



15

ANNUAL CONFERENCE

15-16 JUNE 2019

Stadium MK
Milton Keynes

UKSCA

C O N F E R E N C E B R O C H U R E

EXHIBITORS

OUR EXHIBITORS ARE AN INTEGRAL PART OF OUR CONFERENCE, THEIR DETAILS CAN BE FOUND BELOW

ABSOLUTE PERFORMANCE

www.aperformance.co.uk



AUSTRALIAN STRENGTH AND CONDITIONING ASSOCIATION

www.strengthandconditioning.org



BLKBOX FITNESS

www.blkboxfitness.com



CATAPULT

www.catapultsports.com



ELEIKO

www.eleiko.com



FIRSTBEAT

www.firstbeat.com



HAB DIRECT

www.habdirect.co.uk



HAWKIN DYNAMICS

www.hawkindynamics.com



ORIGIN FITNESS

www.originfitness.com



PERFORM BETTER

www.performbetter.co.uk



PLAE

Plae.us



PLAYERMAKER

playermaker.com



PULLUM SPORTS

www.pullum-sports.co.uk



ROUTLEDGE

www.routledge.com



STATSPORTS

statsports.com



SHEFFIELD HALLAM UNIVERSITY

www.shu.ac.uk



UNIVERSITY OF GLOUCESTERSHIRE

www.glos.ac.uk



VALD PERFORMANCE

www.valdperformance.com



WATTBIKE

www.wattbike.com



WELCOME

FROM UKSCA CHAIRMAN CHRIS BISHOP



The Annual Conference is the flagship event for strength and conditioning (S&C) in the UK each year and it promises to deliver a wide spectrum of outstanding UK-based and international speakers sharing their expertise and knowledge with you, the members. If this is your first time at our Annual Conference, a very big welcome from us all at the UKSCA and we hope you have a thoroughly enjoyable weekend with us.

It is currently a very exciting time for S&C in the UK, with the organisation driving forward in a direction that promotes increased professionalisation of the sector for those just starting their careers and those with 20+ years' experience. The AGM will provide an overview of some of the changes already achieved and others we are working towards in the near future, all of which are underpinned by raising professional standards and employability for S&C in the UK. We hope you can join us to hear about these exciting developments and have your say in the future of our profession.

On a final note, I would like to say a big thank you to two individuals who have invested a huge amount of time into planning this event. Firstly to Anthony Turner, our conference director, who has organised a fantastic line-up of speakers this weekend. It promises to be an absolute cracker! Secondly, to Sarah Kilroy and her team, without whom we would be sincerely lost every time it came round to organising this event!

Enjoy your weekend and we look forward to seeing you!

FROM CONFERENCE DIRECTOR ANTHONY TURNER

The UKSCA annual conference has always provided us with a tremendous opportunity to learn from a series of incredible speakers and importantly, to come together as a strength and conditioning community to connect with old, new, and future friends and colleagues. In fact, a constant highlight of the conference is the atmosphere generated in which we can strengthen existing relationships and build new ones. This in turn drives forward our practice, research and the organisation as a whole. I hope this conference can continue to offer the same.

Given the success of previous conferences, this year has just a few new additions. Firstly, the oral presentations. These provide all our members with the opportunity to present and show case their work. For the audience, these provide a series of short talks, with data presented "ahead of print", along with emerging topics within our field. Collectively we will gain a glimpse into the future of our profession at what awaits around the corner. Secondly, given our bigger venue we can now look to run three parallel sessions, thus more variety as we look to capture the diverse interests of the membership. When applied to the pre-con, we can also attempt to make the sessions more practical in nature. We hope these additions prove valuable.



In closing, it is of course an incredible honour to be conference director and continue the tremendous work of all those involved in making the conference what it is today. I could not have done this without the help and advice of so many. Thank you to the board, in particular Kev Paxton, Dan Cleather and Chris Bishop, and also to Jon Hughes, Ben Jones and Rhodri Lloyd.

I hope you have a fantastic weekend!

SATURDAY SPEAKERS

BIOGRAPHIES



TRAVIS TRIPLETT (0930–1020) TRAINING FEMALE ATHLETES: IS IT REALLY THAT DIFFERENT?

SESSION OVERVIEW: This presentation will describe the physiological differences in male and female athletes and how these differences do or don't need to change how training is planned. In addition, the most common injuries in female athletes will be discussed, as well as a few areas that can be addressed in training that will help to avoid injuries.

BIOG: Professor of Exercise Science at Appalachian State University and the current President of the National Strength and Conditioning Association (USA), her past experience includes Research Assistant in Sports Physiology at the US Olympic Training Center, Postdoctoral Research Fellow at Southern Cross University in Australia and international research at the University of Jyväskylä (Finland) and the University of Valencia (Spain). Dr. Triplett has served as Senior Associate Editor for the Journal of Strength and Conditioning Research, Assistant Editor-in-Chief for the Strength and Conditioning Journal, and received the NSCA's Terry J. Housh Outstanding Young Investigator and William J. Kraemer Outstanding Sport Scientist awards. She also served on advisory boards for NASA, one of which developed resistance exercise countermeasures to micro-gravity environments for the International Space Station. She is a founding Fellow of the NSCA, and holds the Level 1 certification from USA Weightlifting.



JASON LAKE (1030–1120) FORCE PLATE ASSESSMENT

SESSION OVERVIEW: This session will introduce delegates to what they can use force plate assessment for, by considering the type of tasks that qualify for force plate assessment and going on to look at the variables needed to quantify these tasks. This involves revisiting some basic biomechanical principles, including Newton's laws of motion and the impulse-momentum theorem. The result will question why many of the popular and common variables are used, what they actually mean in the context of some of the more common tasks that are used within strength and

conditioning and what their limitations might be. The aim is to provide a better understanding of what tasks are appropriate for force plate assessment, what and why certain variables should be considered and why certain variables really should be avoided.

BIOG: Jason is currently a Reader in Sport and Exercise Biomechanics at the University of Chichester where he teaches on both undergraduate and postgraduate biomechanics modules and coordinates their MSc in Strength and Conditioning. His research attention has focused on the mechanical demands of resistance exercise and vertical jumping with more recent attention on methods used to assess the force-time characteristics of vertical jumping and the calculation of power output. In addition to this, Jason is considering appropriate methods for deconstructing the vertical jump force-time curves whilst he continues to focus on the mechanical demands of weightlifting derivatives and asymmetry at the foot-floor interface.

SATURDAY SPEAKERS

BIOGRAPHIES



MARK RUSSELL (1030–1120) MATCH-DAY STRATEGIES

SESSION OVERVIEW: Practitioners and athletes invest considerable time and resources into the optimisation of training and preparation in the days and weeks pre-competition. Ergogenic strategies employed on match-day, however, have received less attention. Elite sporting competitions typically start at various times throughout the waking day and athletes can be susceptible to changes in physical performance over this time. There is a role for interventions performed on competition day to enhance subsequent performance. With this in mind, Mark's talk

will focus on the opportunities that exist to enhance markers of team sports performance that can be executed in the hours before competition starts or during the event itself.

BIOG: Professor Mark Russell is based at Leeds Trinity University and focuses his research on topics allied to performance nutrition and applied exercise physiology for team sport athletes. Mark has published over 75 peer-reviewed articles, presented at international conferences and led multiple industry-funded contract research projects. He currently supervises a number of Doctoral candidates working on projects related to profiling the performance and physiological responses of soccer goalkeepers and team sport substitutes, optimising half-time strategies and facilitating recovery in Rugby League players. Mark also works with a range of professional rugby and football teams and has consulted to a number of English Premier League football clubs and National and International Rugby squads. As the National Lead for Applied Exercise Physiology with UK Deaf Sport between 2010 and 2017, he was responsible for the co-ordination of the sports science support services for DeaflympicsGB at the 2013 Summer Deaflympics held in Bulgaria.



EDWARD BAKER (1030–1120) PROBLEM SOLVING: LEARNING FROM WHEELCHAIR RUGBY

SESSION OVERVIEW: This talk has two themes; the problem-solving approach to physical preparation used in the 2016 Rio Cycle for the GB Wheelchair Rugby Team and the application of current advances in neurological rehabilitation to the S&C coach working across all sports. The material will explore S&C delivery for a decentralised squad with a range of severe impairments, playing a concurrent team sport with minimal resources. Edward will also draw on his experience in neurological rehabilitation to present examples of optimising nervous system performance for all athlete groups.

BIOG: Edward Baker graduated from Middlesex University with an MSc in Strength and Conditioning in 2010. He worked for Performance Hertfordshire at the University of Hertfordshire followed by a stint at the English Institute of Sport where he led first the GB Wheelchair Rugby and later the England Netball programmes. Since the beginning, his S&C career has been marked by a passion for Paralympic Sport. In 2017 he joined Neurokinex, a non-profit organisation providing specialist rehabilitation for spinal injuries. He is a guest lecturer at the University of Gloucestershire and UWE in Bristol, spanning both S&C and rehabilitation modules.

SATURDAY SPEAKERS

BIOGRAPHIES



ROB AHMUN (1150–1240) IMPLEMENTING A S&C STRATEGY IN INTERNATIONAL CRICKET

SESSION OVERVIEW: International cricket is played year-round and is now interspersed with various high-profile franchise competitions where players can earn vast sums of money. One of our performance problems is how do we keep the players fit to perform for their country when they are never really fully under our control and constantly in competition mode.

BIOG: Rob has worked in professional cricket for almost 15 years with teams including Glamorgan and Surrey Cricket. He is now National Lead for S&C with England Cricket and is responsible for managing the delivery of S&C services within the ECB and across the Professional Men's and Elite Women's Game, primarily to ensure performance impact and to provide quality assurance of S&C as a specialist support discipline within elite Cricket.



DEBBY SARGENT (1150–1240) THE MISSING PIECES OF THE FEMALE ATHLETE PUZZLE

SESSION OVERVIEW: With the increased professionalisation of female sport, the demand on the strength and conditioning coach to further individualised training programmes beyond the fundamentals, is of paramount importance. An improved understanding of physiological and psycho-social nuances of the female athlete is essential, yet the evidence-base to support training and coaching decisions is minimal. This session aims to simplify the complexity of female biology by highlighting and critically evaluating what has been studied, plus it aims to identify key areas for further investigation. A summary of key ideas will help coaches immediately improve understanding, awareness and impact on their female athletes training.

BIOG: Debby has over 20 years of experience working with high performance athletes has been a UKSCA Tutor and assessor since 2008. Debby currently works at the University of Gloucestershire (UoG) delivering undergraduate and postgraduate strength and conditioning courses. She is also responsible for delivery of services to TASS-funded athletes and manages a team of scholarship coaches that provide services to UoG performance teams. Prior to joining UoG, she was the Performance Sport Manager at the University of St Andrews and has also provided S&C and coach education to Scottish Rugby, Scottish Golf and Scottish Institute of Sport. She led on the Womens Artistic Gymnastics in the lead up to Glasgow 2014.

SATURDAY SPEAKERS

BIOGRAPHIES



EAMONN FLANAGAN (1150–1240) RE-THINKING REACTIVE STRENGTH

SESSION OVERVIEW: In this presentation Dr. Eamonn Flanagan will challenge his own philosophy and understanding on reactive strength testing and training. What do we know? How strongly do we know it?

BIOG: Dr. Eamonn Flanagan is the lead Strength & Conditioning Consultant with the Sport Ireland Institute where he oversees the S&C support to all Olympic and Paralympic sports. He has a PhD in Sports Biomechanics from the University of Limerick. Eamonn has previously worked for the Irish Rugby Football Union, the Scottish Rugby National Academy and Edinburgh Rugby.



DEAN RIDDLE AND PETE MCKNIGHT (1400–1450) DEVELOPING THE PRACTITIONER SKILLSETS TO WORK IN VARIOUS SPORTS ACROSS DIFFERENT INTERNATIONAL CULTURES

SESSION OVERVIEW: This session, hosted by Kevin Paxton, will cover how S&C coaches can develop their CPD strategy, practical skills and relationship building to be able to work in sports and environments different to their previous vocational experience. Dean and Pete will provide insights into how they have adapted their 'professional toolboxes' over their careers as the industry has changed.



DEAN BIOG: A high performance specialist with over 25 years of experience and a proven track record working across a range of sports and with world-class athletes, Dean Riddle has built a global network of relationships within the industry, including world class athletes and elite coaches. Dean has held various positions at a number of elite sports organisations including Strength & Conditioning coach, Sports Scientist and Performance Manager while living in the UK from 1991 to 2011. He moved to the USA in late 2011 to join Nike at the World HQ before joining the Seahawks in the summer of 2014 as the Applied Sports Scientist adding the NFL to Cricket, Rugby and Soccer in a diverse sporting background.

PETE BIOG: Pete is the Director of Coaching and Sport Science at Hinsta, working around the globe in F1 and Motorsports. Previously he has worked across multiple sports, countries and cultures with Olympic and professional athletes in sports such as Rowing, Athletics, Cricket, Swimming, Football and Alpine Skiing.

Pete has been an Accredited member of the UKSCA since 2005, serving on the Board of Directors for nine years, five of these as Chairman.

SATURDAY SPEAKERS

BIOGRAPHIES

MEMBER ORAL PRESENTATIONS / SHORT TALKS (1500–1550) THEMES AND SPEAKERS

ASSESSING AND UNDERSTANDING CHANGE OF DIRECTION SKILLS

MARK HELME / RICHARD CLARKE / THOMAS DOS SANTOS

TRAINING HIGH PERFORMING ATHLETES

DAN MCPARTLAN / ADAM SIMPSON / SHYAM CHAVDA

INJURY, RECOVERY AND REHABILITATION

CIAN GORMLEY / BEN YOUNG / ERWAN IZRI

DEVELOPING THE YOUTH ATHLETE

GILL MYBURGH / TOM BROMLEY / MATTHEW WRIGHT

OPTIMISING TRAINING INTERVENTIONS

IAN GREENWOOD / XIANG ZHAO / EMMA ARCHER



RICHARD HUNWICKS (1620–1710) FROM BUSINESS CLASS TO CATTLE CLASS: OPTIMAL PERFORMANCE AND PREPARATION IN TEAM SPORTS

SESSION OVERVIEW: This session will give an insight into the intricacies and philosophies of elite team preparation from world cup finals to bottom of the league weekly competition. Its focus is to provide a clear understanding of the performance principles applied when working with elite athletes whilst considering the numerous constraints including budgets, facilities and cultures. The content will be based on applied coaching experience and transferring theory to practice. With significant detail of the personal challenges, self-doubt and critical reflection that coaches can face in high pressure environments, this session is relevant to established coaches and new graduates alike.

BIOG: Richard is currently the Head of Performance at Super League Rugby Club Catalans Dragons, where he won the 2018 Challenge Cup after his first year in position. Prior to this, he was Head of Performance with the England Rugby League team which culminated in a hugely successful campaign during the 2017 Rugby League World Cup, reaching the final vs. Australia. As a consequence of his success in these posts, Richard received the award for UKSCA Strength and Conditioning Coach of the Year in Elite Sport in 2018.

Previous roles have included working at The Rugby Football League, Leeds Rhinos Rugby League and English Institute of Sport and Rugby Union. These have provided Richard with a wide variety of coaching and managerial skills that have helped him develop a holistic approach to athlete development and an eye for the creation of sustainable performance pathways. Richard also currently serves as the current Vice-Chair and Board Director for the UKSCA.

SUNDAY SPEAKERS

BIOGRAPHIES



DAN JOHN (0920–1010)

THINGS I HAVE LEARNED, RE-LEARNED, RE-RE-LEARNED AND RE-RE-RE-LEARNED

SESSION OVERVIEW: After 40 years of coaching and sneaking up on 55 years of lifting, Dan suggests that it is embarrassing to see that the lessons learned in the beginning were all true. And forgotten. And relearned...again and again. Mastering the fundamentals, emphasising tension and assessing true (and real) measurements is more important than the nonsense we find in most gyms and training facilities.

BIOG: Dan John has spent his life with one foot in the world of lifting and throwing and the other in academia. An All-American discus thrower, Dan competed at the highest levels of Olympic lifting, Highland Games and the Weight Pentathlon, an event in which he holds the American record. Dan now spends his work life combining weekly workshops and lectures with writing, and is also an online religious studies instructor for Columbia College of Missouri. As a Fulbright Scholar, he toured the Middle East exploring the foundations of religious education systems. He is also a Senior Lecturer for St Mary's University, Twickenham, London.

Dan has published many books, on weightlifting, including 'Intervention', 'Never Let Go', 'Mass Made Simple' and 'Easy Strength', written with Pavel Tsatsouline. Other titles include 'From Dad, To Grad' and he and Josh Hillis co-authored 'Fat Loss Happens on Monday'. In 2015, Dan wrote 'Can You Go?' covering his approach to assessments and basic training. 'Before We Go' became an Amazon bestseller as did his early 2017 book, 'Now What?', his approach to performance and dealing with life. 'Hardstyle Kettlebell Challenge' is his latest work.



STEVE MAGNESS (1010–1100)

OBSESSION AND PERFORMANCE: THE SLIPPERY SLOPE TO PERFORMANCE ENHANCING DRUGS

SESSION OVERVIEW: An insider's look at the world of performance enhancing drugs (PEDs) and athletics. This session will explore the slippery slope towards the use of drugs, why some athletes and coaches cross the ethical line and where the future of antidoping lies.

BIOG: Steve Magness has coached numerous athletes to the Olympic Games and the IAAF World Championships. He is the author of three books, including his latest work called The Passion Paradox. He's consulted with business executives and professional sports teams across the globe.

SUNDAY SPEAKERS

BIOGRAPHIES



NEIL GIBSON (1130–1220) HIGH INTENSITY INTERVAL TESTING AND TRAINING

SESSION OVERVIEW: High intensity interval training is often prescribed using standardised work to rest ratios whilst little attention has been given to how recovery intermissions are scheduled. Many athletes who, despite modest scores in tests of physical capacity, are able to outperform their peers during competition, perhaps because of a better ability to pace themselves during and between bouts of high intensity activity. Incorporating the requirement to allocate recovery periods during testing and training may give us a better idea of 'size of the engine' as well as the ability of the driver. In this session we will explore the validity and usefulness of allowing athletes to self-select recovery intervals with a view to optimising performance.

