFID, this article and included information will have profound importance to your everyday practice—so I strongly suggest you read it! It's open-access and is available by clicking the link above.

I feel the development of the force load metric, in combination with RFID (radio frequency identification), may pave the way for physical analysis in sport in the coming years. I also firmly believe that GPS has already met its sell-by-date and is only a matter of time before in becomes redundant."



Owen Walker

TITLE

FITBIT ACTIVITY MONITORS: ALL SHOW AND NO GO?

OBJECTIVE:

The aim of this study was to examine the accuracy of the Fitbit One and Fitbit Flex activity monitors in measuring steps, sedentary time, and time spent in light, moderate, and vigorous intensity activities in free-living conditions.

WHAT THEY DID:

22 females (aged: 21.23 ± 1.63 years) wore two Fitbit Ones (bra and waist), one Fitbit Flex on the wrist, and one ActiGraph GT3X+ on the waist for 7 consecutive days. The ActiGraph GT3X+ was used for comparison as it is often seen as a "gold-standard" for activity monitors. A repeated measures ANOVA was used to examine the differences between steps, sedentary time, and time spent in light, moderate and vigorous intensity activities among the four devices.

WHAT THEY FOUND:

In terms of steps recorded, no differences were found between any of the devices. However, the Fibit One, placed in both the bra and waist, significantly overestimated the time spent in light intensity activities. Similarly, both the Fitbit One (waist) and Fitbit Flex overestimated the time spent in moderate intensity activities. Again, the Fitbit One (waist and bra) and Fitbit Flex overestimated the time spent in vigorous intensity activities. Lastly, all Fitbit activity monitors underestimated sedentary time.

In summary, all Fitbit activity monitors underestimated sedentary time and overestimated moderate and vigorous physical activity.

Reference:

Reid RER, Insogna JA, Carver TE, Comptour AM, Bewski NA, Sciortino C, Andersen RE. (2016) Validity and reliability of Fitbit activity monitors compared to ActiGraph GT3X+ with female adults in a free-living environment. J Sci Med Sport. [Link]

EDITORS COMMENTS:

"Not a great day for the Fitbit crowd, but I'd be surprised if people genuinely believed they were accurate for measuring everything. It's not all bad though because they were shown (in this study), and have been shown before (**HERE**) to be reliable step counters—although that previous study looked at the Fitbit Zip.

Part of the trouble with these trackers is the validity and reliability of them can be compromised by even a software/firmware update and by the time research catches up, there's already an update/ updated model on the shelves—we simply cannot keep up, in my opinion. So whilst understanding the accuracy of these things are great, it doesn't really mean a lot in the grand scheme of things. What I believe may be more important, is whether wearing one increases physical activity, and one review (**HERE**) has shown that they can increase daily steps by 2,500. So they may not be 100% accurate, but at least they're getting people moving!"

Owen Walker

Fatigue & Recovery

This month's top sports science research on fatigue and recovery.

FEATURE

ICE BATHS VS. CRYOTHERAPY: WHICH IS BETTER FOR REDUCING BLOOD FLOW AND TISSUE TEMPERATURE?

Mawhinney, C., D. A. Low, H. Jones, D. J. Green, J. T. Costello, And W. Gregson. Med. Sci. Sports Exerc., Vol. 49, No. 6, pp. 1252–1260, 2017.

2

DOES ELITE SPORT AFFECT SLEEP QUALITY?

Gupta L, Morgan K, Gilchrist S. Sports Med. 2017 Jul;47(7):1317-1333.

3

COMPRESSION GARMENTS: DO THEY AFFECT THE CARDIOVASCULAR AND NERVOUS SYSTEMS?

Piras, A and Gatta, G. J Strength Cond Res 31(6): 1636–1643, 2017.

SCIENCE for SPORT

ICE BATHS VS. CRYOTHERAPY: WHICH IS BETTER FOR REDUCING BLOOD FLOW AND TISSUE TEMPERATURE?

OBJECTIVE: The purpose of this study was to compare the effects of cold water immersion (CWI) and whole-body cryotherapy (WBC) on lower limb tissue temperature and blood flow after exercise.

WHAT THEY DID:

10 recreationally active males (aged: 22.3 ± 3.4 years) were randomly allocated to either the CWI or WBC protocol in a crossover design, separated by a minimum of 1-week. The CWI protocol consisted of 10-mins immersion in 8˚C water to waist level (iliac crest), while the WBC consisted of 2-mins full-body exposure in a cryo-chamber at –110˚C. Before the WBC exposure, participants entered a pre-chamber for 30-secs at –60˚C. All thermoregulatory and hemodynamic measures (see measurements) were assessed before and 4-mins after the intervention.

MEASUREMENTS:

- Rectal temperature
- Thigh skin temperature
- Deep and superficial thigh muscle temperature
- Thigh blood flow (laser Doppler flowmetry)
- Calf blood flow (laser Doppler flowmetry)
- Superficial femoral artery blood flow (duplex ultrasound)
- Heart rate
- Arterial blood pressure

WHAT THEY FOUND:

- Immediately after exposure, the CWI protocol saw far greater reductions in thigh skin (–5.9 vs. –0.2%), superficial (–4.4 vs. –1.8%) and deep (–2.9 vs. –1.3%) tissue temperature in comparison to WBC, respectively.
- The CWI intervention observed greater decreases in femoral artery conductance in comparison to WBC (–84 vs. –59%, respectively).
- The CWI group also observed greater reductions in thigh (–80 vs. –59%) and calf (–73 vs. –45%) blood flow in comparison to the WBC group, respectively.
- Heart rate significantly decreased during the cold exposure in both the CWI and WBC groups ($p < 0.001$) and returned within 10mins after the exposure in the CWI group. However, heart rate remained significantly higher in the WBC group throughout the post-cooling recovery period.
- While systolic blood pressure remained the same in both the pre- and post-intervention groups, diastolic pressure and mean arterial pressure were higher at 10– and 40-mins after the CWI protocol.
- Lastly, the reductions in rectal temperature were similar between groups and not statistically different.