BIOG: Since completing his Master of Science at Sheffield Hallam University, Neil has worked for the English Institute of Sport, Heart of Midlothian FC, the Scottish Football Association and is currently the Director for Sport, Performance and Health at Oriam: Scotland's sports performance centre. Neil is an accredited strength and conditioning coach with the UKSCA and high performance physiologist with the British Association of Sport Sciences where he sits on the editorial and accreditation committees. Neil has held consultancy roles with GB Water Polo, the English FA, Scotland Rugby League and Scottish Squash with whom he attended the 2014 and 2018 Commonwealth Games. His research interests include the use of self-selected recovery periods during high intensity interval training, growth and maturation and the performance characteristics of team sport athletes. As well as academic writing, Neil regularly contributes to the national press, radio and industry publications.



KEVIN TILL (1130–1220) UNDERSTANDING YOUTH TALENT: HOW CAN WE HELP?

SESSION OVERVIEW: Substantial resources are invested within professional sporting organisations to achieve success. A popular system to achieve this success, is the ability to 'identify' and 'develop' young athletic talent into the sporting superstars of tomorrow, commonly known as Talent Identification and Development (TID). However, TID is not a straightforward process, which becomes even more complex within young athletes where numerous physiological and psycho-social factors can impact upon understanding, identifying and developing the future sporting superstars. S&C practitioners have an important role to play in 'Understanding Talent'. Kevin will highlight the numerous challenges and provide solutions that practitioners could implement within their roles. These S&C solutions range from data analysis methods to coach education and S&C programming and demonstrate the importance of the practitioner and how we can help this complex process.

BIOG: Kevin is a Professor in Athletic Development of the Carnegie School of Sport at Leeds Beckett University. He's published over 120 international scientific peer-review publications over the last decade related to youth athletes, talent identification and development, sport science and strength & conditioning coaching. Kevin is a UKSCA accredited strength and conditioning coach and has worked across multiple sports, mainly within youth rugby athletes for the last 12 years. Kevin currently works as a S&C coach at Yorkshire Carnegie RUFC and Leeds Rhinos RLFC within their academy programmes.

SUNDAY SPEAKERS

BIOGRAPHIES



EMILY NOLAN (1130–1220) S&C FOR THE PARA ATHLETE

SESSION OVERVIEW: Para sport has grown significantly in professionalism and profile around the world, helped by the London Paralympics highlighting the super-human feats of these incredible athletes. With increased coverage and an increase in global competition opportunities, National sports federations are investing more and more into Para athlete programmes. Due to the complexity of disability, very little research exists to guide professionals in this space leaving a significant information gap. This presentation will draw from Emily's experience of coaching para athletes for the past 15 years, including multiple global medallists. It will unlock the coaching, programming and technical considerations for the S&C coaching of para athletes via a range of case studies, practical examples and guiding principles.

BIOG: Emily Nolan is a Life Member of the ASCA and a Level 3 Master Strength & Conditioning Coach based in Auckland, New Zealand. Over the last 15 years, she has supported 12 Olympic and Paralympic sports through the last 4 cycles in both the Australian and New Zealand high performance sport systems. She has extensive experience across a plethora of team and individual sports, able and para sports, including orienteering, waterpolo, taekwondo, rowing, athletics and swimming.

Emily is a strong advocate for female and young coaches in the S&C industry, establishing the Women's Advisory Group in association with the Australian Strength and Conditioning Association, as well as founding learning based S&C internships in both Australia and NZ to guide the next generation of S&C coaches on their journey.



DAVE COLLINS (1340–1430) PSYCHO CONSIDERATIONS FOR STRENGTH COACHES

SESSION OVERVIEW: Strength and conditioning is a core support science, which has seen significant growth in the last few years. As specialisms grow, however, divisions between the professions can also occur. In this presentation Dave looks at some 'between the ears' considerations which might help us 'Mind the Gap'. Considerations from a psychomotor, psychobehavioural and psychosocial perspective are pertinent for all types of coach.

BIOG: Professor Dave Collins has published over 350 peer reviews and 70 books/chapters. Research interests include performer/coach development, expertise, and peak performance. As a practitioner, he has worked with over 70 World or Olympic medallists plus professional teams and performers. Current applied assignments include football, rugby, ski and snowboard and motorsport, plus work with non-sports organisations, including combat athletes, dance companies and professional musicians. Dave has coached to national level in three sports, is a 5th Dan Karate, Director of the Rugby Coaches Association, Fellow of the Society of Martial Arts, ZSL and BASES, Associate Fellow of the BPS and an ex Royal Marine.

SUNDAY SPEAKERS

BIOGRAPHIES



SCOTT DRAWER (1440–1530) THE TRUE VALUE OF SPORT

SESSION OVERVIEW: Scott will share his experiences and insights of high performance across a number of diverse sports, domains and industries and the opportunity this has to change the way we think and operate to showcase the true value of sport as an environment for learning and development.

BIOG: Dr Scott Drawer is the current Director of Sport at Millfield School. Prior to this role, he was responsible for the Team Sky Performance Hub, an external facing innovation agency connecting outside industry across business, education, the arts, military and sport. Scott has also worked for England Rugby in player development and spent most of his early career from 2003-2013, heading up 'Research & Innovation' at UK Sport (EIS) across a number of summer and winter Olympic and Paralympic Games. Scott has worked across all parts of the sporting pathway and is now using his experience in high performance to showcase the true value of sport in developing young people.



RICH BLAGROVE (1440–1530) ENHANCING PERFORMANCE AND MAINTAINING HEALTH IN DISTANCE RUNNERS

SESSION OVERVIEW: Middle and long-distance runners are a challenging group of athletes to work with as a strength and conditioning coach. Distance runners typically engage with large amounts of running training and the incidence of overuse type injuries is high compared to other sports. Moreover, the relative energy deficiency in sport (RED-S) syndrome is common, particularly in young and high-

performing distance runners. RED-S affects a wide range of physiological functions and can adversely affect health both in the short- and long-term.

In this session, Richard will explore the physiological factors that underpin distance running, and the evidence that strength training modalities benefit important determinants of performance. He will address strategies to mitigate the risk of common overuse injuries and how strength and conditioning coaches can contribute to identifying and preventing RED-S in athletes.

BIOG: Richard is a Lecturer in Exercise Physiology at Loughborough University and a Senior Fellow of the Higher Education Authority. He previously worked at Birmingham City University as Course Leader for the BSc Sport and Exercise Science, and was Programme Director of the BSc Strength and Conditioning Science at St Mary's University from 2010-17.

Richard is an Accredited Strength and Conditioning Coach and previously a Director of the UK Strength and Conditioning Association. He has provided support to numerous athletes over the last 12 years including several Olympic finalists and Paralympic athletes. In 2015 he published a book entitled 'Strength and Conditioning for Endurance Runners'.

Richard's extensive work with middle and long-distance runners provided the inspiration for his doctoral research, which investigated the utility of strength-based exercise on the physiological determinants of performance in distance runners.

SUNDAY SPEAKERS

BIOGRAPHIES



JAMES WILD (1440–1530) ENHANCING TEAM SPORT INITIAL SPRINT ACCELERATION: AN INDIVIDUALISED APPROACH

SESSION OVERVIEW: Performance during the initial steps of a sprint are important in team sports where there is an inherent requirement to sprint maximally over short distances. Surprisingly, however, the technical features associated with performance during this sprint phase are not well understood. In this presentation James shares some of his research findings on the initial sprint acceleration techniques of team sport athletes. In the process, he offers insight into his approach for enhancing sprint acceleration capabilities, providing some take-home practical ideas.

BIOG: James has gained wide-ranging experience across multiple sports since 2005, supporting coaches and athletes at the grassroots level through to those competing in major international competitions. Currently he holds a dual role as the Technical Lead for Performance at Surrey Sports Park and a Teaching Fellow at the University of Surrey. As a consultant James is responsible for overseeing the performance support team for the England Women's Lacrosse national squad. He leads the speed programme at Harlequins Rugby Club implementing speed training systems and speed-relevant strength diagnostics tests. James has provided similar support to professional football teams and some of the fastest athletes in the country. He is a book author and is currently undertaking a PhD investigating the biomechanics and motor control of team sport athletes during initial sprint acceleration.'



MIKE YOUNG (1600–1650) SCIENCE AND PRACTICE OF ELITE SPEED DEVELOPMENT

SESSION OVERVIEW: Speed is the common denominator amongst many of the top athletes in the world. Across many sporting disciplines, speed is the 'difference maker.' In this lecture, Mike will review the body of speed research relating to biomechanics, physical qualities and training. Using this as a starting point, he will provide unique insight gained through his years working as both a sport scientist and practitioner. With the perspective and experience gained as a coach of elite speed-power athletes, he will share the evidence-based means and methods of training he uses with his athletes. Coaches will leave with both a framework for speed development as well as in-depth insight on how to put the science of speed in to practice.

BIOG: Dr. Mike Young is the Director of Performance at Athletic Lab Sports Performance Training Center and the Performance Director for the North Carolina Courage and FC professional football clubs. In athletics, Mike won 6 team NCAA championships in 4 years while at LSU, he's coached 4 USA Track & Field National Champions and Olympic and World Championship competitors in half a dozen events. Outside of athletics, Mike has coached international competitors in weightlifting, skeleton, and bobsleigh. In team sports, he has been the High Performance Director for 4 professional football clubs including the most successful women's professional football club in North American history. Mike has trained World Cup, Super Bowl, and World Series champions and has consulted for some of the top sports teams in the world including 4 World Cup rugby teams and 3 Premiership football clubs.

MEMBER ORAL PRESENTATIONS

SESSION 1 ASSESSING AND UNDERSTANDING CHANGE OF DIRECTION SKILLS (1500–1550)



MARK HELME LEEDS BECKETT UNIVERSITY

THE RELATIONSHIP OF UNILATERAL LEG STRENGTH ON LINEAR SPEED AND CHANGE OF DIRECTION PERFORMANCE IN RUGBY LEAGUE PLAYERS



RICHARD CLARKE UNIVERSITY OF GLOUCESTERSHIRE

CHANGE OF DIRECTION TASK COMPLETION STRATEGY: RELIABILITY AND RATIONALE



THOMAS DOS'SANTOS UNIVERSITY OF SALFORD

THE CUTTING MOVEMENT ASSESSMENT SCORE (CMAS): A QUALITATIVE SCREENING TOOL TO IDENTIFY ATHLETES WITH HIGH-RISK MOVEMENT MECHANICS DURING CUTTING

THE RELATIONSHIP OF UNILATERAL LEG STRENGTH ON LINEAR SPEED AND CHANGE OF DIRECTION PERFORMANCE IN RUGBY LEAGUE PLAYERS

Mark Helme, Dr Stacey Emmonds & Dr Chris Low, Leeds Beckett University

PURPOSE: Rugby League (RL) is an intermittent, high intensity, collision sport characterised by frequent accelerations and changes of direction (Gabbett et al., 2008). Leg strength has been associated with improved performance in both linear and change of direction speed (CODS) (Bret et al., 2002, Wisløff et al., 2004, Cronin and Hansen, 2005, McBride et al., 2009). Previous research has used bilateral methods of investigating this association, yet few studies have taken a unilateral approach to strength assessment. The aim of this study was to investigate the relationships between unilateral leg strength speed, momentum, change of direction speed and change of direction deficit, in RL players. Further understanding the interaction to different forms of strength and performance measures may better enable practitioners to prepare their athletes. It was hypothesized that increased leg strength would positive influence performance in sprint and CODS measures.

METHODS: With institutional ethical approval testing was conducted at the respective facilities of three participating Rugby League clubs (n = 50). Physiological testing was separated into two sessions the first being speed and change of direction assessment and the second collection of strength data. CODS was measured using the modified 5-0-5 test, speed was tested using a 20m linear sprint from a standing start. For both tests three trials were performed and the best result used for analysis. Unilateral leg strength was measured using the rear foot elevated split squat (RFESS) 5RM (Helme et al, under review). Strength data was calculated in both absolute and relative terms, linear speed was analysed at both 10m and 20m for time, mean velocity and mean momentum for each 10m section. CODS was analysed for time and also for change of direction deficit, (Nimphius et al., 2016)

RESULTS: The mean absolute load achieved in the RFESS 5RM was 88.92 ±12.59kg, when expressed relative to body mass was 1.01 ±0.17kg/kg. Possibly to likely small negative associations were found to both change of direction times and change of direction deficits. Possibly small positive associations were observed between momentum and velocity, for the 10-20m section, but not for 0-10m. No correlations reached the alpha level of significance ($p < 0.05$) for absolute strength. A most likely or almost certain moderate negative relationship was found between CODS and relative leg strength ($p < 0.05$) and a likely moderate positive relationship to linear mean velocity between 10 and 20m. Almost certainly moderate (10-20m) or large (0-10m) negative relationships were observed with momentum in a linear sprint ($p > 0.05$).

CONCLUSIONS: The data from this study suggests that absolute unilateral leg strength is not significantly related to sprinting or CODS performance. However, increasing relative unilateral leg strength is positively associated with increased change of direction speed and velocity, specifically between 10m and 20m. Furthermore, almost certainly large negative correlations were found between relative leg strength and momentum, which is at odds with the other findings of this study. Baker and Newton (2008) identified momentum as a significant contributor to performance in RL, particularly in winning collisions, which are in turn, essential for successful match outcomes. Practitioners may consider the use of relative unilateral leg strength to better understand the development of velocity and CODS in their athletes. This should be taken with caution though, as further investigation is required to better understand the interaction between relative strength and momentum.

MEMBER ORAL PRESENTATIONS

SESSION 1 ASSESSING AND UNDERSTANDING CHANGE OF DIRECTION SKILLS (1500–1550)

CHANGE OF DIRECTION TASK COMPLETION STRATEGY: RELIABILITY AND RATIONALE

Richard Clarke, Dr Jonathan Hughes - School of Sport and Exercise, University of Gloucestershire, Dr Paul Read - Aspetar Orthopaedic Sports Medicine Hospital, Dr Mark De Ste Croix - School of Sport and Exercise, University of Gloucestershire

PURPOSE: Traditional performance assessment of change of direction (COD) speed has been via a single reported total time variable during tests such as the 505 test. However, a performer's overall COD ability is contributed to by factors such as straight-line sprinting speed, acceleration and deceleration. Therefore, it has been proposed that discrete qualities such as entry and exit speed could be examined independently which may provide greater information to coaches for enhancing performance. However, the reliability of such measures during the 505 test have not been investigated.

METHODS: Twenty-one youth rugby athletes (age = 17.4 ± 1.2 yrs; height = 177.73 ± 6.45 cm; weight = 89.36 ± 15.83 kg) volunteered to take part in the study. After familiarisation, all participants completed the 505-test six times (three in each turning direction) on three separate occasions at the same time of day and day of the week, while continuing their normal training and playing schedule. The test was completed with speed gates placed at 0 and 10m with a beam-based ground contact system at the 15m turning line in order to independently measure entry time, approach time and exit time. Between and within session reliability was calculated for both the dominant (fastest direction 505 performance) and non-dominant (slower direction 505 performance) turning performances.

RESULTS: Results show that full approach (ICC = 0.92; CV = 2.9%), Entry time (ICC = 0.81; CV = 5.7%) and 505 time (ICC = 0.89; CV = 3.7%) can be considered to have almost perfect reliability in all methods of analysis. However, entry time drops to the substantial reliability threshold (ICC = 0.73; CV = 6.3%) for between session analysis of the non-dominant turning direction. Further, 505 time drops to the substantial reliability threshold (ICC = 0.79; CV = 4.2) during within session dominant side analysis. Exit time is reported to have substantial reliability in all analyses (ICC = 0.72; CV = 6.6%) other than when the dominant turning side is analysed between sessions where the reliability increased to almost perfect (ICC = 0.85; CV = 4.4%).

CONCLUSIONS: Therefore, it may be concluded that athletes can complete a 180° change of direction task with a reliable between and within session strategy on both limbs. Exit time and entry time should be analysed closely depending on the trial types being compared, as exit times reliability is increased when analysing between session dominant-side attempts while entry time reliability is decreased during between session non-dominant-side attempts.

THE CUTTING MOVEMENT ASSESSMENT SCORE: A QUALITATIVE SCREENING TOOL TO IDENTIFY ATHLETES WITH HIGH-RISK MOVEMENT MECHANICS DURING CUTTING

Thomas Dos'Santos, Alistair McBurnie, Thomas Donelon, Christopher Thomas, Paul Comfort and Paul A. Jones, Centre for Health Sciences Research, University of Salford

PURPOSE: Side-step cutting is associated with non-contact anterior cruciate ligament (ACL) injuries due to the propensity to generate high multiplanar knee joint loads (knee abduction [KAM], flexion [KFM], and internal rotation [KIRM] moments) which increases ACL strain. Screening movement quality and identifying abnormal movement patterns can provide important information regarding an athlete's potential 'injury-risk'. These abnormal deficits include knee valgus, lateral trunk flexion, extended knee postures, wide lateral foot-plant distances, and hip internal rotation which contribute to greater knee joint loads. Although three-dimensional (3D) motion analysis is the 'gold standard' for evaluating movement mechanics, this method is expensive, time-consuming, and difficult to implement in the field. Practitioners require a field-based screening tool. The aim of this study was to explore the relationship between cutting movement assessment score (CMAS - a qualitative screening tool) and peak KAMs via 3D motion analysis, and compare cutting mechanics between CMAS trials classed as high (CMAS ≥ 7) and low (CMAS ≤ 3).

METHODS: 41 athletes from multiple sports performed six 90° cuts as fast as possible. For each trial, 3D data using 10 Qualisys Oqus 7 infrared cameras (240 Hz) operating through Qualisys Track Manager software and ground reaction force (GRF) data from two AMTI force platforms (1200 Hz) were collected. Three Panasonic Lumix FZ-200 cameras sampling at 100 Hz simultaneously filmed the cutting trials. Peak joint moments were computed over weight acceptance and expressed relative to body mass. Trunk and lower-limb kinematics were also assessed. Video footage of all cutting trials was viewed in Kinovea Software (0.8.15) and screened using the CMAS tool by the lead researcher. A co-investigator also screened one trial from each subject to establish inter-rater reliability. The CMAS is a nine-item screening tool (maximum score is 11) based on technical and mechanical determinants of peak KAMs during side-step cutting, such as trunk, hip, knee, and foot postures and motion.

RESULTS: A large relationship was demonstrated between CMAS and peak KAM ($p = 0.692$, $p < 0.001$, $n = 214$). Excellent intra-rater ($k = 0.805$ - 0.940) and moderate to good inter-rater kappa-coefficients ($k = 0.431$ - 0.633) for CMAS items were demonstrated. CMAS trials classed as 'high' compared to 'low' displayed cutting mechanics with greater peak knee valgus angles ($p < 0.001$, $g = 1.09$), greater lateral trunk flexion angles ($p < 0.001$, $g = 0.42$), wider lateral foot-plant distances ($p < 0.001$, $g = 1.06$), greater internal foot progression angles ($p < 0.001$, $g = 1.45$), and greater KAMs ($p < 0.001$, $g = 2.25$), KFM ($p < 0.001$, $g = 0.79$), and KIRMs ($p < 0.001$, $g = 0.93$).

CONCLUSIONS: The CMAS is a valid and reliable screening tool for evaluating side-step cutting movement quality and offers practitioners a cost-effective and easily applicable field-based method to identify athletes who generate high peak KAMs during side-step cutting.

MEMBER ORAL PRESENTATIONS

SESSION 2 TRAINING HIGH PERFORMING ATHLETES (1500–1550)



DAN MCPARTLAN ENGLISH INSTITUTE OF SPORT

THE EFFECT OF ISOMETRIC AND PLYOMETRIC EXERCISE ON MUSCULOTENDINOUS ANKLE STIFFNESS AND ITS SUBSEQUENT EFFECT ON PERFORMANCE IN ELITE SPRINT TRACK CYCLING



ADAM SIMPSON ST MARY'S UNIVERSITY, TWICKENHAM

THE EFFECTIVENESS OF FORCE-VELOCITY OPTIMISED TRAINING DURING A PROFESSIONAL RUGBY LEAGUE PRE-SEASON



SHYAM CHAVDA MIDDLESEX UNIVERSITY

TRAINING OF A WEIGHTLIFTER: A SCIENTIFIC APPROACH

THE EFFECT OF ISOMETRIC AND PLYOMETRIC EXERCISE ON MUSCULOTENDINOUS ANKLE STIFFNESS AND ITS SUBSEQUENT EFFECT ON PERFORMANCE IN ELITE SPRINT TRACK CYCLING

Dan McPartlan - Great Britain Cycling Team, English Institute of Sport and St. Mary's University Twickenham, Jamie Tallent - St. Mary's University Twickenham, Louise Burnie - English Institute of Sport and Sheffield Hallam

PURPOSE: Maximal power applied to the pedal is a key indicator of performance in sprint track cycling. The ankle has a meaningful contribution of transferring power from the hip and knee. However, the ability of the musculotendinous unit around the ankle to directly produce power through the mechanism of the stretch shortening cycle (SSC) is unknown. The aim of this study was to measure the influence of isometric and plyometric training on ankle stiffness and its subsequent effect on sprint track cycling performance.

METHODS: Fifteen elite sprint track cyclists (age: 17.3 ± 1.2 years, stature: 172 ± 0.08 cm, body mass: 71.9 ± 10.8 kg) were recruited as part of either a control or experimental group. The experimental group performed high volume plyometrics and isometric calf raises for 10 weeks, whilst the control group continued with normal training. Pre and post training intervention measures of vertical stiffness, isometric peak force and concentric mean force were taken. Bicycle ergometer trials were also performed at 60 and 135RPM. Ankle stiffness, ankle angle, ankle power, ankle moment and peak

RESULTS: The training intervention significantly increased vertical stiffness when hopping (68 ± 29.4 N.cm, $p=0.0003$, Cohen's $d=1.2$) and isometric peak force during plantar flexion (217 ± 53 N, $p=0.001$; $d=0.65$). Post-intervention bicycle ergometer trials also showed significant increases for the experimental group, in ankle stiffness at 135 RPM (1.3 ± 0.4 , $p=0.009$; $d=0.42$) and average ankle angle at 60 RPM ($2.92 \pm 0.83^\circ$, $p=0.004$, $d=0.43$). There was no significant change in peak crank power or any other metrics across all trials.

CONCLUSIONS: Combining plyometrics and isometric strength training is an effective method for increasing stiffness and force production at the ankle for elite sprint track cyclists. This combination of stimulus effects the utilisation of the ankle in sprint cycling, and can enhance the efficiency of power production at that joint. The results did not show a direct improvement in cycling specific measures and the mechanisms responsible cannot be conclusively stated. This study provides the first evidence that the SSC may contribute to enhanced performance in sprint cycling.

MEMBER ORAL PRESENTATIONS

SESSION 2 TRAINING HIGH PERFORMING ATHLETES (1500–1550)

THE EFFECTIVENESS OF FORCE-VELOCITY OPTIMISED TRAINING DURING A PROFESSIONAL RUGBY LEAGUE PRE-SEASON

Adam Simpson, Jamie Tallent - St Marys University, Twickenham

PURPOSE: This study aimed to assess the efficacy of an 8-week strength-power programme optimised to an athlete's force-velocity profile during a professional rugby league preseason. Existing research has shown the effectiveness of this approach in semi-professional athletes; however, this is the first study to utilise a sample of highly trained collision sport athletes.

METHODS: 3RM squat, 10- and 20-m sprints were assessed alongside squat jump (SJ) over five load conditions to ascertain a vertical force-velocity profile for 29 elite male rugby league players (age 20.5 ± 2.5 years; body mass 94.9 ± 21.6 kg). Players were then strength matched and alternatively assigned to a force-velocity optimised group ($n = 15$) and a non-optimised, traditional strength-power group ($n=14$) before completing an 8-week intervention period.

RESULTS: There was a significant improvement in force-velocity deficit for the optimised training group compared to the non-optimised group (OP pre: 51.13 ± 31.42 %, post: 62.26 ± 31.45 %, NO pre: 33.00 ± 19.60 %, post: 31.14 ± 31.45 %, $p < 0.00$). Despite no significant differences post intervention ($p > 0.05$), the optimised group presented with larger effect sizes in 3RM squat (ES = 0.47 vs. 0.26), peak power (ES = 0.36 vs. 0.03), SJ (ES = 0.37 vs. 0.12), and 10-m sprint (ES = 0.47 vs. 0.30).

CONCLUSIONS: This study supports the existing body of experimental and theoretical research on the effectiveness of programming based on an athlete's force-velocity profile. Moreover, it provides support for the use of these methods with a highly trained sample. Consequently, force-velocity optimised training may be a more time-efficient method for targeting an athlete's deficiencies during time constrained periods of training. Coaches aiming to concurrently develop strength and power during the preseason period should consider this approach when designing training programmes.

TRAINING OF A WEIGHTLIFTER: A SCIENTIFIC APPROACH

Shyam Chavda, Middlesex University, London Sport Institute

INTRODUCTION: This case study reports the monitoring and training process of an international refugee weightlifter (ranked No. 1 in GB at the 96 and 102Kg weight class) over a 30-week period, from November 2018 to June 2019. To date, evidenced based case studies on weightlifters have typically utilized and presented results from standardized lab tests with little consideration of objective technical analysis. The purpose of this applied case study is to provide training and monitoring insights into how an amalgamation of objective physical and technical monitoring can aid the process of weightlifting programming and thus enhance the likelihood of success.

APPROACH: One international male weightlifter (age: 23 years, height: 1.78-m, body mass: <102-kg) was monitored for this case study with the aim to peak for the British National Seniors. A repeated measures observational design was used across 3 time points where the isometric mid-thigh pull (IMTP) and countermovement jump (CMJ) was measured within 48 hours of each competition to identify meaningful changes in peak force (PF), relative peak force (rPF) and concentric impulse (ConImp). Furthermore, at 2 major competitions bar bell trajectory was collected using a high-speed camera (165fps) by tracking a reflective marker from a lateral perspective. The kinetic and kinematic data was analyzed using Quintic and then extracted into a custom spreadsheet for subsequent analyses. All prescribed programming was done across a 3-4 day period using relative percentages of his most recent 1RM values.

RESULTS: Note: During the submission of this application a major competition will take place which will be added to the current results in time for the conference (if accepted). Initial results show a large increase in PF and ConImp (ES = 2.5 and 1.9, respectively) between competitions 1 and 2. rPF had trivial changes (ES = -0.11), suggesting the weight increase of the athlete did not affect his force generating capabilities. More importantly the athlete achieved a 20kg increase in his total from competition 1 to 2, achieving multiple national records. Technical analysis revealed that his missed lift (snatch) during competition 1 at 150-kg was potentially due to the bar being further away following the power position as indicated by trajectory being outside of the 95% CI.

PRACTICAL APPLICATIONS: Utilising PF, rPF and ConImp to monitor a weightlifting athlete may help to understand their physical state leading into competitions and may help coaches intuitively account for any increase/decrease on the total load lifted. Secondly, utilizing an objective method of technical analysis on barbell trajectory can help better inform the programming process, with improved athlete buy in from a data visualization perspective. Following competition 1 the program focused on the bar trajectory during and after the power positions as well as strength at this position. The prescription of exercises relating to its development had increased strength generating capabilities and may have been a potential reason as to the PB's achieved during competition 2.

MEMBER ORAL PRESENTATIONS

SESSION 3 INJURY, RECOVERY AND REHABILITATION (1500–1550)



CIAN GORMLEY INSTITUTE OF TECHNOLOGY CARLOW

GPS IN GAELIC FOOTBALL: IS VOLUME OR INTENSITY A BETTER INDICATOR OF PLAYER RECOVERY TIME?



BENJAMIN YOUNG UNIVERSITY OF GLOUCESTERSHIRE

THE ACUTE EFFECTS OF NETBALL MATCH-PLAY EXPOSURE ON HAMSTRING AND HIP FLEXOR EXTENSIBILITY



ERWAN IZRI SPORTS SURGERY CLINIC DUBLIN

ANALYSING THE ENTIRE TORQUE-ANGLE CURVE: ISOKINETIC KNEE EXTENSOR AND FLEXOR TORQUE DIFFERENCES BETWEEN THE ACL-RECONSTRUCTED AND NON-OPERATED LIMBS

GPS IN GAELIC FOOTBALL: IS VOLUME OR INTENSITY A BETTER INDICATOR OF PLAYER RECOVERY TIME?

Cian Gormley, Colin Coyle, Declan Browne, Rosemary O'Hara - Institute of Technology Carlow, Bryan Cullen - Dublin Gaelic Athletic Association

PURPOSE: Halson (2014) suggested the importance of monitoring both internal and external training load measures for optimisation of recovery and subsequent performances. Global Positioning System (GPS) has become common place in quantifying external load in team sport athletes, however, alone it is insufficient. Immunoendocrine markers have allowed exploration of individual load tolerance in rugby and soccer, with salivary testosterone (T) and cortisol (C) demonstrating fluctuations in response to competitive match-play (West et al., 2014) with temporary immunosuppression also reported (Cunniffe et al., 2010). Exploring the relationship between immunoendocrine concentrations and GPS metrics will allow coaches to better understand the recovery timelines of their athletes, subsequently allowing them to better periodise their recovery and training protocols.

METHODS: Pooled saliva samples ($n = 17$; age 24.4 ± 0.8 yr, height 186.1 ± 1.5 cm, body mass 88.0 ± 1.1 kg) were collected across 5 games, 36 and 2h pre-match, and 0, 48 and 72h post-match, alongside pooled serum samples ($n = 11$; age 26.0 ± 1.0 yr, height 187.2 ± 1.9 cm, body mass 87.7 ± 1.8 kg). GPS variables volume (minutes played; min, total; TD, and high-speed running distance; m) and intensity (m.min⁻¹ and high-speed running density; HSR%) variables were recorded. Multiple regression analysis explored GPS metrics and the Δ_{36-0} , Δ_{0-2} , Δ_{0-48} and 0-72h immunoendocrine concentrations.

RESULTS: T:C ratios increased from 36-2h pre-match (Mean \pm SEM, 0.05 ± 0.01 vs. 0.10 ± 0.06). T:C ratios decreased from 0-48h post-match (0.03 ± 0.01 vs. 0.05 ± 0.01). SAA concentrations decreased from 2h pre- to 0h post-match (124.3 ± 6.5 vs. 121.7 ± 7.5 ng.mL⁻¹) with peak post-match concentration occurring at 48h (126.9 ± 7.9 ng.mL⁻¹). SAA concentrations remained elevated 72h post-match compared to 36h pre-match (121.3 ± 8.7 vs. 119.6 ± 6.9 ng.mL⁻¹). Multiple regressions determined the metric that best explained T Δ_{0-48} concentrations was TD x min (27%), while both TD x min, and HSR% x m.min⁻¹ explained 17% of T Δ_{0-72} concentrations. HSR% x m.min⁻¹ best explained C Δ_{0-48} and C Δ_{0-72} concentrations (18% and 20%, respectively). HSR% x m.min⁻¹ explained 20% of SAA Δ_{0-48} concentrations, while TD x mins explained 19% of SAA Δ_{0-72} concentrations.

CONCLUSIONS: Immunoendocrine fluctuations were apparent from pre- to post-match for all immunoendocrine markers, while the magnitude of recovery in the 48 to 72h window post-match for SAA and salivary T and C was best explained by HSR% x m.min⁻¹. Previous research demonstrated a significant difference in immunoendocrine markers between intentionally over-trained athletes and athletes undertaking normal training. A reduction in T concentrations indicated a reduced anabolic state in over-trained rugby league players (Coutts et al., 2007). By monitoring both HSR% and m.min⁻¹ of athletes in games, coaches can better manage athletes in the post-match window to better optimise recovery and subsequent performances.

MEMBER ORAL PRESENTATIONS

SESSION 3 INJURY, RECOVERY AND REHABILITATION (1500–1550)

THE ACUTE EFFECTS OF NETBALL MATCH-PLAY EXPOSURE ON HAMSTRING AND HIP FLEXOR EXTENSIBILITY

Benjamin Young, Dr. Jonathan Hughes - University of Gloucestershire

PURPOSE: Netball as a sport consists of multiple accelerations, decelerations, jumps and changes of direction which depend on well-developed physical qualities e.g. flexibility, strength, power, endurance and speed. Females have a 4 to 6-fold increased risk of ACL injuries in comparison to males and this may be increased with pronounced limb dominances and joint laxity. Further, it is known that the hamstrings are used to stabilise the knee during anticipated and unanticipated impacts, such as landing from jumps. The purpose of this study was to investigate the impact of netball match play on interlimb hip flexor extensibility.

METHODS: Twenty-four female national performance league netball players (age: 17.75 ± 1.65 yr; mass: 67.41 ± 8.2 kg and stature: 172.10 ± 7.2 cm) were assessed during a single competitive match. Pre- and post-match testing consisted of the participants performing Single Leg Countermovement Jumps (SLCMJ) on dominant (DL) and non-dominant limb (NDL). The Back Saver Sit and Reach (BSSR) test was then used to measure hamstring and hip flexor extensibility. This was chosen for its reliability (CV = 3.73, ICC = 0.97)⁴, and ability to test DL and NDL independently. Session ratings of perceived exertion (sRPE) was recorded for the warm up, each quarter and the match as a whole to quantify exercise intensity and physiological stress for each player. Repeated measures ANOVA's were performed to assess differences in dependent variables. The classification of effect size for pre-to post-match was calculated on dependent variables, this was determined by Cohen's d and classified as < 0.2 (trivial), 0.2 - 0.49 (small), 0.5 - 0.79 (moderate) and > 0.8 (large).

RESULTS: Significant differences between pre- to post measures for the BSSR assessment ($p = 0.01$) and between limbs for the SLCMJ ($p = 0.04$) were shown. Effect size statistics demonstrated small increases for DL BSSR ($d = 0.21$; 95% CI: -0.36, 0.78) and NDL BSSR ($d = 0.29$; 95% CI: -0.28, 0.86) from an average match duration of 46.6 ± 10.4 minutes and accumulated match sRPE of 841.1 ± 146.4 . There were only trivial effects for DL ($d = 0.13$; 95% CI: -0.44, 0.70) and NDL SLCMJ ($d = 0.04$; 95% CI: -0.53, 0.60). Participants ($n=16$) who were on court >45min (51.94 ± 7.42 min, sRPE = 841.13 ± 146.43) saw a no significant differences in the BSSR or SLCMJ and small increases in the NDL BSSR ($d = 0.22$; 95% CI -0.48, 0.91).

CONCLUSIONS: The results identify that match-play increased the extensibility in both DL and NDL despite no significant changes in pre-post SLCMJ measures. Further, players who had reduced court time showed an increase in hip flexor extensibility. Therefore, players, and especially those with reduced court time, could more susceptible to increased joint laxity post-match and that elongated periods of being in a hyper-extensible state (such as sitting), may result in the athlete being pre-disposed to next day injuries.

ANALYSING THE ENTIRE TORQUE-ANGLE CURVE: ISOKINETIC KNEE EXTENSOR AND FLEXOR TORQUE DIFFERENCES BETWEEN THE ACL-RECONSTRUCTED AND NON-OPERATED LIMBS

Erwan Izri, Luke Hart & Dr Andy Franklyn-Miller, SSC Sports Medicine, Sports Surgery Clinic, Dublin

PURPOSE: Isokinetic dynamometry (IKD) is often used to assess torque-producing capabilities of knee extensor and flexor musculature post-ACL-reconstruction (ACLR) surgery. In particular, between-limb peak torque symmetry is often used as a strength marker to guide the return-to-play (RTP) decision. However, peak torque occurs at a single point of the range of motion tested. Continuous waveform analysis allows comparison of full waveforms, which could offer additional information to improve rehabilitation practice. The aim of this study was to compare the entire torque-angle waveforms of knee extensors and flexors in the operated and non-operated limbs of ACL-R patients.

METHODS: A cohort of 361 field sports-playing males (age = 24 ± 3 yr, height = 1.78 m ± 0.05 m) performed three sets of five maximum-effort repetitions of concentric/eccentric knee extension/flexion at $60^\circ/s$ on an isokinetic dynamometer 8-10 months post-ACL-reconstruction. Torque data were gravity-corrected, filtered and body mass-normalised ('relative torque'). Only isokinetic velocity ($>50^\circ/s$) data were analysed to avoid inertial effects, providing a total analysable range of 15° - 85° of knee flexion. Continuous waveform analysis was performed using the Statistical Parametric Mapping (SPM) MATLAB package. Parametric paired t-tests ($\alpha = 0.05$) compared relative torque waveforms of operated and non-operated limbs for both extension and flexion separately. Knee flexion angles of 0° refer to a fully extended knee i.e. straight leg.