WHAT THIS MEANS:

The findings from this study suggest that when CWI and WBC are applied in the same manner as they were in this study (i.e., 10-mins in 8˚C water to waist height versus 2-mins, full-body exposure at –110˚C), CWI immersion appears to be more effective for reducing superficial and deep tissue temperature, decreasing blood flow, and increasing diastolic and mean arterial pressure.

Although CWI appears to be more effective, it is also important to acknowledge that WBC also appears to be an effective median for reducing superficial and deep tissue temperature, decreasing blood flow, and increasing post-exposure heart rate.

LIMITATIONS:

Several key limitations of this study are:

1. Small sample size ($n = 10$).
2. No control group
3. The WBC temperature was warmer than often used (e.g., –135˚C)
4. The participants moved around in the WBC which may have affected blood flow parameters, for example.

FUTURE RESEARCH:

Future research should look to replicate this study with a larger sample size, elite athletes, and after strenuous physical activity.

It would also add value by measuring the same thermoregulatory and hemodynamic responses over a longer period of time (e.g., up to 48-hrs post-exposure), including the likes of muscle soreness.

Mawhinney, C., D. A. Low, H. Jones, D. J. Green, J. T. Costello, And W. Gregson. Cold Water Mediates Greater Reductions in Limb Blood Flow than Whole Body Cryotherapy. Med. Sci. Sports Exerc., Vol. 49, No. 6, pp. 1252–1260, 2017. [Link]

SCIENCE for SPORT

TITLE

DOES ELITE SPORT AFFECT SLEEP QUALITY?

Reference:

Gupta L, Morgan K, Gilchrist S. Does Elite Sport Degrade Sleep Quality? A Systematic Review. Sports Med. 2017 Jul;47(7):1317-1333. [Link]

OBJECTIVE:

The aim of this review was twofold: 1) examine the structure, patterns and quality of sleep in elite athletes; and 2) to consider which factors cause the greatest sleep disturbance.

WHAT THEY DID:

Four research databases (SPORTDiscus, PubMed, Science Direct and Google Scholar) were searched for relevant studies published up to April 2016. From the search, 37 studies which met the inclusion-exclusion criteria were used for the review.

WHAT THEY FOUND:

Although there is little high-quality research on this topic, elite-level athletes appear to have a high prevalence of insomnia symptoms. These symptoms are characterised by longer sleep latencies (i.e., the time it takes to fall asleep), greater sleep fragmentation (i.e., continuously waking and falling back to sleep), non-restorative sleep (i.e., unrefreshing), and excessive daytime fatigue (i.e., tiredness, lethargic, etc). The two mechanisms believed to cause these symptoms of insomnia are: sleep restriction and pre-sleep cognitive arousal.

EDITORS COMMENTS:

"Given the importance of sleep on health, performance and recovery, ensuring athletes get sufficient high-quality sleep is critical. And as elite athletes endure rigorous training regimes which demands a lot of recovery time and far exceeds the demands of the non-athletic general public, my question to you is: what are you doing to improve the sleep and recovery of your athletes, and how much thought have you given it?

The outcomes of this study suggest we need to ensure we maximise sleep hours and reduce pre-sleep cognitive arousal. Not every sport is the same, nor is every athlete. E.g., swimming and rowing athletes often wake very early for training which causes issues with sleep restriction, while individual or image-based sports (e.g., bodybuilding) may also cause greater pre-sleep cognitive arousal due to stress and anxiety. It has been suggested that this may be less pronounced in team sport athletes due to the diffusion of responsibility amongst team mates—unlike individual sports."

Owen Walker

TITLE

COMPRESSION GARMENTS: DO THEY AFFECT THE CARDIOVASCULAR AND NERVOUS SYSTEMS?

Reference:

Piras, A and Gatta, G. Evaluation of the effectiveness of compression garments on autonomic nervous system recovery after exercise. J Strength Cond Res 31(6): 1636–1643, 2017. [Link]

OBJECTIVE:

The purpose of this study was to examine the effects of a whole-body compression garment (CG) on hemodynamic parameters (i.e., cardiovascular system) and on vagal activity (i.e., nervous system) after a swimming performance.

WHAT THEY DID:

10 male national-level athletes (age: 21.60 ± 1.58 years) were tested with, and without, wearing the CG during the recovery phase in a non-randomised, non-crossover design on 2 separate days. On the first session, after completing a 400m freestyle swim, participants then completed passive rest for 90-mins (CON). On the second session, and after having completed the same 400m freestyle swim, participants then wore the CG for 90-mins in a supine position. Heart rate variability (HRV), baroreflex sensitivity (BRS), and hemodynamic parameters were recorded for the 90-min recovery phase.

WHAT THEY FOUND:

With regards to the nervous system, high frequency (HF) power of the R-R intervals, NN50 and pNN50 showed a faster recovery in the CG protocol in comparison to the control protocol. Contrastingly, the low frequency (LF) component, LF:HF ratio, and the BRS alpha index were all increased in the CON protocol in comparison to the GC protocol.

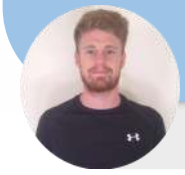
With regards to the cardiovascular system (i.e., the hemodynamic parameters), stroke volume remained constant and cardiac output increased in the CG protocol when compared to the CON protocol. The restoration on the pre-swim heart rate took 20-mins longer in the CON protocol than it did in the CG protocol.

In summary, the findings from this study suggest that whole-body CG has a positive influence on the recovery of the cardiovascular and nervous systems after maximal aerobic exercise.

EDITORS COMMENTS:

"CGs have been consistently shown to improve various aspects of recovery, but their effects on the nervous system in particular, are far less apparent. So when I saw this study, I thought it would be very useful to review its effects for you—i.e., to see if CGs influence HRV and hemodynamics. If you're not familiar with these topics, you can read about them **HERE** and **HERE**.

However, whilst these results may be promising for CGs, I will take this opportunity to highlight a couple of things which weaken the results of this study. 1) the groups were NOT randomised; 2) 10 participants is very minimal; 3) there was no control for caffeine intake; and 4) there was no control over the participants training during the study. Of course, these are just some of the issues with this paper, but they highlight the poor quality of this study and something you should lookout for when you're reading and interpreting research for yourself."



Owen Walker

Youths

This month's top sports science research on youth populations.

FEATURE

PREDICTING THE MATURITY OFFSET: ARE THE NEW EQUATIONS BETTER?

Kozieł SM, Malina RM. Sports Med. 2017.

2

THE IMPACT OF THE RELATIVE AGE EFFECT ON THE INTERNATIONAL STAGE

Müller L, Hildebrandt C and Raschner C. Journal of Sports Science and Medicine (2017) 16, 195-202.

3

YOUTH SPORT: ARE YOUR CHANCES BETTER IF YOU'RE OLDER AND BIGGER?

Johnson A, Farooq A and Whiteley R. Science and Medicine in Football. 2017.

SCIENCE for SPORT

PREDICTING THE MATURITY OFFSET: ARE THE NEW EQUATIONS BETTER?

OBJECTIVE: The aim of this study was to validate the new maturity offset prediction equations published in 2015 against the older, and traditional, Mirwald equations published in 2002.

WHAT THEY DID:

3 new equations (2 for boys, and 1 for girls) were evaluated using data from the Wroclas Growth Study and compared against the original Mirwald (2002) equations. The two new predictive equations for boys included: 1) chronological age and sitting height; and 2) chronological age and stature. The new predictive equations for girls included: chronological age and stature. Observed age at peak height velocity for each youth was estimated with the Preece–Baines Model 1.

MEASUREMENTS:

- Predicted age at peak height velocity = chronological age at prediction – maturity offset.
- Compared the validity of the new equations against the traditional equations using longitudinal data.
- Maturity timing (early, average, and late maturing)

WHAT THEY FOUND:

- For average maturing boys, the new equations were more accurate at predicting actual age of peak height velocity than the original equations, however, there was no differences with the equations for girls.
- Both the new and the old equations appear to consistently under- and over-predict the actual age of peak height velocity in late maturing and early maturing children of both sexes, respectively.
- The new equations had smaller variation for both predicted and actual age at peak height velocity.
- There is considerable intra-individual variation in predicted age at peak height velocity for all equations, original and new.

WHAT THIS MEANS:

The results from this study suggest that neither of the equations (new or original) are perfect for predicting maturity offset and actual age at peak height velocity. Having said that, the new equations appear to produce smaller variation when it comes to estimating predicted and actual age at peak height velocity, and were more accurate for predicting actual age at peak height velocity in average maturing boys, but not girls.

In a practical sense, it may be worthwhile adopting the new equations—perhaps even in conjunction with the old—when attempting to estimate the maturity offset and the predicted age at peak height velocity in young athletes. However, the gold standard for assessing maturity offset is still by using radiography to determine skeletal maturity. You can download our free maturity offset calculator **HERE**.

LIMITATIONS:

There were some key weaknesses to this study:

1. The data is only based on Polish children of European descendent.
2. Variations in maturity timing is also a consideration which was not accounted for in the present study. In other words, over the past century it is clear that the age of peak height velocity has fluctuated in many countries, but this was not accounted for.

FUTURE RESEARCH:

Future research should continue to improve current non-invasive methods of predicting the maturity offset and age at peak height velocity.

Kozieł SM, Malina RM. Modified Maturity Offset Prediction Equations: Validation in Independent Longitudinal Samples of Boys and Girls. Sports Med. 2017. [Link]

SCIENCE for SPORT

TITLE

THE IMPACT OF THE RELATIVE AGE EFFECT ON THE INTERNATIONAL STAGE

OBJECTIVE:

The purpose of this study was to examine the influence of the relative age effect (RAE) and biological maturity status on those selected to represent their country at the International Children`s Winter Games.

WHAT THEY DID:

The RAE of 572 participants/athletes (365 males, 207 females) and the biological maturity status of 384 participants/athletes (243 males, 141 females) included within the tournament were analysed. The maturity status of the participants/athletes was determined using the Mirwald (2002) predictive equations.

WHAT THEY FOUND:

The results of this study demonstrated that a significant RAE was present for both male and female athletes, and also for strength-, endurance- and technique-related sports. Among female athletes, the younger athletes who were selected for the tournament also appeared to be early maturers, demonstrating a significant maturation bias. However, the same was not observed for male athletes. When the athletes were divided into early, average, and late maturing athletes, very few late maturing athletes were present in the tournament – again, suggesting a significant maturation bias. The authors also found that older athletes had a 3.5 times greater chance of being selected for the tournament than younger athletes.