RESULTS: The SPM analysis revealed significant differences in torque between the operated and non-operated limbs for the entire length of the torque-angle waveforms for both knee extension ($p < 0.001$) and flexion ($p < 0.001$). The largest and smallest average between-limb asymmetry was 49% BM and 19% BM for extension, occurring at 31° and 85° of knee flexion and 5% BM and 2% BM for flexion, occurring at 85° and 15° , respectively.

CONCLUSIONS: Continuous waveform analysis of torque data of ACL-R patients 8-10 months post-surgery revealed significant differences across the entirety of the isokinetic torque-angle curve. Practitioners using IKD data to guide the RTP decision are recommended to look at the entire torque-angle curve to complement the information provided by peak torque values. By analysing torque production of knee musculature at different points of the muscle length-tension curve in ACL-R patients, rehabilitation programs can be further individualised to ensure optimal strength restoration and thus RTP outcomes.

MEMBER ORAL PRESENTATIONS

SESSION 4 DEVELOPING THE YOUTH ATHLETE (1500–1550)



GILL MYBURGH LAWN TENNIS ASSOCIATION

DEVELOPMENTAL FITNESS CURVES, AN INNOVATIVE STRATEGY FOR ASSESSING ACCELERATION RELATIVE TO AGE AND MATURITY IN ELITE YOUTH TENNIS PLAYER



TOM BROMLEY MK DONS FC

EFFECTS OF A COMPETITIVE SOCCER MATCH ON JUMP PERFORMANCE AND INTERLIMB ASYMMETRIES IN ELITE ACADEMY SOCCER PLAYERS



MATTHEW WRIGHT TEESSIDE UNIVERSITY

FOOTBALL SPECIFIC FITNESS IN GIRLS' ASSOCIATION FOOTBALL PLAYERS

DEVELOPMENTAL FITNESS CURVES, AN INNOVATIVE STRATEGY FOR ASSESSING ACCELERATION RELATIVE TO AGE AND MATURITY IN ELITE YOUTH TENNIS PLAYER

Gillian Myburgh - Lawn Tennis Association, Sean P. Cumming - Sport, Health and Exercises Science Research Group, University of Bath, Robert M. Malina - Professor Emeritus, Department of Kinesiology and Health Education, University of Texas at Austin

PURPOSE: Physical performance testing is routinely implemented in youth sport programmes to assess the physical capabilities of young athletes. Such practices are commonplace in elite youth tennis programmes and are generally used to inform talent identification and monitor athletic development. In youth tennis populations, measures of speed have been found to distinguish between players of different abilities, highlighting the importance of assessing this component. Speed development in youths does, however, not follow a linear pattern of improvement. Two accelerated periods of development have been identified, with improvements attributed to neurological and maturational components (increased limb length, hormone levels). The purpose of this study is therefore to develop maturity sensitive strategies for assessing speed measures in youth tennis players and evaluate the degree to which performance varies according to biological age.

METHODS: Historical measures of age, sex and acceleration were collected from 3120 elite youth tennis players attending Talent Identification days held between 2009 to 2014 to create developmental curves for acceleration at selected quantiles (10th, 25th, 50th, 75th and 90th). Equivalent data collected from a different sample of elite youth players aged between 8.9 to 15.1 years, who attended National Age Group Training Camps held between 2011-12 and 2016-17, was then used to determine the extent to which assessments of player acceleration varied relative to chronological (CA) and biological age (BA). Parental consent and player assent was obtained, with ethical approval granted by the Research Ethics Approval Committee for Health at the University of Bath. A BA index was created for each participant with methods proposed by Gillison and colleagues. A Wilcoxon Signed Rank Test and Mann Whitney U Test were employed to determine performance differences between CA and BA of early, on-time and late maturers, as well as any differences between the maturity classifications, respectively.

RESULTS: Results demonstrated that acceleration varied as a function of chronological and biological age when considered relative to developmental curves. Specifically, early maturing males and females demonstrated significantly poorer performance when acceleration was considered relative to biological age. Significant discrepancy in percentiles obtained with biological versus chronological age was most pronounced among individuals at the opposite ends of the spectrum (early and late maturers), with the percentage change between biological age and chronological age greater in males than females.

CONCLUSIONS: This research provides a novel approach to monitoring and evaluating physical development in acceleration measures in elite youth British tennis players. Whilst the impact of maturity on athletic performance is widely acknowledged and well documented, methodological and practical issues surrounding the accurate monitoring of biological age, as well as a distinct lack of longitudinal data, has impacted the success of various models. Whilst highlighting the extent of advantage afforded players advanced in maturation, this research provides a practical means of quantifying the effects of biological maturation in acceleration measures.

MEMBER ORAL PRESENTATIONS

SESSION 4 DEVELOPING THE YOUTH ATHLETE (1500–1550)

EFFECTS OF A COMPETITIVE SOCCER MATCH ON JUMP PERFORMANCE AND INTERLIMB ASYMMETRIES IN ELITE ACADEMY SOCCER PLAYERS

Tom Bromley, Milton Keynes Dons Football Club, Anthony Turner - Middlesex University, Paul Read - Aspetar Sports Medicine Hospital, Jason Lake - Chichester University, Sean Maloney - Middlesex University, Shyam Chavda - Middlesex University and Chris Bishop - (Middlesex University)

PURPOSE: Interlimb asymmetry has been a popular line of investigation in recent years, with numerous investigating its associations with surrogate measures of athletic performance. However, research investigating the interaction between asymmetry and actual soccer matchplay is scarce; thus, was the primary purpose of this study.

METHODS: Fourteen elite academy soccer players from a professional category 3 soccer academy performed three unilateral countermovement jumps (CMJ) on each limb, pre, post, 24, 48 and 72-hours post-match on a force platform. Recorded metrics for each limb and their accompanying asymmetry score included: jump height, peak propulsive force, eccentric impulse, concentric impulse, peak landing force and landing impulse were recorded at each time point.

RESULTS: Significant negative changes in jump performance were noted at all time points for all metrics ($p < 0.05$), with the exception of jump height. Interlimb asymmetries were metric-dependent and showed very large increases, specifically post-match, with a tendency to reduce back towards baseline values at the 48 hour time point for propulsive based metrics. Asymmetries for landing based metrics did not peak until 24 hours, but also reduced towards baseline levels at 48 hours.

CONCLUSIONS: This study highlights the importance of monitoring multiple jump metrics given that jump height alone was not sensitive enough to detect significant changes in jump performance. In addition, given interlimb asymmetries showed substantial increases after a soccer match, practitioners could consider monitoring between-limb differences as part of the routine monitoring process during unilateral jump testing.

FOOTBALL SPECIFIC FITNESS IN GIRLS' ASSOCIATION FOOTBALL PLAYERS

Dr Matthew Wright, Teesside University

INTRODUCTION: The development of football specific fitness is important in girls' association football players given the substantially lower yo-yo intermittent recovery test (YYIR) performance reported in female players in comparison to males. Furthermore, without exposure to training, girls demonstrate lower age-related changes in fitness to boys. This longitudinal case-study summarises the development of football specific fitness in high performing girls football players.

APPROACH: YYIR performance was tracked in over four years at four timepoints (July, September, December, May) in our FA Girls' Regional Talent Club. Pre- and in-season changes in performance were estimated from data on 86 players (459 observations). Long-term changes in performance were evaluated in 23 players who completed three consecutive seasons. Here the within-player correlations between changes in performance and biological maturation were also assessed. The internal response of training and matches was monitored in 33 players over one season using differential ratings of perceived exertion (dRPE). Data were analysed using general or mixed-linear modelling and magnitude-based inferences subsequently applied to evaluate the probability that differences were practically important.

RESULTS: We observed 'most likely' moderate improvements in YYIR (32, 90% confidence interval 17 - 49%) over three years, and these were moderately associated with changes in maturation ($r = 0.46$, 0.13 - 0.70). Pre-season training tended to elicit 'very likely' small improvements (14, 8.1 - 20%) but in-season training resulted in 'possibly' trivial differences (5.5, 0.41 - 11%). Compared to matches, breathlessness RPE for pre-season fitness training was perceived as 'most likely' harder (21, 15 - 28 AU) whilst, in-season training was 'most likely' easier (-13, -16 - -8.8). Breathlessness was rated substantially greater than leg exertion after fitness training (19, 12 - 26), reflecting the predominant central or cardiovascular demand.

PRACTICAL APPLICATIONS: Substantial long-term improvements in football specific fitness can be achieved in girls' football players. However, improvements tended to occur in pre-season periods where specific fitness training was prescribed. In-season football training may not provide a sufficient cardiovascular load to elicit adaptations and coaches working with this group may wish to consider supplementary interval training to close the observed gap in physical performance between male and female players.

MEMBER ORAL PRESENTATIONS

SESSION 5 OPTIMISING TRAINING INTERVENTIONS (1500–1550)



IAN GREENWOOD UNIVERSITY OF NORTHAMPTON

EFFECTS OF UNILATERAL AND BILATERAL PLYOMETRIC TRAINING ON ENDURANCE RUNNING PERFORMANCE



XIANG ZHAO THE UNIVERSITY OF EDINBURGH

THE EFFECTS OF 5 WEEKS UNILATERAL VS BILATERAL LEG PRESS TRAINING ON STRENGTH, JUMPING AND SPRINTING PERFORMANCE IN ADOLESCENT RUGBY UNION PLAYERS



EMMA ARCHER ST MARY'S UNIVERSITY, TWICKENHAM

THE EFFECT OF SHORT-TERM WEIGHTLIFTING DERIVATIVE TRAINING ON VERTICAL IMPULSE, HANDSPRING VAULT PERFORMANCE AND KINEMATICS IN ADDITION TO SELF-EFFICACY AND OUTCOME PERCEPTIONS IN FEMALE YOUTH GYMNASTS

EFFECTS OF UNILATERAL AND BILATERAL PLYOMETRIC TRAINING ON ENDURANCE RUNNING PERFORMANCE

Ian Greenwood, Anthony W. Baross, Anthony D. Kay, University of Northampton

PURPOSE: Successful endurance running performance (rEND) requires the maintenance of high velocities and economical movements over extended periods of time. Whilst maximal oxygen uptake (VO_{2max}), fractional utilisation, running economy (RE), velocity at VO_{2max} and biomechanical factors (stride length, mechanical stiffness of the musculotendinous system) are well established as important markers of success (Beatie et al., 2017) a growing body of evidence has emerged demonstrating that neuromuscular factors associated with plyometric training improves RE and rEND. Therefore, the purpose of the study was to investigate the effects of an 11-week unilateral and bilateral plyometric training intervention on endurance running performance.

METHODS: Twenty-seven recreationally trained male and female endurance runners (12 females and 15 males; age; 35 ± 6 years, VO_{2max} ; [males] 53.5 ± 6.3 and [females]; 42.8 ± 4.5 ml.kg⁻¹.min⁻¹) were randomly assigned to one of three groups: unilateral plyometric training (UPT; n = 9), bilateral plyometric training (BPT; n = 9) and control (CON; n = 9) group. RE, VO_{2max} , 3-km treadmill TT, maximal isometric leg extensors force (ISOLE; bilateral and unilateral) and countermovement jumps (CMJ; bilateral and unilateral) were measured prior to and after 11-weeks of training (UPT and BPT; volume equated, 20-45 minutes, 2-3 days/week). A three-way repeated measures ANOVA was used to assess the within and between groups changes in RE, VO_{2max} , 3-km TT, ISOLE and CMJ.

RESULTS: Following 11 weeks of plyometric training there were significant improvements in RE (UPT; 197.1 ± 14.2 - 181.1 ± 14.3 , BPT; 189.7 ± 18.6 - 177 ± 15.2 ml.kg⁻¹.km⁻¹, $p = 0.001$) and 3km TT performance (UPT; $13:19 \pm 1:46$ - $13:01 \pm 1:48$, BPT; $13:48 \pm 1:26$ - $13:27 \pm 1:18$ minutes/seconds, $p = 0.001$) in addition to CMJ (UPT; 31.5 ± 8.3 - 33.9 ± 8.7 , BPT; 29.6 ± 6.1 - 33.4 ± 7.2 cm, $p = 0.001$). However, there were no statistically significant differences between training interventions ($p > 0.05$). Additionally, there were no significant differences in VO_{2max} or anthropometric measures between or within groups ($p > 0.05$).

CONCLUSIONS: Few studies have investigated the effects of UPT and BPT in isolation on endurance development (Howe et al., 2014). This study provides practitioners and coaches with more information regarding the application and transfer effect of sports specific plyometric training for enhancing endurance running performance. In light of these findings it may be advantageous for coaches to add a combination of UPT and BPT 2-3 times a week to a regular run training programme to optimise endurance running performance in recreational endurance runners.

MEMBER ORAL PRESENTATIONS

SESSION 5 OPTIMISING TRAINING INTERVENTIONS (1500–1550)

THE EFFECTS OF 5 WEEKS UNILATERAL VS BILATERAL LEG PRESS TRAINING ON STRENGTH, JUMPING AND SPRINTING PERFORMANCE IN ADOLESCENT RUGBY UNION PLAYERS

Xiang Zhao, Tony Turner, John Sproule & Shaun Phillips, The University of Edinburgh

PURPOSE: In recent years, the use of unilateral resistance training has become popular in strength and conditioning practice. The potential benefit of unilateral resistance training may include 1. A higher relative intensity and better injury prevention 2. Unilateral training may be as effective as bilateral training. A previous study found that bilateral and unilateral resistance training may be equally efficacious in improving measures of lower body strength and power however this has not yet been investigated in adolescent population. Because of young people's immature physiological and psychological state, the response to the training may be different from adults. Therefore, the purpose of this study was to compare the effects of 5 weeks of bilateral and unilateral leg press training on lower body strength, jumping and sprinting performance in adolescent rugby players.

METHODS: Twenty-six adolescent rugby players were assigned to a 5 weeks unilateral (n= 9) or bilateral (n = 9) training programme supplementary to habitual training, or a control group (n = 8) using a stratified blocked randomization approach, with biological maturation the blocking variable. Five-RM unilateral/bilateral leg press strength, 30-m sprint and countermovement jump were tested before and after the 5-weeks intervention. Statistical evaluation was accomplished with a 3x2 (group x time) repeated measure analysis of variance. Change score Δ (POST-PRE) within each group was compared by one-way analysis of variance.

RESULTS: No significant PRE to POST difference was seen in any of 30-m sprint, countermovement jump, 5-RM leg press and 5-RM single leg press variables. Significant difference was seen in 5-RM single leg press test, the unilateral group showed greater improvement than the bilateral group and control group. No significant differences were seen between the groups in 30-m sprint, countermovement jump, 5-RM leg press.

CONCLUSIONS: This study was the first to compare the effects of unilateral and bilateral resistance training on strength and power in adolescent male rugby union players. The findings indicate that 5-weeks twice weekly unilateral/bilateral leg press training has limited effect on improving lower body strength and may not sufficient to improve jumping and sprinting performance. Future research should try a longer period of training or focus on other types of exercise.

THE EFFECT OF SHORT-TERM WEIGHTLIFTING DERIVATIVE TRAINING ON VERTICAL IMPULSE, HANDSPRING VAULT PERFORMANCE AND KINEMATICS IN ADDITION TO SELF-EFFICACY AND OUTCOME PERCEPTIONS IN FEMALE YOUTH GYMNASTS

Emma Archer, Daniel Cleather, St. Mary's University, Twickenham

PURPOSE: It was hypothesized that weightlifting pulling derivatives would increase net vertical impulse, positively influencing kinematic variables of the vault thus improving vault performance. Furthermore, young female gymnasts may have negative preconceptions around weightlifting self-efficacy and body image. Therefore, the aim of this study was to investigate whether an eight-week progressive weightlifting pull derivative intervention influences jump performance and kinetic variables of the handspring vault in female youth artistic gymnasts and whether these adaptations transfer to improvements in vault execution score. A secondary aim was to assess actual versus perceived weightlifting self-efficacy and expectations of body image and performance.

METHODS: Prospective randomized, single blinded training study consisting of 23 female youth gymnast novice weightlifters. Participants were randomly assigned to either a control (CG) or weightlifting (WLG) group. The WLG performed weightlifting derivatives twice weekly for 8 weeks. The CG continued normal training. Before and after, a vault was scored, filmed, then analysed to evaluate run-up velocity (RUVel), take-off velocity (TOVel), pre-table flight time (PREFT), table contact time (TCT) and post-flight time (POSTFT). Net vertical propulsive impulse during a countermovement jump was calculated and a 5-point Likert scale containing questions relating to weightlifting self-efficacy and perceived outcomes completed. Group-time interactions were evaluated with a repeated measures MANOVA (significance = $p \leq 0.05$). Multiple regression was used to predict vault scores from kinetic variables.

RESULTS: There was no significant group-time effect for vault score ($p = 0.068$, partial $\eta^2 = 0.15$). However, a moderately sized significant group-time interaction for vertical impulse ($p = 0.047$, partial $\eta^2 = 0.17$) and TOVEL ($p = 0.016$, partial $\eta^2 = 0.25$) occurred with large and significant group-time interactions for RUVEL ($p = 0.012$, partial $\eta^2 = 0.27$), and PREFT ($p = 0.009$, partial $\eta^2 = 0.28$) and POSTFT ($p = 0.037$, partial $\eta^2 = 0.19$). TOVEL and POSTFT jointly strongly and significantly predicted vault execution score ($p < 0.001$, adjusted $r^2 = 0.49$). Self-efficacy changed over time with the WLG becoming more confident they had the skills to weightlift and the CG less confident. Neither body image or performance expectations changed after the intervention, however mood expectations did.

CONCLUSIONS: The WLG demonstrated greater improvements in vertical impulse and vault kinematics but not in execution score. Weightlifting derivatives may prove useful for improving vault and jump performance instead of traditional physical preparation when used as part of a periodized and progressive strength and conditioning plan. Furthermore these young gymnasts appeared not to hold any negative beliefs surrounding weightlifting & body image which it is widely suggested exist in aesthetic sports.