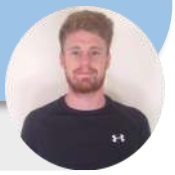
Reference:

Müller L, Hildebrandt C and Raschner C. The Role of a Relative Age Effect in the 7th International Children's Winter Games 2016 and the Influence of Biological Maturity Status on Selection. Journal of Sports Science and Medicine (2017) 16, 195-202. [Link]

EDITORS COMMENTS:

"Yet more evidence to stack on the pile which demonstrates the influence the RAE has on 'talent selection'. What's even better with this study is the fact they incorporated biological maturity into the mix to determine if the selection bias was just to do with when the athletes are born, or whether it is also to do with their physical maturation. The results showed physical maturation also played a big part in the selection bias.

This information corresponds with another recent study (**see below**) which showed that biological maturity status (calculated using radiography [X-ray]) had a much bigger influence—approximately 10-fold –over RAE when it came to on selection bias."



Owen Walker

TITLE

YOUTH SPORT: ARE YOUR CHANCES BETTER IF YOU'RE OLDER AND BIGGER?

OBJECTIVE:

The aim of this study was to examine the existence of the relative age effect (RAE) and maturity status (i.e., biological age) within elite academy football (soccer) players.

WHAT THEY DID:

472 elite youth footballers (U9's to U17's) from Manchester United Football Club and the Aspire Academy had their data compared to reference normative data to examine the effect of the RAE and maturity status on academy selection. Birth date (separated into yearly quarters), and skeletal age measured using radiography (X-ray) were used to classify players as early, average, or late maturers.

WHAT THEY FOUND:

The results of this study suggest that biological maturation has a much greater influence over selection – approximately 10-fold – than RAE. It also demonstrated that this maturation selection bias is relatively non-existent between U9-U11, but becomes significant at U12's and gets larger with every age group until U17's. On the other hand, the RAE was evident at all age groups apart from U17's.

Reference:

Johnson A, Farooq A and Whiteley R. Skeletal maturation status is more strongly associated with academy selection than birth quarter, Science and Medicine in Football. 2017. [Link]

EDITORS COMMENTS:

"These results demonstrate that athletes are being selected based on their age and physicality, putting younger and less physically developed players at a disadvantage.

This reoccurring trend is repeatedly demonstrating the significant disadvantage certain athletes are put under. What we need is solutions, and the concept of 'bio-banding' may well be one effective strategy (**READ HERE**). Another useful strategy, which involves using shirt numbering during tryouts, also appears to be doing the trick. If you're unsure what that is, check out our February issue (issue #5) of the *Research Alerts* to learn about it."

Owen Walker

Nutrition

This month's top research on nutrition.

FEATURE

BRANCHED-CHAIN AMINO ACIDS: ARE THEY USEFUL FOR MUSCLE PROTEIN SYNTHESIS?

Jackman S, Witard O and Philp A et al. (2017) Frontiers in Physiology, 8.

2

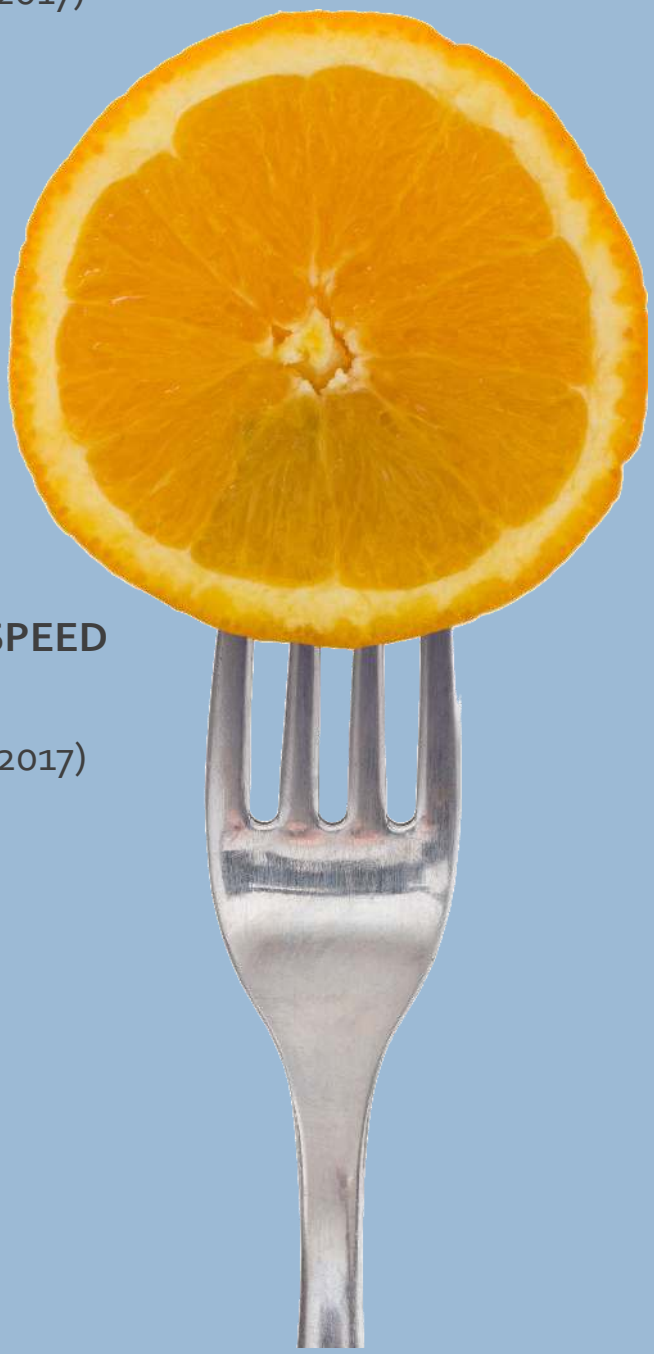
FOOD GROUPS AND RISK OF ALL-CAUSE MORTALITY: ARE SOME WORSE THAN OTHERS?

Schwingshackl L, Schwedhelm C and Hoffmann G et al. (2017) The American Journal of Clinical Nutrition, ajcn153148.

3

CAFFEINE AND BICARBONATE FOR SPEED ENDURANCE

Christensen P, Shirai Y and Ritz C et al. (2017) Frontiers in Physiology, 8.



SCIENCE for SPORT

BRANCHED-CHAIN AMINO ACIDS: ARE THEY USEFUL FOR MUSCLE PROTEIN SYNTHESIS?

OBJECTIVE: To determine the myofibrillar-MPS (muscle protein synthesis) response to ingestion of a drink containing Branched Chain Amino Acids (BCAAs), but no other Essential Amino Acids (EAAs), protein, or macronutrients, following resistance exercise.

WHAT THEY DID:

Ten young (20.1 ± 1.3 years), resistance-trained (≥2 x/week for >1 years) men completed two trials, ingesting either 5.6g BCAA (equivalent BCAA content of 20g whey protein) or a placebo (PLA) drink immediately after resistance exercise. The resistance exercise protocol consisted of four sets of 10 repetitions at 70% 1RM on the leg press machine and four sets of 10 repetitions at 75% 1RM on the leg extension machine. Measures of muscle anabolism were taken 1 and 4hrs-post BCAA or PLA drink.

MEASUREMENTS:

- Myofibrillar-MPS
- Phosphorylation status of mTORC1 signalling proteins
- Plasma amino acid concentrations

WHAT THEY FOUND:

Myofibrillar-MPS was 22% higher after BCAA ingestion than after consuming the placebo. A greater phosphorylation status of mTORC1 signalling proteins was observed in BCAA than PLA at 1hr-post drink ingestion. Therefore, the authors concluded that ingesting BCAAs alone increases the post-exercise stimulation of myofibrillar-MPS and phosphorylation status mTORC1 signalling.

However, the magnitude of this increase in MPS is relatively small. Previous studies have shown that consuming 20-25 g whey protein (providing approximately the same amount of BCAA as in this study), results in approximately double the increase in MPS.

WHAT THIS MEANS:

Despite their widespread popularity as supplements, this was the first study to examine the impact of isolated BCAAs on MPS rates. From this study, it is clear that BCAAs can stimulate myofibrillar-MPS following exercise, however, a full complement of essential amino acids is likely necessary to stimulate a maximal MPS response following resistance exercise. Therefore, ingestion of BCAAs alone is likely not the best nutritional strategy to maximise muscle growth post-resistance training, and instead, whey protein appears to be a superior option.

LIMITATIONS:

- Small sample size (10 subjects)
- Findings are confined to male participants
- Potential insufficient dose of BCAAs – 5.6g BCAAs is equivalent to 20g whey protein, however, trainees often consume closer to 30g whey protein post workout.

FUTURE RESEARCH:

Future research should investigate this topic using female participants to see if the same MPS response is observed. Furthermore, future research should examine whether consuming BCAAs during a workout (which is more common practice among gym goers) followed by whey protein post-workout enhances muscle hypertrophy gains long-term. Future research should also examine the impact of a higher dose of BCAAs equivalent to 30g whey protein.

Jackman S, Witard O and Philp A et al. (2017) Branched-Chain Amino Acid Ingestion Stimulates Muscle Myofibrillar Protein Synthesis following Resistance Exercise in Humans. Frontiers in Physiology, 8. [Link]

SCIENCE for SPORT

TITLE

FOOD GROUPS AND RISK OF ALL-CAUSE MORTALITY: ARE SOME WORSE THAN OTHERS?

OBJECTIVE:

To investigate the associations of 12 food groups, including whole grains, refined grains, vegetables, fruits, nuts, legumes, eggs, dairy, fish, red meat, processed meat, and sugar-sweetened beverages, with risk of all-cause mortality.

WHAT THEY DID:

The authors conducted a systematic review and meta-analysis of all available data from prospective studies on this topic published up until December 2016. They conducted a systematic search in PubMed, Embase, and Google Scholar for such studies, and included studies with participants ≥18 years of age.

WHAT THEY FOUND:

When compared with intakes always from the highest risk category, selecting optimal intakes of the investigated food groups can lead to a significant decrease (by ~80%) in the relative risk of premature death. With increasing intake (for each daily serving) of whole grains, vegetables, fruits, nuts, and fish, the risk of all-cause mortality decreased.

On the other hand, higher intake of red meat and processed meat was associated with an increased risk of all-cause mortality in a linear dose-response. Optimal consumption of risk -decreasing foods results in a 56% reduction of all-cause mortality, whereas consumption of risk-increasing foods is associated with a 2-fold increased risk of all-cause mortality.

Reference:

Schwingshackl L, Schwedhelm C and Hoffmann G et al. (2017) Food groups and risk of all-cause mortality: a systematic review and meta-analysis of prospective studies. The American Journal of Clinical Nutrition, ajcn153148. [Link]

EDITORS COMMENTS:

"Many food groups, such as dairy, fruit and whole grains, are often demonised by the media as being harmful to our health. This review shows that dairy, fruit and whole grains (among other food groups) are actually inversely associated with risk of all-cause mortality (i.e., good).

Furthermore, even for the food groups that this review identifies to be 'risk-increasing', it is important to understand that the risk is dose-dependent, and small amounts of these foods (such as red meat) are unlikely to meaningfully alter the risk of premature death."