POSTERS 2019

INTRODUCTION

The following pages contain abstracts of the posters on display at this year's conference. We would like to congratulate those that have been accepted, demonstrating the breadth and depth of strength and conditioning, that is representative of the great work of our membership through both research and applied case studies.

The posters will be on display for the whole weekend, but this year the authors will also be standing by their posters during the afternoon breaks to discuss their work and answer your questions. We encourage you to take this valuable opportunity to both learn and network with colleagues.

The posters can be found in the concourse area of the conference venue, where tea and coffee will also be served.

POSTER GRANTS

Each year, the UKSCA awards grants to members, whether they are students nearing the completion of their studies or members who have novel and exciting research findings or a case study to present and may not have access to alternate funding streams. The aim of this grant is for members to:

- **Disseminate their research findings or a case study at the annual conference in the form of a poster presentation**
- **Facilitate personal and career development through the learning and networking opportunities provided by the conference**

This year a grant has been awarded to the following members:

Emma Archer
Jack Benford
Thomas Dos'Santos
Benjamin Humphrys
Callum Stratford
Ben Young

POSTER AWARDS

The winners of this year's poster awards will be accounted at the Gala Dinner on Saturday night.

We would like to thank Routledge for donating the prizes for this year's poster awards.

POSTER ABSTRACTS 1/2

VARIATIONS IN STRENGTH STATUS ACROSS THE MENSTRUAL CYCLE IN EUMENORRHEIC WOMEN: A SYSTEMATIC REVIEW AND META-ANALYSIS

Dr Richard Blagrove, Loughborough University; Dr Georgie Brunivels, ORRECO Ltd and St Mary's University; Dr Charles Pedlar, ORRECO Ltd and St Mary's University

PURPOSE: Fluctuations in ovarian sex hormones (OSH) can explain variations in physical performance over the course of a menstrual cycle. Oestrogen peaks just prior to ovulation and is known to exert an excitatory effect on the nervous system, which has been hypothesised to increase strength compared to in the early-follicular and luteal phases. The effect that changes in OSH exert on strength-related tasks has received considerable attention, however this literature has not previously been reviewed and collectively analysed. The aim of this study was to systematically review the current body of research that has investigated changes in strength-related variables during different phases of the menstrual cycle in eumenorrhic women.

METHODS: A literature search was conducted in Pubmed, SPORTDiscus and Web of Science using search terms related to the menstrual cycle and strength-related measures. Studies were included if participants were eumenorrhic (24-35 days), at least one strength-related measure was taken, outcome measurements occurred in ≥ 2 phases, and a physiological measure was taken to identify or verify cycle phases. Studies were excluded if participants used oral contraceptives or hormone replacement therapy, and if comparative time points were separated by longer than one menstrual cycle. Two reviewers reached consensus that 21 studies met the criteria for inclusion. Methodological rigor was assessed using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. Random effects meta-analyses were used to compare the early-follicular, ovulatory and mid-luteal phases for maximal voluntary contraction, isokinetic peak torque, and explosive strength.

RESULTS: The assessment of study quality showed that a high level of bias exists in specific areas of study design. Non-significant and trivial effect sizes ($p \geq 0.25$, Hedges $g < 0.2$) were identified for all strength-related variables in each comparison between phases. 95% confidence intervals for each comparison suggested the uncertainty associated with each estimate may extend to a small effect on strength performance ($-0.43 \leq g \leq 0.40$). The heterogeneity for each comparison was also small ($p > 0.5$, $I^2 < 30\%$).

CONCLUSIONS: Strength status appears to be minimally affected by the fluctuations in OSH that occur during the menstrual cycle. This finding should be interpreted with caution due to the methodological shortcomings identified by the quality assessment. The main study design issues are associated with: accurate determination of phases, sample sizes, randomisation of trials, and blinding of assessors. Practitioners should be aware that individual differences may also exist, and that the adaptive response following strength training may be mediated by OSH, but this warrants further investigation. PROSPERO registration number: CRD42019126598.

HIGH-VELOCITY MUSCULAR POWER TRAINING IMPROVES FUNCTIONAL OUTCOME MEASURES IN OLDER ADULTS

Chris Hattersley, Sheffield Teaching Hospitals Trust; Dave Hembrough, Sheffield Hallam University; Kaseem Khan, Rotherham Hospital; Tom Maden-Wilkinson, Sheffield Hallam University

PURPOSE: Muscular power reduces at a faster rate and is more associated with functional task performance than muscular strength in older adults (Gernster et al, 2017). This is underpinned by reductions in neural drive, motor unit synchronisation, rate of force development and the subsequent atrophy of fast twitch muscle fibres (Caserotti et al, 2008). The decrease in physical function caused by these factors is the initial stage of the age-related muscular disease sarcopenia (Cruz-Jentoft, 2018). Sarcopenia is one of the most debilitating physiological effects of ageing and costs an estimated £2.5 billion annually in the UK (Vilanueva et al, 2018).

METHODS: The study carried out was a systematic review. CINAHL, MEDLINE, and SPORTDiscus were searched along with grey literature to identify appropriate articles. Inclusion and exclusion criteria were set to ensure that the search only targeted studies that were relevant to the research question. PICO Characteristics were also set. Their methodological quality was assessed using the McMaster quantitative appraisal tool and results presented using the PRISMA framework.

RESULTS: High-velocity power training improved functional outcome measures in older adults and therefore quality of life. The key determinants of improvement were utilising a maximum intended movement velocity as well as the length and frequency of the interventions. Improvements are possible with a relatively low training volume, at minimal loads (0% 1RM) and occur in a dose-dependent manner.

CONCLUSIONS: High-velocity power training offers a potentially simple to implement method to enhance physical function in older adults. This has the potential to improve quality of life as well as reducing social and economic burdens for a rapidly expanding demographic. Further research is required with larger sample sizes and longer durations to determine the optimal exercise selection, training loads, training frequencies and repetition velocities.

POSTER ABSTRACTS 3/4

THE EFFECT OF RESISTANCE TRAINING INTERVENTIONS ON 'THE SELF' IN YOUTH: A META-ANALYSIS

Helen Collins, University of Dundee & University of Edinburgh; Dr Josephine N Booth, University of Edinburgh; Dr Audrey Duncan, University of Dundee; Dr Samantha Fawcner, University of Edinburgh; Dr Ailsa Niven, University of Edinburgh

PURPOSE: There is growing evidence that physical activity (PA) is beneficial for the mental health of young people. One area that has been widely examined is the impact of PA on 'the self', which is a term that encompasses a range of specific and related terms (e.g. self-esteem, self-efficacy, self-perceptions). There is evidence that PA is strongly associated with 'the self' in childhood and beyond. However, the impact of the specific PA of resistance training (RT) is not yet clear. The purpose of this review was to advance knowledge on the potential of RT for enhancing mental health by examining the effect of RT interventions on 'the self' in youth.

METHODS: This meta-analysis followed the PRISMA guidelines (PROSPERO registration number CRD42016038365). Electronic literature databases were searched from the year of their inception up to and including October 2018. The search included English language articles that examined the effect of isolated RT on 'the self' in youth, with participants of school age (5-18 years). Data were extracted using an electronic form by one reviewer with 10% conducted by a second reviewer. The "Quality Assessment Tool for Quantitative Studies" was used to assess quality and risk of bias and was conducted by two reviewers.

RESULTS: From seven peer reviewed studies, ten data sets were included exploring seven outcomes related to 'the self' in participants aged between 10-16 years. Four of these studies (including seven data sets) were combined in a meta-analysis, with results from the remaining three studies reported separately. Significant intervention effects were identified for: resistance training self-efficacy (Hedges' $g = 0.538$, 95% CI 0.254 to 0.822, $P < 0.001$), physical strength (Hedges' $g = 0.289$, 95% CI 0.067 to 0.511, $P = 0.011$), physical self-worth (Hedges' $g = 0.319$, 95% CI 0.114 to 0.523, $P = 0.002$) and global self-worth (Hedges' $g = 0.409$, 95% CI 0.149 to 0.669, $P = 0.002$). There was variable quality of studies, with just two studies being classified as 'strong'.

CONCLUSIONS: This is the first review to synthesise research on the effects of isolated RT interventions on 'the self'. The findings indicate that RT has a positive impact on some aspects of 'the self' in youth. More high quality studies should be conducted to further investigate this topic. If validated, this type of intervention could have a positive impact on 'the self' and ultimately improve the health of individuals not only during childhood but as they progress through life.

EFFECTS OF VARYING INERTIAL LOADINGS ON ECCENTRIC OVERLOAD IN THE FLYWHEEL ROMANIAN DEADLIFT EXERCISE

Joey O'Brien, Declan Browne & Des Earls, Institute of Technology Carlow, Carlow, Ireland

PURPOSE: Flywheel devices were designed to provide resistance by the inertial force generated by rotating flywheels during acceleration (concentric) and braking (eccentric) movement phases. This inertial force is reliant on the diameter, thickness and density of the flywheel while also depending on the acceleration generated by the athlete. In contrast to traditional resistance training exercises flywheel training may produce greater force during the eccentric phase than in the concentric phase which leads to an eccentric overload. The purpose of this intervention was to investigate the effects of different inertial loadings on eccentric overload during the flywheel Romanian deadlift and identify an optimal loading to maximise desired response.

METHODS: Fourteen recreationally trained males (27.9 ± 6.4 years, 90 ± 10.7 kg, 180.7 ± 5.5 cm) participated in the study. All participants performed 4 sets of 12 repetitions of the Romanian deadlift exercise performed on a flywheel device (kBox 3, Exxentric, AB TM, Bromma, Sweden). Each set was performed using different inertia loads, these being 0.025, 0.050, 0.075 and $0.100 \text{ kg}\cdot\text{m}^2$. The order of the inertia load setting was randomised for each participant. A 5 minute inter-set rest period was given. During each repetition power was recorded by means of a data reader and transmitter (Kmeter, Exxentric, AB TM, Bromma, Sweden) attached to the flywheel device.

RESULTS: Mean % Eccentric Overload was analysed for each inertial loading. A one way ANOVA discovered a significant difference ($p < 0.001$) between different inertia loadings. Further post hoc analysis discovered a statistically significant difference between 0.025 and 0.075 ($p < 0.001$), 0.025 and 0.01 ($p < 0.001$), 0.05 and 0.075 ($p < 0.001$) but no statistical significance was discovered between 0.05 and 0.075 ($p = 1.00$), 0.05 and 0.1 ($p = 0.227$) or 0.075 and 0.1 ($p = 0.538$) inertia loadings. Cohen d effect size showed a large effect between 0.025 and 0.1 (0.79) inertia loadings.

CONCLUSIONS: The aim of this study was to analyse the effect of different inertial loading on eccentric overload in the flywheel Romanian deadlift exercise. This study established that higher inertial loads lead to higher eccentric overload values. The results show that the lightest load ($0.025 \text{ kg}\cdot\text{m}^2$) displayed significantly lower eccentric overload values when compared to greater loads (0.050, 0.075 and $0.100 \text{ kg}\cdot\text{m}^2$). Specifically, the $0.100 \text{ kg}\cdot\text{m}^2$ load led to the greatest eccentric overload and may be the optimal loading when the aim is to generate maximum eccentric overload. Coaches can be confident that moderate to heavy inertial loadings (0.050, 0.075 and $0.100 \text{ kg}\cdot\text{m}^2$) will lead to eccentric overload in the flywheel Romanian deadlift exercise.

POSTER ABSTRACTS 5/6

THE EFFECTS OF SIX-WEEKS CHANGE OF DIRECTION SPEED AND TECHNIQUE MODIFICATION TRAINING ON CUTTING PERFORMANCE AND MOVEMENT QUALITY IN MALE YOUTH SOCCER PLAYERS

Thomas Dos'Santos, Alistair McBurnie, Paul Comfort and Paul A. Jones, Centre for Health Sciences Research, University of Salford, Salford, UK

PURPOSE: Cutting manoeuvres are important actions associated with soccer performance and a key action associated with non-contact anterior cruciate ligament injury; thus, training interventions that can improve cutting performance and movement quality is of great interest to practitioners. Change of direction (COD) speed training has been shown to improve COD performance, while reductions in knee joint loads have been observed following COD technique modification training. However, there is paucity of research considering the implications of COD technique modification training on both performance and injury risk, particular in soccer players. The aim of this study, therefore, was to determine the effects of a six-week change of direction (COD) speed and technique modification training intervention on cutting performance and movement quality in male youth soccer players (U17s, n=13), in comparison to a control group (U18s, n=13) who continued normal training.

METHODS: A non-randomized, controlled 6-week intervention study with a pre-to-post design was used. The intervention group (IG) (U17s) performed two COD speed and technique modification training sessions per week (20 mins) for 6 weeks. Soccer players from the same club (U18s) acted as the control group (CG) and continued their normal field-based warm-ups (low-level jump-landing and sprint drills). 70° cutting performance (5-m entry and exit) was assessed based on completion time and COD deficit, and the field-based cutting movement assessment score (CMAS) qualitative screening tool was used to assess cutting movement quality. The CMAS is based on technical and mechanical determinants of peak KAMs (lateral trunk flexion, extended knee posture, knee valgus, hip and foot internal rotation) and has been validated against the gold standard of 3D motion analysis (Jones et al., 2017).

RESULTS: Significant main effects for time ($p \leq 0.041$, $\eta^2 = 0.224-0.839$) (pre-to-post changes) and significant interaction effects ($p \leq 0.025$, $\eta^2 = 0.262-0.330$) of time and group were observed for cutting completion times, COD deficits, and CMASs. Improvements in completion time ($p < 0.001$, $g = 1.90$, -11.7% vs. $p < 0.001$, $g = -1.21$, -5.9%) and COD deficit ($p \leq 0.012$, $g = -2.43$, -51.5% vs. $p < 0.001$, $g = -1.32$, -27.9%) for the IG were approximately two times greater than the CG and significantly different ($p \leq 0.025$, $g = -1.09$ to -1.57). Furthermore, lower CMASs (i.e. improved cutting movement quality) were observed only in the IG ($p = 0.025$, $g = -0.85$, -22.5%, -1.46 score) compared to the CG ($p = 0.779$, $g = 0.08$, +5.6%, +0.12). These positive changes in CMASs were attributed to improved cutting technique and reduced incidences of high-risk deficits.

CONCLUSIONS: The results of this study indicate that COD speed and technique modification training, in addition to normal skills and resistance training, improves cutting performance and cutting movement quality in male youth soccer players. Practitioners working with male youth soccer players should implement COD speed and technique modification training to improve cutting performance and movement quality, which may decrease potential injury risk.

A STUDY INTO COUNTERMOVEMENT JUMP ECCENTRIC PHASE PERFORMANCE AND JUMPING HEIGHT IN COLLEGIATE ATHLETES

Chien-Chun Chang, Graduate Institute of Athletics and Coaching Science, National Taiwan Sport University, Taiwan; Shu-Huang Lin, Hong Kong Sportsline Asia Co., Ltd. Taiwan Branch; Chien-Ying Chiang, Department of Sport Training Science-Combats, National Taiwan Sport University, Taiwan

PURPOSE: The purpose of this study was to investigate the relationships between eccentric performance of countermovement jump (CMJ) and its jumping height (JH). The secondly purpose was to evaluate whether eccentric performance can be characterized among basketball, judo, weightlifting.

METHODS: Twenty four NTSU Division I athletes participated in this study (age: 20.9 ± 1 year, height: 175.37 ± 9.63 cm, weight: 76.87 ± 15.85 kg). CMJs were measured on a force platforms, force-time curves were collected for further analysis. JH, eccentric center of mass (COM) displacement, force at zero velocity (F@0V), eccentric acceleration duration (EccAccDur), minimum velocity (MinV) were calculated from a customized python software. Associations between eccentric variables and JH were used for analyzing the Person-product moment correlation.

RESULTS: Eccentric COM displacement, F@0V, and EccAccDur showed moderate to strong positive correlation with JH ($r = .465-.618$). F@0V and JH showed positive strong correlation ($r = .572$), MinV and JH showed moderate negative relationships ($r = -.765$) in basketball; eccentric MinV and JH showed moderate negative relationships ($r = -.314$) in Judo. In addition, eccentric COM displacement moderate relationships with JH ($r = .32$) in weightlifting. The JH, eccentric COM displacement, F@0V, EccAccDur were significant different across three sports. Weightlifters showed significantly superior JH, F@0V, EccAccDur than basketball and Judo athletes.

CONCLUSIONS: The results indicate CMJ eccentric performance associated with JH, however, the relationships were sports dependent. Further research is needed to investigate the relationships between eccentric performance and individual sport-specific performance.

POSTER ABSTRACTS 7/8

HAMSTRING STRENGTH ASYMMETRIES IN ACADEMY CRICKETERS: THE IMPACT OF TRAINING THROUGHOUT A PRE-SEASON

Luke Taylor, Oxford Brookes University; John Jakeman; John Harman & Max Honigsbaum

INTRODUCTION: This aim of this study is to assess the levels of hamstring asymmetry across multiple tests in male English University Academy (MCCU) and the impact of training during the 2018-19 season, and measuring any differences across playing position. It is evident that muscular asymmetry can impact injury risk and physical performance across various sports and actions, with recent research suggesting that this may be a sport specific adaptation to functional performance (Gray et al. 2016). Fast bowlers are known to be at a heightened injury risk due to the ballistic nature of their action compared to other roles within cricket with batters being another position identified as at risk. This case study looked to assess the levels of asymmetry across playing position in hamstring strength and capacity.

APPROACH: Three testing sessions during pre-season (30 weeks) were taken to assess the impact of training and overall development. The following measurements were taken from Nordboard assessments; absolute peak force (N) left and right. Furthermore, a single leg hamstring bridge capacity assessment was tested to assess muscular capacity in both left and right legs. Athletes were grouped by broad specialty into spin bowlers (n = 5), fast bowlers (n = 9) and all-rounders and batsmen (n = 10). The S&C programme lasted 30 weeks, with an average of 5 S&C sessions each week. Each strength training session had elements of hamstring work within the session either eccentric or isometric in focus or both. Furthermore, alongside sprint mechanic development, athletes were exposed to max velocity work throughout pre-season.