Tim Rowland

TITLE

CAFFEINE AND BICARBONATE FOR SPEED ENDURANCE

OBJECTIVE:

To evaluate and compare the effect of the popular and potentially ergogenic supplements caffeine, bicarbonate, beta-alanine and nitrate on intense endurance exercise performance lasting 45-seconds to 8-minutes.

WHAT THEY DID:

The authors conducted a meta-analysis on the effect of caffeine, beta-alanine, bicarbonate and nitrate on endurance performance, with a strict focus on closed-end performance tests lasting from 45-seconds to 8-minutes. They conducted a systematic search in PubMed and SPORTDiscus, combined with evaluation of cross references, and a total of 7 (beta-alanine), 25 (bicarbonate), 9 (caffeine), and 5 (nitrate) peer-reviewed placebo controlled studies were included in the meta-analysis. For each study, performance was converted to an average speed (km/h) from which an effect size (ES) was calculated.

WHAT THEY FOUND:

A small effect and significant performance improvement relative to a placebo was observed for caffeine (ES: 0.41) and bicarbonate (ES: 0.40). On the other hand, trivial and non-significant effects on performance were observed for nitrate (ES: 0.19) and beta-alanine (ES: 0.17).

Reference:

Christensen P, Shirai Y and Ritz C et al. (2017) Caffeine and Bicarbonate for Speed. A Meta-Analysis of Legal Supplements Potential for Improving Intense Endurance Exercise Performance. Frontiers in Physiology, 8. [Link]

EDITORS COMMENTS:

"This review has significant implications for intense endurance athletes, as even a 1% change in average speed is enough to affect an athlete's placing in endurance events of this duration, such as the 100m and 200m swimming, 400m, 800m and 1,500m running, 4000 m track cycling and 2,000m rowing.

It is important to note that an individualised 'trial and error' approach is advised for all of these supplements, since factors such as diet, gender, muscle oxidative capacity and fiber distribution may impact on whether an ergogenic effect is obtained. However, experimentation with these supplements should occur in training and not during competition to ensure any potential negative effects of supplementation don't impact competitive performance."

Tim Rowland

Team Sports

This month's top sports science research in team sports.

FEATURE

ARE THERE LONG-TERM EFFECTS OF SPORTS-RELATED CONCUSSION?

Manley GT, Gardner AJ, Schneider KJ, et al. Br J Sports Med 2017;0:1–10.

2

ARE WE TRAINING THEM ENOUGH TO TOLERATE MATCH DEMANDS?

Tom G. A. Stevens, Cornelis J. de Ruiter, Jos W. R. Twisk, Geert J. P. Savelsbergh & Peter J. Beek (2017) Science and Medicine in Football.

3

TRAINING AND MONITORING IN ELITE RUGBY

Tavares, F., Healey, P., Smith, T. B., & Driller, M. (2017) J Sports Med Phys Fitness, in press.

4

CAN PREDICTIVE MODELLING BE USED TO ACCURACY PREDICT INJURIES?

Carey DL, Ong KL, Whiteley R, Crossley KM, Crow J, Morris M. Cornell University Library. 2017.

5

WORKLOAD RECOMMENDATIONS FOR FAST BOWLERS: ARE WE SLOWING THEM DOWN?

Schaefer A, O'Dwyer N, Ferdinands RED and Edwards S. Journal of Sports Sciences. 2017.

SCIENCE for SPORT

ARE THERE LONG-TERM EFFECTS OF SPORTS-RELATED CONCUSSION?

OBJECTIVE: The aim of this review was to assess the possible long-term effects of sports-related concussion in retired American Football players.

WHAT THEY DID:

After a search of 10 research databases, the authors refined the included studies down to 47 which met the inclusion-exclusion criterion. The study selection included: incidence, risk factors or causation related to long-term mental health or neurological problems; individuals who have suffered a concussion; retired athletes as the subjects and possible long-term sequelae defined as >10 years after the injury.

MEASUREMENTS:

- Study population
- Exposure/outcome measures
- Clinical data
- Cognitive assessment
- Neuroimaging findings
- Neurological examination findings
- Neuropathology results

WHAT THEY FOUND:

- Some former athletes have depression and cognitive deficits later in life, and there is an association between these deficits and multiple prior concussions.
- Former athletes are not at increased risk for death by suicide (two studies).
- Former high school American football players do not appear to be at increased risk for later life neurodegenerative diseases (two studies).
- Some retired professional American football players may be at increased risk for diminishment in cognitive functioning or mild cognitive impairment (several studies), and neurodegenerative diseases (one study).
- Neuroimaging studies show modest evidence of macrostructural, microstructural, functional and neurochemical changes in some athletes.

WHAT THIS MEANS:

The findings from this study suggest that sustaining multiple concussions appear to be a risk factor for cognitive impairment and mental health problems in some individuals. However, more research is needed to better understand the prevalence of chronic traumatic encephalopathy and other neurological conditions and diseases, and the extent to which they are related to concussions and/or repetitive neurotrauma sustained in sports.

Therefore, the results of this study suggest that there may be some connection between sports-related concussions and cognitive impairment and mental health problems later in life.

LIMITATIONS:

- The study research was limited to the English language.
- No relevant "third variables" were considered in the original research. For example, whether the athletes gave up all physical activity and abused drugs after retirement (both of these are linked to cognitive impairment).
- Studies could not be pooled together to conduct a meta-analysis due to heterogeneity between studies.

FUTURE RESEARCH:

Future research should aim to better understand the incidence and prevalence of chronic traumatic encephalopathy (i.e., dementia pugilistica) and other neurological conditions among former athletes. It should also aim to improve our understanding of the extent to which repetitive neurotrauma causes static, or progressive, changes in brain microstructure and physiology, and how that contributes to later life mental health and cognitive issues.

Manley GT, Gardner AJ, Schneider KJ, et al. A systematic review of potential long-term effects of sport-related concussion. Br J Sports Med 2017;0:1–10. [Link]

SCIENCE for SPORT

TITLE

ARE WE TRAINING THEM ENOUGH TO TOLERATE MATCH DEMANDS?

OBJECTIVE:

To quantify the physical loads of in-season training sessions by comparing them with match workloads. Also, to compare the training loads of the players that did not start the match (non-starting group) with main team training sessions and average match loads.

WHAT THEY DID:

Using a local positioning measurement (LPM) system the researchers analysed that external load of 28 elite outfield soccer players from the Dutch Eredivisie. They quantified the average loads across multiple metrics for 3 sets of match data, 44 regular training sessions and 32 non-starter sessions. The training sessions were categorized in 'match day minus' categories (MD-4, MD-3, MD-2, MD-1) for both the regular training sessions and the non-starter sessions. Linear mixed modelling was used to examine the differences between the multiple categories.

WHAT THEY FOUND:

The researchers found that training load decreased as the week progressed towards the match, in all of the metrics measured. The training load metrics that most closely reflected the match load throughout the training sessions were duration, high-threshold accelerations (> 3m/s^2) and medium (-1.5 to -3 m/s^2) and high-threshold decelerations (< -3m/s^{-2}). The training load metrics with the greatest discrepancy from match loads were time spent at >90% of max heart rate and high speed running (>19.8km/h). The training sessions designed specifically for the non-starting group were also shown to be significantly lower than match loads across all metrics and also lower than main group training sessions across the majority of metrics measured.

Reference:

Tom G. A. Stevens, Cornelis J. de Ruiter, Jos W. R. Twisk, Geert J. P. Savelsbergh & Peter J. Beek (2017) Quantification of in-season training load relative to match load in professional Dutch Eredivisie football players, Science and Medicine in Football. [Link]

EDITORS COMMENTS:

"The research presented demonstrates the training load measurements from one specific team playing in the Dutch Eredivisie, and therefore, must be taken as a case-specific example of in-season training load. However, it certainly does provide results that question how we periodise in-season training loads, in particular for the non-starting members of the squad.

A key point that arises from the results of this study, is the lack of high speed running (>19.8km/h) and time spent>90% of max heart rate during training sessions. Although this data may only be relevant to the team in the study, it does raise the question: Are your players performing enough high speed running and time spent above >90% of max heart rate? If not, they may be susceptible to hamstring injuries and reductions in fitness.

Lastly, the planning of non-starter training is difficult in the real world of football because there are multiple considerations that come into play. However, in this situation, it would seem reasonable to suggest that there would be some risk in putting these players into a 90-minute match situation."

Greg King

TITLE

TRAINING AND MONITORING IN ELITE RUGBY

OBJECTIVE:

The purpose of this study was to monitor the training load, wellness, neuromuscular performance and various perceptual measures of soreness of elite Rugby athletes during a non-competitive training week.

WHAT THEY DID:

Markers of load and fatigue were monitored during a training week where the athletes trained on days 1, 2 and 4. On each training day, the athletes attended 1 gym session (~75 min; 336 – 446 arbitrary units) and 2 rugby practices (day 1: 120 min, 7154 m; day 2: 135 min, 7059 m; day 3: 150 min, 9308 m). In addition to this, on day 2 athletes had an extra off-feet conditioning (44 min, 375 arbitrary units). Running load was measured as distance (m) and high metabolic load (m) via GPS and extra off-feet conditioning and gym-based sessions loads were obtained from the individual rate of perceived exertion (sRPE). Markers of fatigue were measured using a countermovement jump (CMJ), while perceptual fatigue was obtained every morning from a 5-item wellness questionnaire and a questionnaire on the muscle soreness of 9 different muscle sites from each side of the body.

WHAT THEY FOUND:

The running load was considered high in accordance to previous literature. During the training week, the load performed on day 4 was significantly higher in comparison to training days 1 and 2. Lower body muscle soreness and neuromuscular performance were more adversely affected after the cumulative workloads of days 1 and 2. During the training week, upper-body muscle soreness was not affected by training. After two days of rest, all markers returned to baseline. There were no significant differences in soreness ratings between left and right sides for any of the 9 muscles sites.

The findings from this study demonstrate the clear effect of training load on soreness and neuromuscular fatigue. Monitoring soreness from different lower-body muscle sites may provide important information that relates to the fatigue levels of Rugby athletes, and therefore, it is recommended to be included as part of the training load monitoring protocol.

Reference:

Tavares, F., Healey, P., Smith, T. B., & Driller, M. (2017) The effect of training load on neuromuscular performance, muscle soreness and wellness during an in-season non-competitive week in elite Rugby athletes. J Sports Med Phys Fitness, in press. [Link]

EDITORS COMMENTS:

"While the effect of training on different fatigue markers is not a novelty, the information on muscle soreness from different muscles is scarce in team-sport athletes.

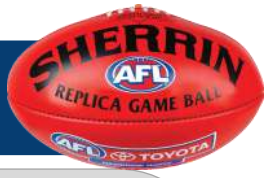
It's important to understand that monitoring fatigue and soreness from various lower-body muscle sites is more sensitive than using a single muscle soreness question. Moreover, upper-body muscles did not demonstrate any significant decrement from baseline, suggesting they may not a reliable site for monitoring purposes.