RESULTS: There were significant improvements in absolute strength for all groups in both left (+14.4% ($\pm 16.9\%$)) and right (+18.4% ($\pm 18.6\%$)) legs, assessed with the Hamstring bridge, and assessed with the Nordboard (left + 9.9% ($\pm 5.8\%$), right + 5.9% ($\pm 3.3\%$)). The Nordboard indicated a small, but statistically significant improved symmetry (reduced asymmetry) over the three testing sessions (0.04% ($\pm 0.01\%$)), but the same effect was not observed using the hamstring bridge.

PRACTICAL APPLICATIONS: This case study shows the impact of targeted hamstring strength training over the course of a pre-season to create a lower level of hamstring asymmetry prior to the competitive season commencing. Establishing the dominant limb prior to an intervention may allow the practitioner to develop targeted programmes for specific asymmetries. The practitioner must also be conscious of the fact that some asymmetries are a sport specific adaptation and therefore previous guidelines indicating injury risk are not relevant to all sporting populations. Decisions based on these findings must be applied in a case by case basis taking into account the athletes; sport, position and injury history in addition to their physical outputs. This case study will continue to assess whether the increase of bowling workload, particularly in the fast bowling unit, will induce a new hamstring asymmetry favouring the landing leg during the delivery stride.

EVALUATION OF LOWER EXTREMITY STIFFNESS AND LINEAR ACCELERATION PERFORMANCE IN COLLEGIATE BASKETBALL PLAYERS

Xiang Yao, Middlesex University; Cheng-Yu Liu, Huai-Hsuan Hsu, Ping-Hai Rao, Tzu-Yen Cho, Shu-Huang Lin, Mao-Sen Sang & Chien-Ying Chiang, National Taiwan Sport University

PURPOSE: The majority of research discuss acceleration biomechanics and kinematics based on sprinters. However, acceleration is also important in team sports, such as basketball. This study is to compare the difference between fast and slow basketball players in lower extremity stiffness and acceleration characteristics over a short distance.

METHODS: Fifteen collegiate basketball players (height: 183 \pm 7.6cm, body mass: 81.9 \pm 15.6kg) performed a 10-m linear acceleration test. Timing gates were used to collect split times. Acceleration characteristics were recorded via high speed camera (240 fps) and analyzed with Silicon Coach Analysis software. The split-middle method was used to separate athletes into fast and slow groups based on their 10-m finished times. To evaluate lower extremity stiffness during jumping tasks, a force plate and high-speed camera (240 fps) were used to collect force and movement data. An independent samples t-test was used to compare the differences between the fast and slow groups.

RESULTS: In terms of the 0-5-m, 5-10-m, and 0-10-m sprint times, participants in the fast group were significantly faster than those in the slow group (9%, 5%, 7%, respectively). However, in terms of acceleration characteristics, the fast and slow groups showed significant differences only in the SL and SF for the 0-5-m sprint. In terms of lower extremity stiffness, no significant differences were found between the two groups.

CONCLUSIONS: The subjects in the present study were a sample of well-trained athletes. Thus, our results might only be applicable to athletes with similar characteristics to those of the participants in the study. For team sports athletes, the first 5m during sprinting is the key point to have a faster 10m sprint, which is a distance important for most team sport athletes. Our study showed that faster team sport athletes have a higher SF and shorter GCT during early 5m acceleration. Lower extremity stiffness showed no difference between fast and slow groups, which future research should focus on how stiffness affects sprint characteristics.

POSTER ABSTRACTS 9/10

A KINETIC AND KINEMATIC ANALYSIS OF THE REAR FOOT ELEVATED SPLIT SQUAT FIVE REPETITION MAXIMUM TEST

Mark Helme, Dr Stacey Emmonds and Dr Chris Low, Leeds Beckett University

PURPOSE: The rear foot elevated split squat (RFESS) is a multi-joint, unilateral resistance exercise, commonly used in strength and conditioning (McCurdy (2017). McCurdy, Langford et al. (2004) and McCurdy and Langford (2005) have previously reported the RFESS as a reliable measure of unilateral leg strength (1RM ICC, 0.97- 0.99). To further enhance the proposed frequency of use and reliability as both a single and multiple repetition test of leg strength, it is pertinent to quantify the kinetic and kinematic characteristics of the exercise. No study, to date, has yet analysed the intra-set differences in kinetic and kinematic parameters, in a multi-repetition test of leg strength. The aim of this study was to firstly quantify the kinetic and kinematic characteristics of the RFESS 5RM test protocol. Secondly to profile the intra-set differences between repetitions.

METHODS: 26 volunteers were recruited, with institutional ethical approval (age = 23.8 ±4.6 years, mass = 88.1 ±10.7kg, height = 1.79±0.1m), all subjects were engaged in a structured strength and conditioning program. Participants were required to undergo an incremental loading test until maximal load was achieved. Kinetic data was collected from the front and rear foot through two independent Kistler 9827C force plates at 1000Hz (Kistler Group, Winterthur, Switzerland), as depicted in figure 1. Kinematic data was captured through Qualysis Track Manager System at 250Hz (Qualysis AB, Gothenburg, Sweden) using 10 cameras (six ceiling mounted and four, floor mounted). Data was exported to a bespoke R code for this project. Magnitude based inferences were made on intra-set differences between repetitions for each of the kinetic and kinematic variables.

RESULTS: The mean load lifted was 84kg ±16.8kg (0.96 ±0.18 kg/kg). The mean vertical displacement of the bar was 0.38 ± 0.06m, mean concentric velocity was 0.32 ±0.05m/s and peak concentric velocity was 0.49 ±0.11m/s. The mean vertical ground reaction force (vGRF) of the lead foot was 1432.54±200.87N, (1.66 ±0.20BW). The lead foot produced 83.53±4.03% of total vGRF. There were unclear differences in all kinetic variables between all repetitions, except for peak (vGRF) of the lead foot only (1.90±0.28BW) of Repetition 5, which was very likely larger. Repetitions 1 and 2 were likely to very likely to have higher mean concentric velocities (MCV) than repetitions 4 and 5.

CONCLUSIONS: The RFESS 5RM produces mean and peak concentric vGRF of 1.66±0.20 BW and 1.84±0.24BW, which approximately equals the values reported by (Ebben and Jensen, 2002) for a bilateral squat. The inconsistent inferential findings across the set suggest that the final repetition may be different to repetitions 1-4, generating the highest peak force, largest vertical displacement and slowest MCV. Such findings indicate that repetition 5 represents the maximal effort of that set and the maximal protocol. The RFESS 5RM is valid and reliable method of measuring unilateral leg strength. A multi-repetition protocol can be used to determine maximal strength, yet intra-set differences may not exist prior to completion of the final repetition. Practitioners should consider this information when evaluating the efforts of athletes during this exercise.

VALIDATION OF THE BRZYCKI AND EPLEY EQUATIONS FOR FEMALE ATHLETES

Des Earls, Ciara Hennessy & Katie White, Institute of Technology Carlow

PURPOSE: The use of prediction equations to estimate 1 Rep Maximum (RM) from submaximal loads has been proven as a viable means of assessing maximal strength in several populations, however the applicability for female athletes remains unclear. The purpose of this study was to investigate the validity of the Brzycki (1993) and Epley (1985) equations in predicting 1RM using 5RM and 10RM reps-to-fatigue loads in competitive female athletes.

METHODS: 20 participants (age, 21 ± 1.7 years; weight, 65.95 ± 8.88 kg; height, 166.8 ± 5.09 cm) were tested on the Bench Press (BP) and hex bar Deadlift (HBDL) exercises. Following familiarisation participants were tested for 1RM, 5RM and 10RM values following NSCA guidelines with at least 48 hours in between tests. Pearson product moment correlation coefficients (r) were used to evaluate the relationship between actual and predicted 1RM values. Paired t-tests determined the difference between estimated and actual 1RM scores. An alpha level of $p \leq 0.05$ was accepted for statistical significance. Constant error and percentage error determined for each estimation.

RESULTS: Statistical analysis revealed a strong positive correlation between all predicted 1RM values and actual 1RM ($r > 0.98$; $p < 0.01$) for BP. There was also a strong positive correlation between actual 1RM and all predicted 1RM values ($r > 0.95$; $p < 0.01$) for HBDL. Paired t-tests showed, that the Epley formula significantly overestimated actual 1RM ($p < 0.05$) when using 5RM reps-to-fatigue assessment in BP. There was also a significant difference between the Brzycki 10RM test compared to the achieved 1RM for the HBDL ($p < 0.05$). All other paired t-tests showed no significant differences between equation predicted 1RM and actual 1RM loads ($p > 0.05$).

CONCLUSIONS: The results of this investigation indicate that predicted 1RM values calculated from 5RM and 10RM submaximal loads using the Brzycki (1993) and Epley (1985) equations are highly correlated to actual 1RM values. This validation of the prediction equations will allow strength and conditioning coaches and researchers to assess predicted 1RM values when 1RM testing is impractical due to time or training experience constraints in competitive female athletes.

POSTER ABSTRACTS 11/12

EFFECTS OF CONCENTRIC VERSUS ECCENTRIC RESISTANCE TRAINING ON THE VASTUS LATERALIS ARCHITECTURE

Jack Benford, Dr Jonathan Hughes, Dr Nicola Theis, University of Gloucestershire

PURPOSE: A wealth of evidence has demonstrated hypertrophic responses to eccentric (ECC) and concentric (CON) training. Such responses to lengthening vs. shortening contractions are likely to be achieved by different adaptations in the architecture of the muscle, but these changes are not fully understood. The purpose of this study was to investigate the effect of ECC and CON training on muscle strength and architecture of the Vastus Lateralis (VL).

METHODS: Nine physically active healthy males (age: 20.7 ± 0.9 years; stature: 174.9 ± 6.4 cm; mass: 73.9 ± 10.6 kg) performed ECC or CON unilateral isokinetic knee extensions twice weekly over a 5-week period. A novel concurrent single leg design was utilised, whereby each participant completed both the CON and ECC training. Whether the dominant or non-dominant leg performed CON or ECC training was randomised and balanced between participants. Training comprised of 4 x 8 repetitions completed at $30^\circ \cdot s^{-1}$ on an isokinetic dynamometer. Before and after 5 weeks of training, resting measures of whole VL Lf were collected using a 3D Ultrasound (US) technique, which allowed the curvature of the fascicle to be visualised and measured. Resting PA was measured using 2D US at the mid-belly of the muscle. Maximal isometric and isokinetic torque were also assessed before and after the training using dynamometry. Two-way Repeated Measures ANOVAs were conducted on all dependent variables. The classification of effect size for pre-to post-training was calculated on dependent variables, this was determined by Cohen's d and classified as < 0.2 (trivial), $0.2 - 0.49$ (small), $0.5 - 0.79$ (moderate) and > 0.8 (large).

RESULTS: Following 5 weeks of training, both the CON and ECC group showed significant increases in isometric and isokinetic strength ($p < 0.05$), although no significant differences were found between groups. This increase in strength was accompanied by a significant increase in Lf in the ECC group ($p = 0.00$; $d = 2.06$) whilst the CON group showed significantly greater increases in PA ($p = 0.00$; $d = 2.71$).

CONCLUSIONS: The present study confirmed the finding that 5-weeks of ECC and CON training, led to significant strength gains. However, these results suggest that skeletal muscle responds differently to the mechanical stimuli induced by ECC and CON muscle actions. This differentiation may be important for both rehabilitation and performance, where a greater maximum shortening velocity or a greater force output of the muscle are required to reduce the risk of injury or enhance performance.

THE RELATIONSHIP BETWEEN WEIGHTLIFTING PERFORMANCE AND ALTERNATE JUMP VARIABLES

Shyam Chavda,^{1,2} Xiang Yao,¹ Jake Harcoff,¹ Stuart Martin,² Dr Anthony Turner¹, ¹Middlesex University, ²British Weightlifting

PURPOSE: Surrogate measures of weightlifting performance (WLP) have previously been monitored using loaded and unloaded squat jumps (SJ) (Bazylar et al 2018; Travis et al 2018; Carlock et al 2004) and countermovement jumps (CMJ) (Carlock et al 2004). Typically measures of jump height (JH) (Travis et al 2018; Carlock et al 2004) and peak power (PP) (Carlock et al 2004), and their associated scaled counterparts (Travis et al 2018; Carlock et al 2004) have been used to identify relationships between them and WLP. While these variables have been shown to have moderate to strong relationships ($r = 0.60-0.93$) (Carlock et al 2004), further information into the underpinning mechanisms that contribute to such outcome measures has not yet been investigated and may provide insight into variables more sensitive to change; thus, owing to the continued monitoring process.

METHODS: Thirty-nine ($n = 39$) male and female national and international level weightlifters volunteered to participate in this study conducted during a national championship, 2019. Following the competition subjects were invited to perform 2 CMJ's on a force plate (Kistler 9286, Winterthur, Switzerland) interspersed with ~1-minute rest between reps. All jumps were executed in accordance to the methods outlined by Chavda et al (2018). Raw force-time data was analysed in a customised excel spreadsheet (Chavda et al 2018) where variables relating to jump height, peak force, impulse and power were extrapolated. All CMJ variables were analyzed for reliability using the coefficient of variation (CV) and intraclass correlation coefficient (ICC) with absolute agreement and 95% confidence intervals. Relationships between competition data and jump variables were analysed using a Spearman's rho correlation with the alpha level set at $p < 0.05$.

RESULTS: Results indicated concentric impulse (ConImp) to be the most reliable variable (CV = 1.68, ICC (95% CI) = 0.99 (0.98-0.99)), closely followed by peak power (PP) (CV = 1.9, ICC (95% CI) = 0.99 (0.98-0.99)). The Spearman's rho correlations indicated a stronger relationship between ConImp and all performance variables for snatch, C&J and total ($r = 0.85, 0.76, 0.77$ respectively) compared to PP ($r = 0.85, 0.73, 0.73$ respectively). Also of note is the lack of relationship that existed between ConImp duration and WLP; thus, suggesting the magnitude of propulsive force during a CMJ is of high importance.

CONCLUSIONS: The current findings suggest that ConImp during a CMJ is best related to WLP, when compared to other CMJ variables. Although it had similar relationships to WLP as PP, the lower CV makes it more sensitive to detect change therefore potentially being useful in the monitoring of weightlifters. Given the lack of relationship between ConImp duration and WLP, it is stipulated that the magnitude of force is the confounding factor that relates ConImp to WLP, and therefore a focus on training maximal dynamic strength, specific to propulsive elements of the lift (i.e. mid thigh pulls) may assist in greater WLP. Lastly, contrary to previous research, JH had very weak ($r = 0.42-0.49$) relationships to WLP, and therefore may not be a key indicator for WLP.

POSTER ABSTRACTS 13/14

CHANGE OF DIRECTION TASK COMPLETION STRATEGY: ASSESSING ASYMMETRIES

Benjamin R. Humphrys, Dr Jonathan, D. Hughes & Richard Clarke, University of Gloucestershire

PURPOSE: It has recently been proposed that completion strategy (entry and exit time) of change of direction (COD) tasks could be examined for a greater understanding of performance. When comparing COD performance in different turning directions, asymmetries have been reported in a range of populations. However, these asymmetries have not been investigated in relation to the associated task completion strategy. Thus, the present study aims to determine the magnitude of asymmetries in COD strategy during the 5-0-5 test and the relationships between 5-0-5 performance asymmetry and completion strategy asymmetry.

METHODS: Thirty-six youth athletes (height: 170.9 ± 9.6 cm; mass: 66.1 ± 12.9 kg; maturity offset: 2.4 ± 0.7 years post PHV) performed three 5-0-5 trials in each turning direction (clockwise and anti-clockwise). Asymmetries (Dominant [D] vs Non-dominant [ND]) between directions were calculated using the percentage difference method. Participants with a percentage asymmetry greater than their individual maximum CV% were considered asymmetrical ($n = 11$). Only the asymmetrical group was used for further analysis. Task completion strategy was measured by; initial approach time (0-10m), full approach time (0-15m) entry time (10-15m) and exit time (15-20m). Performance and strategy variables were compared between directions using a Paired Samples T-test and a Pearson's Correlation established relationships between COD strategy asymmetries and 5-0-5 asymmetries.

RESULTS: There were significant differences between turning directions for 5-0-5 time ($D = 2.49 \pm 0.14s$ vs $ND = 2.61 \pm 0.13s$, $p < 0.01$), entry time ($D = 1.12 \pm 0.11s$ vs $ND = 1.23 \pm 0.08s$, $p < 0.01$) and full approach time ($D = 3.02 \pm 0.20s$ vs $ND = 3.15 \pm 0.14s$, $p < 0.05$). No significant difference was reported for initial approach or exit time ($p > 0.05$). Entry time asymmetry was the only COD strategy variable to have a significant negative correlation to 5-0-5 asymmetry percentage ($r = -0.65$, $p < 0.05$). However, exit time asymmetry displayed a significant negative association with entry time asymmetry ($r = -0.95$, $p < 0.01$).

CONCLUSIONS: The results indicate that individuals who enter their non-dominant turn faster, demonstrate a slower exit speed and subsequently a greater asymmetry in 5-0-5 performance. This may be attributed to a lack of centre of mass control during the deceleration phase or poor joint-joint co-ordination during the entry phase, negatively impacting exit time via poor application of propulsive impulse. The identification of this performance limitation may provide useful information to coaches although further investigation to aid understanding is required.

THE EFFECTS OF A 12-WEEK NEUROMUSCULAR TRAINING INTERVENTION ON ISOMETRIC MID-THIGH PULL KINETICS AND DROP JUMP PERFORMANCE IN TRAINED YOUNG FEMALE GYMNASTS

Sylvia Moeskops,¹ Jon L. Oliver,¹ Paul J. Read,² John B. Cronin,³ Gregory D. Myer,⁴ Gregory G. Haff,⁵ Steph J. Morris,¹ Rhodri S. Lloyd¹

¹Cardiff Metropolitan University, ²Aspetar Orthopaedic & Sports Medicine Hospital, ³AUT University, ⁴Cincinnati Children's Hospital, ⁵Edith Cowan University

PURPOSE: While some research has explored the effectiveness of neuromuscular training (NMT) programmes in young female gymnasts (2-4), these studies have primarily relied on performance outcomes during jumping protocols (e.g. jump height) without examining underlying mechanical adaptations (e.g. kinetic variables). Therefore, this study aimed to investigate the effects of a 12-week NMT intervention on isometric and dynamic force-time characteristics during an isometric mid-thigh pull (IMTP) and drop jump (DJ) respectively, in trained young female gymnasts.