Practitioners are advised to incorporate a lower-body muscle soreness questionnaire (i.e., 5 questions), instead of a single question, to monitor the levels of readiness of their athletes."

Francisco Tavares

TITLE

CAN PREDICTIVE MODELLING BE USED TO ACCURACY PREDICT INJURIES?



OBJECTIVE:

To investigate whether training load monitoring data could be used to predict injuries in elite Australian football players utilising a variety of statistical and machine learning approaches.

WHAT THEY DID:

Three years of training load data from GPS and arbitrary measures were collected from an elite Australian Football club. Absolute and relative training load measures were then calculated for each player including rolling averages, exponentially weighted moving averages, acute:chronic ratios, monotony, and strain. These variables were then used in a variety of injury prediction models (Random forest, logistic regression, generalised estimating equations and support vector machines) to assess injury risk which was divided into non-contact, non-contact time-loss and hamstring (HS) injuries. Model accuracy was assessed on unseen data via a receiver operator curve (AUC).

WHAT THEY FOUND:

Only the multivariate logistic regression model had reasonable accuracy at identifying hamstring injuries (AUC = 0.72). All other models predictive accuracy was only marginally better than chance at predicting injury risk. Whilst the multivariate logistic regression performed reasonably at classifying HS injuries, to correctly capture only 50% of injuries in practice would incur a false positive rate of greater than 10% (more than 1 in 10 sessions unnecessarily modified).

Reference:

Carey DL, Ong KL, Whiteley R, Crossley KM, Crow J, Morris M. Predictive modelling of training loads and injury in Australian football. Cornell University Library. 2017. [Link]

EDITORS COMMENTS:

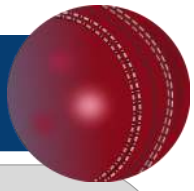
"This is one of the most practically relevant machine learning/statistical modelling papers I have come across. It highlights a lot of the current limitations that statistical/machine modelling approaches have when assessing injury risk within a practical setting.

Furthermore, it highlights the multifactorial nature of injury and while monitoring training load variables may be insightful, when used by itself it likely only explains a small amount of injury risk. However, as sporting organisations become more data driven and data set sizes get larger these techniques may eventually offer some practical insightfulness when assessing injury risk."

Dean Norris

TITLE

WORKLOAD RECOMMENDATIONS FOR FAST BOWLERS: ARE WE SLOWING THEM DOWN?



OBJECTIVE:

This study looked to determine whether a bowling workload which exceeded the recommendations for junior fast bowlers set by the National governing board led to changes in bowling technique and performance.

WHAT THEY DID:

Twenty-five junior fast bowlers bowled 60 balls at competition pace using a self-selected run-up on an indoor track the same length as a cricket pitch whilst aiming for a target on the ground. To try and replicate match conditions a non-bowling period which included walking and random fielding activities was performed following each over. Following this protocol, researchers then determined various kinematic and kinetic variables along with other bowling performance measures.

WHAT THEY FOUND:

For almost all the kinematic, kinetic and performance-based variables measured no significant changes were reported across the 10-over bowling spell which the researchers suggest may not indicate an increase in injury risk for junior fast bowlers.

Reference:

Schaefer A, O'Dwyer N, Ferdinands RED and Edwards S. Consistency of kinematic and kinetic patterns during a prolonged spell of cricket fast bowling: an exploratory laboratory study, Journal of Sports Sciences. 2017. [Link]

EDITORS COMMENTS:

"It is clear that during a single spell of bowling which exceeds the current recommendations for junior fast bowlers that few technical or performance changes occur, providing evidence that these recommendations require modifications if based on the increase in injury due to changes in bowling technique.

However, using the same technique over an extended period of time, either in one match or over a career, may actually be the cause of an increase in bowling-workload injuries. As stated, low variability of the bowling technique may be a causal factor in lower back injuries. Therefore, these the National governing board recommendations may indeed be required."

Will Vickery

Editors

The column editors for the Science for Sport monthly Research Alerts.

STRENGTH & CONDITIONING

TECHNOLOGY & MONITORING

FATIGUE & RECOVERY

YOUTHS

Owen Walker MSc*D CSCS

Owen is the founder, author 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. He also has a master's degree in strength and conditioning and is a NSCA certified strength and conditioning coach.

NUTRITION

Tim Rowland MSc ASCA L2

Tim is the Head Strength and Conditioning Coach at Asquith Rugby League Football Club, and currently assists at the Australian Rugby Sevens. He has a Bachelor of Physiotherapy (1st Class Honours), Master of High Performance Sport and ASCA Level 2.

FOOTBALL

Greg King MSc L2 ASCA

Greg is currently the High Performance Manager at Adelaide United Football Club (A-League). He has previously worked in the AFL with Port Adelaide Football Club as a strength and conditioning coach, and has completed a Master of Exercise Science (Strength and Conditioning) at Edith Cowan University and is also a qualified ASCA Level 2 Coach.

RUGBY

Francisco Tavares MSc CSCS PhD Candidate

Francisco is a PhD candidate at the Waikato University. He is also the Head of S&C at the Portuguese Rugby Union, a S&C Coach at the Chiefs Super Rugby in New Zealand and a guest lecturer for various universities in Portugal and Waikato University.

CRICKET

Will Vickery PhD BSc (Hons)

Will is a 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.

AUSTRALIAN FOOTBALL

Dean Norris MSc PhD Candidate

Dean is currently working as the strength and power scientist at the GWS Giants. He has bachelor in Exercise and Sport Science and Masters in High Performance Sport. Dean is also completing his PhD assessing the influence of strength qualities on recovery of neuromuscular function.

SCIENCE for SPORT