METHODS: Thirty-three pre-pubertal female gymnasts were sub-divided into gymnastics + NMT (GYM+NMT; $n = 17$) or gymnastics only (GYM, $n = 16$) groups (table 1). The GYM+NMT group followed a 12-week NMT program (table 2), consisting of two 1-hr sessions/week, while the GYM group did not receive the additional training stimulus. Data were collected for both the IMTP and 30 cm DJ protocols using dual force plates. The processed variables are presented in table 3. A 2×2 (group \times time) repeated measures ANOVA with a Bonferroni post-hoc analysis was used to identify differences between groups, for all variables ($p < 0.05$), while effect sizes (Cohen's d) were calculated to interpret the magnitude of between-group differences (1).

RESULTS: Following the 12-week intervention, the GYM+NMT group produced significantly more absolute and relative peak force (figure 1), when compared to the GYM group ($p < 0.05$). For absolute and relative force at different time sampling intervals, the GYM+NMT group showed no significant changes. A similar pattern was observed for force at 50 milliseconds for the GYM group. However, the GYM group displayed a significant decrease in absolute and relative peak force at 90, 150, 200 and 250 milliseconds. Neither group showed significant improvements in jump height, stiffness, RSI or CoMFz correlation in the DJ protocol.

CONCLUSIONS: The 12-week intervention significantly improved the maximal force producing capabilities of young female gymnasts, beyond gymnastics training alone. However, neither group significantly improved measures of jump height, stiffness, RSI or CoMFz correlations, which indicates that the NMT program did not elicit a superior training stimulus in fast stretch-shortening cycle function to their habitual gymnastics training. The NMT program primarily targeted the development of movement competency and basic strength, therefore, it is likely that the GYM+NMT group experienced specific adaptations to the imposed demands. Experienced, technically competent young female gymnasts may require NMT programs with higher intensities and longer durations to elicit further improvements isometric and dynamic force-time characteristics.

POSTER ABSTRACTS 15/16

PERFORMANCE ASSOCIATIONS BETWEEN STRENGTH CHARACTERISTICS AND TAEKWONDO FREQUENCY SPEED OF KICK TEST

Hao-Che Tseng, Institute of Athletics and Coaching Science, National Taiwan Sport University; Chien-Ying Chiang, Mu-Yen Chu, Chia-Hsing Liao, Hui-Ting Tang and Jung-San Chang, Department of Sport Training Science-Combats, National Taiwan Sport University

PURPOSE: Kicking Frequency is an important element during taekwondo(TKD) competition. The frequency speed of kick test (FSKT) has been proved to be responsive and sensible to TKD performance. The purpose of the present study was to investigate the relationships between strength characteristics and FSKT.

METHODS: A total of 7 male elite TKD athletes(height: $180.90 \pm 6.68\text{cm}$; weight: $72.75 \pm 10.82\text{kg}$; age: $20.57 \pm 1.51\text{years}$) performed countermovement jump (CMJ), squat jump (SJ) on a force plate and FSKT on a separate occasion. The selected strength and power variables were vertical jumps height (JH), peak force (PF), peak power (PP), rate of force development (RFD) and eccentric utilization ratio (EUR). PF, PP, RFD was normalized as a value relative to body mass. In addition, the variables chosen from FSKT were FSKT with 10s (FSKT10s), mutiple sets (i.e., five 10s sets with 10s intervals in-between; FSKTmult) and kick decrement index (KDI). Pearson correlation statistical analyses was used to evaluate the relationships between FSKT10S, FSKT90s, KDI and aforementioned jumping variables.

RESULTS: FSKT10S showed negative correlation with EUR(PP)($r=-.581$, $p=.171$), FSKT90S also revealed negative correlations with EUR(JH)($r=-.509$, $p=.244$) and EUR(PP)($r=-.749$, $p=.053$). In addition, KDI showed strong relationships with CMJ PP($r=-.528$, $p=.224$), SJ PF($r=-.562$, $p=.189$) and SJ RFD($r=-.598$, $p=.156$).

CONCLUSIONS: The results indicate that lower EUR(PP) may improve TKD kicking frequency(10s and mutiple sets) Moreover, higher CMJ PP, SJ PF, RFD may decrease KDI and improve the overall performance.

THE EFFECT OF FATIGUE ON FOOT POSTURE IN ELITE DISTANCE RUNNERS, PRE AND POST A STRENGTH PROGRAMME FOR THE MEDIAL LONGITUDINAL ARCH OF THE FOOT

Katie Astin, Rik Mellor and Alex Bliss; St Mary's University

PURPOSE: Research has identified that fatigue of the medial longitudinal arch (MLA) negatively impacts foot posture and determined how strengthening the MLA can enhance foot posture. This study aimed to determine whether the negative effect of fatigue on the MLA is apparent in elite highly trained endurance runners, and if fatigued foot posture can be improved via MLA strength training.

METHODS: A matched pairs design formed the basis of this study, including 12 elite highly trained endurance runners. Foot pliability ratio (FPR) and arch height index (AHI) were calculated before and after a 50minute moderate intensity run, then after the intervention group completed a strength intervention for the MLA.

RESULTS: A paired samples t-test (level of significance set at $p \leq 0.05$), revealed no significant difference in FPR ($t = -0.118$, $p = 0.908$), or AHI ($t = 1.202$, $p = 0.255$). No significant difference in fatigued FPR or AHI was identified after the strength intervention was completed in either the intervention group (FPR: $t = 1.911$, $p = 0.114$, AHI: $t = -0.526$, $p = 0.621$), or control group (FPR: $t = 0.037$, $p = 0.972$, AHI: $t = -0.279$, $p = 0.791$).

CONCLUSIONS: Findings suggest that running induced fatigue and strength training for the MLA does not impact foot posture or fatigued foot posture, in elite endurance runners, however more conclusive research into this is required.

POSTER ABSTRACTS 17/18

THE COMPARISON OF DYNAMIC STRENGTH INDEX IN COLLEGIATE BASKETBALL AND TAEKWONDO ATHLETES

Cheng-Ting Ho (Institute of Athletics and Coaching Science), Chien-Chun Chang (Institute of Athletics and Coaching Science), Mau-Seng Sang (Department of Sports Training Science - Balls), Chien-Ying Chiang (Department of Sport Training Science-Combats), National Taiwan Sport University, Taoyuan, Taiwan

PURPOSE: The purpose of this study was to compare dynamic strength index (DSI) between the basketball and taekwondo (TKD).

METHODS: A total of 19 male collegiate elite athletes (14 basketball players, height: 186.7 ± 8.2 cm, weight: 86.4 ± 15.5 kg; 15 TKD athletes height: 181.4 ± 5.3 cm, weight: 65.8 ± 11.4 kg) performed a series of strength test, including countermovement jump (CMJ), squat jump (SJ) and isometric mid-thigh pull (IMTP) on force plates. Peak forces (PFs) were collected from force-time curve. DSIs were calculated as the ratio using PFs of CMJs and SJs, dividing by the PFs from IMTP. An independent sample t-test was used to evaluate the DSI differences between basketball and TKD athletes. In addition, Paired t-test was used to assess evaluate the DSI differences between CMJ and SJ performance.

RESULTS: The CMJ-DSI was significantly higher in basketball athletes than TKD athletes ($p=0.02$), and no significantly different between groups. Interestingly, CMJ-DSI and SJ-DSI were significant difference in TKD group ($p=0.001$), but not in basketball group.

CONCLUSION: The results indicate that the CMJ-DSI might be more suitable for basketball athletes to represent their dynamic strength utilization during vertical jump tests.

THE EFFECT OF AN 8 WEEK STRENGTH AND CONDITIONING PROGRAM ON COMPETITIVE YOUTH SWIMMERS

Ed Harper, Steve Thompson, Sheffield Hallam University

PURPOSE: Research has outlined the importance of muscular strength and the ability to generate force by the arms and legs in swimming performance. A clear correlation has been identified between swimming race times and athlete performance in strength and speed testing. Dry-land resistance training is common place in competitive swimming, however, to-date very little research has evaluated the impact of resistance training programs on youth athletes.

METHODS: 19 youth swimmers (male = 12 and female = 7), training a minimum of 8 hours per week (11.2 ± 1.9 hours training) were recruited for this study. Participants ranged in age (14.4 ± 2.7 years), height (163 ± 11 cm), body mass (60.5 ± 10.1 kg) and performance level (club - international). Participants followed an 8 week training intervention with testing in weeks 1 and 10 (1 session x week). The resistance training program was split up into phases focussing on muscle contraction types. The following format was used - weeks 1, 2 & 3 eccentric focus, weeks 4, 5 & 6 isometric focus, weeks 7 & 8 concentric focus. Participants completed assessments including height and maturation (Khamis-Roche, 1994), squat jump (cm), countermovement jump (cm), 10-5 jump test/reactive strength index (RSI) (m.s-1), maximum press ups (n) and maximum isometric pull up (s). Paired samples t-tests ($P < 0.05$) were carried out on all dependent variables, with Cohen's D effect sizes calculated to measure the strength of the difference (0.2 = small, 0.6 = moderate, 1.2 = large and 2.0 = very large). Pearson correlation coefficient (r) was calculated to assess the relationship between maturation and the performance parameters.

RESULTS: After 8 weeks of training, participants experienced a significant improvement in countermovement jump and maximum isometric pull ups ($P = 0.001$, $ES = 0.2$ and $P = 0.03$, $ES = 0.22$). Squat jump, maximum press ups and RSI did not significantly improve over the 8 week intervention. Pearson's correlation coefficients demonstrated a moderate to strong relationship between maturation and maximum press ups ($r = 0.55$, $P = 0.014$). All other dependent variables showed a weak correlation with maturation.

CONCLUSIONS: The main findings of this study were countermovement jump and maximum isometric pull ups significantly improved over the 8 week intervention, however, small effect sizes indicate these improvements may not be meaningful. Furthermore, maximum press ups had a moderate to strong correlation with maturation. Therefore, coaches could look to employ a single session per week of 'land-training' in order to influence youth athletes strength capabilities. As this is a relatively short amount of contact time, the introduction of S&C sessions in addition to the positive findings mean it is likely to be an idea which is more open to technical coaches, parents and athletes as it wouldn't impede on time in the pool.

POSTER ABSTRACTS 19/20

MATCH DEMANDS OF MID COURT PLAYERS IN NETBALL ACROSS DIFFERENT AGE GROUPS IN AN INDEPENDENT SCHOOL SETTING

James So, Graham Williams, Millfield School

INTRODUCTION: Netballers transitioning to higher standards of competition are required to develop physical qualities to meet the demands of match play. There is a similarity in the positional demands of mid-court players vs shooters and keepers due to court restrictions. However, there is currently limited research on the match demands of mid-court netballers across chronological year groups in school sport. The aim of this study was to investigate the mid-court match demands between U14, U16 and U18 netballers in independent school sport to better optimise their preparation and performance.

APPROACH: Data from 3 matches in the 2018-2019 academic year across the 3 age groups were collected via PlayerTek GPS units (Catapult). Mid court positions were chosen for data collection, including centre, wing attack/defence, goal attack/defence. Magnitude-based inferences were used to analyse the collected data, with the activity profiles for each year group analysed against each other. The activity profiling and subsequent analysis was centred on distance per minute (m/min) and acceleration and deceleration (m/s) count in different zones for each quarter, for each player.

RESULTS: Distance per minute (m.min⁻¹) for each quarter between U16 vs U14 and U18 vs U16 was unclear. There was a likely lower m.min⁻¹ for U18 compared to U14. For U16 compared to U14, acceleration count at 1-2 m.s-2.min⁻¹, >4 m.s-2.min⁻¹ and deceleration count at all zones (1->4 m.s-2.min⁻¹) were likely lower. For U18 compared to U14, acceleration and deceleration count at speed zones 1-4 m.s-2.min⁻¹ were possibly lower to very likely lower and were very likely higher at >4 m.s-2.min⁻¹. For U18 compared to U16, acceleration and deceleration count at 1-2 m.s-2.min⁻¹, 2-3 m.s-2.min⁻¹ and acceleration count at >4 m.s-2.min⁻¹ were unclear, and acceleration and deceleration count at 3-4 m.s-2.min⁻¹ and deceleration at >4 m.s-2.min⁻¹ were most likely higher to very likely higher.

PRACTICAL APPLICATIONS: These findings provide a novel insight into the match demands of netball between different age groups in independent school sport. Netball support staff should be aware of the unique match play demands within this demographic. At more advanced age groups, the development of maximum concentric and eccentric force production, alongside an enhanced acceleration and deceleration profile may be advantageous. In addition, the conditioning of the anaerobic energy system may supplement the repeated expression of these capacities. At the more junior age groups, the early introduction of a curriculum to develop effective movement skills and capacities for the expression of force may be warranted.

PHYSICAL PERFORMANCE CHARACTERISTICS OF ELITE FEMALE INTERNATIONAL FOOTBALLERS

Brian Doyle, Declan Browne, School of Science and Health, Institute of Technology Carlow; Dan Horan, Football Association of Ireland

PURPOSE: Over the last twenty years female participation in football has experienced rapid growth. Global participation grew from 22 million participants in 2000 to 30.15 million participants in 2014. Such rapid growth has resulted in a substantial increase in the number of competitive domestic and international matches being played by elite female footballers.

METHODS: Elite Female international Footballers (n=12) took part in the following anthropometric and physical performance tests. Anthropometric tests: Height Weight Performance tests: Counter Movement Jump (no arms) - 3 trials 10/5 Repeated hop test (Harper Protocol) - 3 trials linear sprints (5m-10m-20m-30m splits) - 3 trials Repeat Sprint Ability : 20m sprint followed by 10m deceleration and 10m active recovery to be completed every 15 seconds , 6 times (Gabbett 2010) - 1 trail Yo-Yo IR Level 1(as per Bangsbo protocol 2994,2003) - 1 trial.

RESULTS: mean± SD; Age 22.45 ± 5.06 yrs, height 170 ± 6.4 cm , body mass 65.44 ± 8.65 kg) This research data indicates as a group this cohort displayed similar physical performance characteristics as other elite female international footballing cohorts. Counter movement jump height: Norway; 30.7 ± 4.1 cm (Haugen et al 2012), Italy ; 31.6 ± 4.0cm (Datson et al 2014). Linear Sprints: data illustrated this cohort were slower over 0 - 10m and 0-20m in comparison to their Norwegian counterparts ,1.67 ± .07 sec, 3.1sec (Haugen et al 2012) vs 1.89 ± .09 sec , 3.26 sec. Though this group did display marginally quicker 0 - 5m and 0 - 10m times than an Australian cohort , 1.14 ± .04 sec , 1.91 ± .04 sec vs 1.09 ± .07 sec, 1.89 ± .09 sec. Repeat sprint ability: Australia 20.9 ± .5 ,total time (sec) vs 20.97 ± 1.1 ,total time (sec) in this study. Yo - Yo IR Level 1: data supported the premise that higher level players cover greater distances in the Yo-Yo IR level 1. As Danish and Spanish top division cohorts reported mean values of 1379 m and 1224 ± 225 vs 1416 ± 277m in this study.

CONCLUSIONS: Current trends within the literature illustrate physical capabilities can be influenced by chronological age, training age, playing position, playing level (elite, non-elite) and starting status (starter, non-starter). In addition it has been well documented within the research that elite female players possess enhanced physical capabilities regards linear speed, repeat sprint ability , explosive power and aerobic endurance . Therefore ,in developing a greater understanding of a players physical performance capacities the opportunity to implement individualised periodised training programs in order to optimise performance, reduce the risk of injury, and maximise recovery may present itself.

POSTER ABSTRACTS 21/22

WHAT DOES IT TAKE TO TRANSITION? MOVEMENT DEMANDS OF FOOTBALL MATCH PLAY AMONGST UNDER 14, U15, U16 AND U18 AGE GROUPS IN AN INDEPENDENT SCHOOL

Liam Bagge, Graham Williams, Millfield School

INTRODUCTION: The physical demands of competitive football have been well described in the literature at a professional senior and academy level. Despite the large participation numbers, the physical demands of football and its development across chronological age groups have not been explored in school sport. As such, little is known about how to best support the successful transition of youth footballers in school football as they transition through academic year groups. The aim of the study therefore was to analyse the competitive match play demands of football in a leading independent school across U14, U15, U16 and U18 age groups.

APPROACH: Twenty-five male football players from a leading independent sports school, participating across U14, U15, U16 and U18, were randomly selected to wear GPS technology (Playertek, Catapult) during the 2018-2019 academic year. Across all four-year groups a total of five competitive matches were analysed. Sprint distance (m), maximum velocity (m/s) and average distance per minute (m/min) were used to identify match play demands. Data was analysed using magnitude-based inferences with the match play demands for each year group analysed against each other.

RESULTS: For average distance per minute, U14 was most likely greater compared with U16, 2nd XI and 1st XI (106.63 ± 7.62 m/min VS 70.93 ± 9.88 , 69.88 ± 6.67 m/min, 61.56 ± 14.31 m/min respectively) and likely greater than U15 (99.44 ± 6.24 m/min). Sprint distance was likely higher in U14 than U16 (617.89 ± 202.45 m VS 372.31 ± 148.46 m) and unclear VS U15, 2nd XI and 1st XI (606.79 ± 346.27 m, 668.57 ± 149.47 m, 874.16 ± 403.43 m respectively). Max velocity was likely greater in 1st XI than U14 (8.13 ± 0.40 m/s VS 7.56 ± 0.59 m/s).

PRACTICAL APPLICATIONS: These results suggest football and physical preparation coaches in independent schools should be aware of the specific and variable physical activity demands associated to competitive football match play. At a more junior level, the development of the aerobic energy system may be warranted given the extensive match play demands. It may be that the more structured and intensive demands of match play in more advanced chronological year groups may require the physical development of high-speed movement and anaerobic energy system development relative to playing position demands. As such, future analysis in this area may require more detail position specific interventions.

A MUSCULAR ACTIVITY ANALYSIS OF THE STICKING REGION WITHIN THE CONVENTIONAL DEADLIFT

Jacob Wymer, Laura Charalambous, University of Bedfordshire

PURPOSE: The sticking region (SR) is the period during which bar velocity decreases from the first maximal velocity to the first located minimum velocity, and velocity is seen to increase again following this (Elliott, Wilson and Kerr, 1989). There is a limited understanding of the causal factors of the SR (Tillaar, Andersen and Saeterbakken, 2014). Muscle activity and relative bar displacement (RBD) are two unexplored factors in regards to the SR within the conventional deadlift. The aim of this study was to extend the current understanding of the causal factors of the SR within the conventional deadlift, and more specifically analyse the changes in muscle activity throughout the SR.

METHODS: Following a warm up and familiarisation eight male raw powerlifters (age: 23.5 ± 3.1 years, height: 1.77 ± 0.05 m, mass 88.18 ± 18.00 kg) completed a single repetition at 90% of their competition one repetition maximum. Bar velocity and displacement was measured (XPV6+, Celesco, Fitness Technology) alongside muscle activity (W4X8LOG, Biometrics, Biometrics) of the erector spinae, gluteus maximus, semitendinosus and rectus femoris. Muscle activity was compared across the pre-sticking region (pre-SR), SR and post-sticking region (post-SR) as per Tillar and Ettema (2010).

RESULTS: Erector spinae muscle activity was significantly lower during the post-SR ($P = 0.002$, $58.03 \pm 13.38\%$ of pre-SR) compared with the pre-SR ($100 \pm 0\%$ of pre-SR), and also between the post-SR ($P = 0.026$) and the SR ($89.85 \pm 22.41\%$ of pre-SR). No significant difference ($P = 0.953$) in erector spinae muscle activity was observed between the pre-SR and SR. No significant differences ($P > 0.05$) were observed across the SR for gluteus maximus, semitendinosus and rectus femoris muscle activity. The SR occurred from $34.76 \pm 16.83\%$ to $56.70 \pm 30.93\%$ of RBD and took place over $21.93 \pm 19.32\%$ of total bar displacement.

CONCLUSIONS: The significant changes in erectors spinae activity were concluded as unlikely to be causal due to occurring within the post-SR. A medium decrease in erector spinae during the SR and inferred technical deviations was concluded as a plausible causal factor. The observed 24.21% decrease in quadriceps activity during the SR alongside inferred kinematic rationale was also concluded as another plausible causal factor. Due to the high variability across all variables it was concluded that the SR within the conventional deadlift is highly individual and affected by a multitude of factors. Further research is needed to make specific practical recommendations for overcoming the SR.

POSTER ABSTRACTS 23/24

THE INTER-DAY RELIABILITY OF THE UNILATERAL STANCE ISOMETRIC MID-THIGH PULL

Jonathan Kelly, Declan Browne, Department of Science and Health, Institute of Technology, Carlow

PURPOSE: Assessing lower limb skeletal muscle function requires a test that continuously provides high levels of reliability and validity. A conglomerate of research has demonstrated relationships between lower limb muscular asymmetries and a neaction in markers of sporting performance. Therefore, a reliable testing modality allows for the quantification of muscular capacity, identification of strengths and weaknesses, along with an objective means of monitoring athletes. The purpose of this study was to investigate the inter-day reliability of force-time curve variables collected via a unilateral stance isometric mid-thigh pull.

METHODS: Fifteen male Gaelic footballers (age, 20.93 ± 1.33 years; weight, 79.76 ± 8.52 kg; height, 181.18 ± 7.81 cm) attended two testing sessions at least 48 hours apart. In each session, participants performed three maximal unilateral IMTP efforts with the dominant limb (DL) followed by three efforts with the non-dominant limb (NDL), over a force plate measuring at 1000 Hz. Reliability was analysed using intraclass correlation coefficient (ICC) and coefficient of variation (CV). Furthermore, the validity and reliability of the testing device for practitioners was assessed by comparing the smallest worthwhile change to the typical error.

RESULTS: High reliability was demonstrated for the DL/NDL unilateral IMTP kinetics PF ($ICC \geq 0.88$, $CV \leq 5.63\%$) and RFD at 0-50, 0-100 and 0-150ms ($ICC \geq 0.95$, $CV \leq 9.61\%$). Greater variability and inadequate reliability were observed for alternate unilateral stance IMTP kinetic variables. DL/NDL RFD 0-50ms and DL 0-100ms were the only variables shown to exhibit a typical error (TE) > smallest worthwhile change (SWC), thus, deeming them capable of detecting sensitive changes in IMTP performance.

CONCLUSIONS: The results of this study demonstrate the high reliability of the unilateral IMTP variables and offer evidence to support that RFD 0-50ms should be considered the most clinically meaningful variable. Enumerating the evidence, practitioners can be confident in assessing isometric kinetic variables using a unilateral IMTP in an athletic population.

THE RELIABILITY OF LOAD-VELOCITY PROFILING IN THE POWER CLEAN

Steve W. Thompson, Harry Banyard, David Rogerson, Alan Ruddock, Andrew Barnes, Sheffield Hallam University

PURPOSE: Load-velocity profiling (LVP) is a common method for assessing strength capabilities and can promote accurate prescriptions when programming. A strong inverse linear relationship has been reported between load and velocity in a number of strength related exercises; however, data is insufficient in any Olympic weightlifting derivative. Assessing the reliability of LVPs in the power clean (PC) could provide S&C coaches with an optimal way of prescribing intensity during a training intervention when employing this exercise. Therefore, the purpose of this study was to investigate the reliability of pooled and individualised LVPs during the power clean exercise.

METHODS: Ten competitive weightlifters (mean \pm SD; age: 25.0 ± 5.6 y; body mass: 73.6 ± 13.9 kg; stature: 169.6 ± 6.6 cm) completed baseline one-repetition maximum assessments in the PC (1RM: 103.0 ± 22.8 kg). Three LVPs consisting of incremental protocols (40-100% 1RM) with mean (MV) and peak (PV) velocity measured via a linear-position transducer were completed. Intraclass correlation coefficient (ICC), coefficient of variation (CV), standard error of measurement (SEM), standard error of the estimate (SEE) and linear regression (r) were used to assess reliability for pooled and individualised LVPs. High reliability was defined a priori as: $ICC > 0.7$; $CV < 10\%$.

RESULTS: Within-participant variation was highly reliable across all relative loads (MV: $ICC = 0.82-0.96$, $CV = 3.0-4.9\%$, $SEM = 0.03-0.05$ m.s⁻¹; PV: $ICC = 0.94-0.98$; $CV = 2.1-3.7\%$; $SEM = 0.04-0.07$ m.s⁻¹). Inverse linear relationships were evident between load and velocity. Stronger relationships were found between load and MV ($r = 0.87$; $SEE = 0.08$ m.s⁻¹) than PV ($r = 0.81$; $SEE = 0.16$ m.s⁻¹). Between-participant variation ranged from 5.2-9.0% and 7.4-8.4% for mean and peak velocity, respectively. Individualised LVPs were stronger in MV ($r = 0.87-0.99$; $SEE = 0.02-0.06$ m.s⁻¹) and PV ($r = 0.85-0.99$; $SEE = 0.02-0.10$ m.s⁻¹) than the pooled LVPs.

CONCLUSIONS: Performing LVPs in the PC for both MV and PV met our criteria for high reliability across all relative loads, indicating that this method can be used for assessing load-velocity relationships and strength developments, with practitioners being confident that changes in LVPs are unlikely to be due to test-retest error. Strong inverse linear relationships were present for MV and PV, but between-participant variation and stronger Individualised load-velocity relationships were evident, suggesting that load-velocity characteristics and neuromuscular recruitment can differ across individuals. Therefore, practitioners should seek to employ individualised LVPs when assessing load-velocity properties in the power clean exercise.

POSTER ABSTRACTS 25/26

MORE THAN FASTER, HIGHER, STRONGER? A CASE FOR WIDER RECOGNITION OF THE BROADER REACH OF A STRENGTH AND CONDITIONING COACH

Dave Hembrough, Sheffield Hallam University

INTRODUCTION: Strength and conditioning as a profession is a relatively new discipline with a predominant focus on sport and helping athletes to be more successful in competition. The purpose of this case study is to introduce and explore the concept that S&C coaches have a wider professional remit than purely performance sport. It is proposed that the skill set of an S&C coach can add significant value within a health and wellbeing context. More specifically in areas such as disease prevention and treatment, youth inactivity, obesity, ageing and older adult and extending to psychosocial considerations too.

APPROACH: This case study will present the modern role of sport in the UK via organisation strategic documents and national policy information. Hallam Barbell Weightlifting and Strength Training Club, based at Sheffield Hallam University, has an ambition to 'Make Sheffield Stronger'. Strength is viewed as physical, mental, emotional and social. The Hallam Barbell club delivery model which serves a wide population to make a positive impact will be used as a case study example to support the argument outlined in the purpose statement.

RESULTS: The outcome of this presentation will be to inform, engage and excite the S&C community about the changing role of sport in society and introduce them to a wider way of working that can impact more lives and significantly increase employability pathways for practitioners.

PRACTICAL APPLICATIONS: Practical applications of this presentation will include recognition of the broader opportunities open to S&C coaches. Current and developing coaches will better understand the political climate of sport and the further reaching opportunities that lie outside of performance sport. A hypothesis will be presented that the S&C coach of the future may work in sport AND physical activity providing wide benefits to many individuals through the application of their skills. As a consequence S&C coaches will have more opportunities in financially more stable roles and be involved in making a bigger positive difference in the world.

A COMPARISON BETWEEN THE DROP JUMP AND 10/5 REPEATED JUMPS TESTS TO MEASURE THE REACTIVE STRENGTH INDEX

Callum Stratford, Dr John J. McMahon, University of Salford

PURPOSE: The drop jump (DJ) is a common test for evaluating reactive strength index (RSI) (Markovic, 2007; Marshall & Moran, 2013). However, limitations of the DJ test include 1) a box is required and 2) individuals will likely either lower or heighten their centre of mass (dependent on strategy) before 'dropping' from the box. Consequently, between-session/athlete comparisons of DJ-derived RSI values may lack efficacy. The purpose of this study was, therefore, to compare RSI values obtained from the DJ test to those derived by an alternative test, the 10/5 repeated jumps test (RJT), which overcomes the aforementioned limitations.

METHODS: Following institutional ethics approval, 30 male sports students who competed in team-sports performed a standardised warm-up and familiarisation prior to testing. Participants then completed a total of 9 maximal-effort jumps; 3 x DJs from a 30 and 40 cm high box and 3 x 10/5 RJT in a randomised order. The participants kept their arms akimbo and were instructed to "aim for maximum height whilst minimising contact time". Jumps were performed on an in-ground force plate sampling at 1000 Hz. Raw force-time data were analysed in Microsoft Excel, where mean values for RSI, jump height (JH) and ground contact time (GCT) were identified. RSI was calculated by JH/GCT.

RESULTS: The 10/5 RJT and DJ tests demonstrated good-excellent and moderate to good between trial reliability for all variables (intraclass correlation coefficient = 0.782-0.928 and 0.598-0.853, respectively). Trivial and non-significant differences in RSI were noted between tests ($p=0.540$). Small but significant differences in JH between the RJT and both DJ tests ($p\leq 0.004$) were also noted, with JH being higher for the DJs. Moreover, significant differences in GCT were observed between jump tasks ($p\leq 0.001$) with the shortest occurring for the RJT. The RSI derived from the RJT and DJ tests demonstrated a large association ($R^2=30\%$), whereas GCT and JH showed a small to moderate association ($R^2=0\%$ and $R^2=25\%$, respectively).

CONCLUSIONS: Practitioners with limited time and resources may benefit from using the 10/5 RJT when measuring an athlete's RSI. Analysis revealed that the RJT yields slightly greater RSI values and lower mean GCTs in comparison to both DJ tests. Furthermore, by using the 10/5 RJT, coaches would eliminate the aforementioned limitations associated with DJ testing. Although, the coefficient of determination revealed that RSI derived from the 10/5 RJT and DJ tests cannot be used interchangeably. Thus, values must not be compared due to the dissimilarities between the jump tests.

POSTER ABSTRACTS 27/28

MONITORING NEUROMUSCULAR FATIGUE IN PROFESSIONAL FOOTBALL

Ian Jones, Middlesex University; Sean Maloney, Bedfordshire University; Anthony Turner and Chris Bishop, Middlesex University

PURPOSE: The current study aimed to examine whether Fatigue Index, a GPS derived metric, was able to monitor/indicate Neuromuscular Fatigue (NMF) in elite academy soccer players.

METHODS: GPS Metrics, Drop Jump Performance (RSI), Session-RPE and a Questionnaire of Fatigue were analysed for correlations relating to NMF.

RESULTS: Fatigue Index was positively correlated with reactive strength index ($r = .290$; $P < 0.001$) and high metabolic load distance ($r = .164$; $P = 0.001$), both correlations were 'small' in magnitude. Fatigue Index values were not correlated with other GPS-derived indices, session-RPE (sRPE) or subjective fatigue scores. 'Small' correlations were observed for Total Score of Fatigue with both reactive strength index ($r = .146$; $P = 0.004$) and sRPE ($r = -.111$; $P = 0.026$).

CONCLUSIONS: Monitoring Fatigue Index and reactive strength index in an attempt to indicate NMF in elite academy soccer players did not appear worthwhile.

INTRA- AND INTER-DAY RELIABILITY OF TYPICAL AND ALTERNATIVE WEIGHTLIFTING VARIABLES DURING HEAVY CLEANS

Angela Sorensen, Shyam Chavda, Anthony Turner, Middlesex University

PURPOSE: To examine the reliability of typical and alternative variables in the kinetics and kinematics of heavy cleans and determine their suitability in performance analysis of weightlifting.

METHODS: Eight competitive weightlifters (female $n = 4$, male $n = 4$) competing at a regional to national level with at least one year of prior strength training performed 3 repetitions of 90% cleans on 3 separate occasions under the same testing conditions. A total of 70 kinetic and kinematic variables were able to be examined. Intra- and inter-day reliability were calculated (ICC, CV) for both best and average measures on all variables.

RESULTS: Eighteen of the 70 variables analyzed were found to have good intra- and inter-day ICC (0.902-0.998 and 0.928-0.997 respectively) and CV (0.64-6.89 and 1.13-7.06 respectively) values. Of these 18 variables, seven were determined to occur during the first weighting of the pull phase, which signifies the initiation of the lift from the floor and is a crucial component in the overall performance of the pull in weightlifting. Furthermore, the intra- and inter-day reliability of typical variables used to assess weightlifting performance, such as peak power (0.990-0.990) and peak bar height (0.979-0.989), exhibited reliabilities similar to other current literature.

CONCLUSIONS: While typical variables (peak power, barbell displacement) have shown to reliably measure weightlifting performance, it appears there are additional alternative variables not examined in current literature that show good reliability as a measure of weightlifting performance; particularly during the weighting 1 phase of the pull. Further research is needed to determine the sensitivity to change and usefulness of monitoring these alternative variables within a training environment as a measure of weightlifting performance.

POSTER ABSTRACTS 29/30

PRE-TRAINING POWER SESSIONS FOR ELITE YOUTH FOOTBALLERS

Ivan Mukandi, Arsenal FC Academy

INTRODUCTION: Pre-training sessions are a unique opportunity in a full-time environment to not only mitigate injury risk and improve movement quality but also develop qualities such as speed, power, and strength. Deciding when and how to develop various qualities along portions of the force-velocity curve prior to football training sessions requires a deep understanding of biomechanics and demands of the sessions following the pre-training session.

APPROACH: As practitioners, our initial aim is to understand the physical demands of match and training for U18 football in order to effectively implement plyometrics, olympic lifting, and their derivatives prior to training. Furthermore, the length of the competitive season means it is imperative to periodise all aspects of training on and off the pitch, in order to avoid injury and overtraining, and induce a positive training stimulus. Depending on competency and tolerance to training load, each player will be exposed to progressively intensive plyometrics, ballistic exercises such as Jump squats, Hang Snatch, Trap bar jumps and semi-ballistic exercises such as Hang Cleans, Cleans, and Snatch Pulls and Split Jerks. This case study will discuss the methods used at Arsenal Football Club.

PRACTICAL APPLICATIONS: Structured pre-training sessions present a unique opportunity to individualise development of speed and power in youth football. The congestion of fixtures as young players progress to senior football means that it is the ideal opportunity to engrain good technique and accustomise players to various lifts that they can continue to utilise at senior level.

FOSTERING SELF-SUFFICIENCY IN YOUTH ATHLETES

Sean Maloney, Maloney Performance

INTRODUCTION: What should we be striving to achieve with our young athletes? Most coaches would agree that we need to have a long-term outlook, but is this long-term view still just considering performance? In neither sport nor life can we guarantee success. Indeed, the only certainty is uncertainty. Nonetheless, as athletes progress within their respective sports they can be expected to lose funding, to be cut from programme or, best case scenario, fly the nest and go on to work with other coaches. How is our coaching preparing athletes for the realities and uncertainties of the adult world?

APPROACH: This presentation will outline why I believe it is important to foster 'self-sufficient' athletes, athletes who understand the physical and mental demands of their sport and how they can train to meet them. The 'Three E's' namely: Engage, Enthuse and Empower provide a scaffold for the fostering process. Autonomy is then built through this scaffold as an internal core. By outlining goals matched to the overarching philosophies of the programme, coaches go on to can identify objective markers of success.

RESULTS: Athlete engagement can be facilitated by considering the types of activity to be performed; are these activities 'appealing' and do they require cognitive involvement? Enthusiasm should consider neurological reward systems. For example, goal attainment and positive social interactions are associated with dopaminergic responses and increased self-efficacy. If the athlete can link these responses to training, it is likely for the athlete will want to come back for more. Empowerment can be seeded initially by offering clear rationales, providing choice over trivial decisions and by asking questions. This is further developed by increasing the level of input that the athlete has within their programme.

PRACTICAL APPLICATIONS: Athletes must be prepared for life without us. They may have to train alone; in which case we've provided them with the tools to do so. More hopefully, our athletes will move forward to have prosperous careers with other coaches. In these instances, we've set them up with the best possible foundation for future endeavours. It is the athletes themselves that are best placed to assess.

POSTER ABSTRACTS 31/32

REACTIVE STRENGTH FATIGUE IN SOCCER PLAYERS: RELIABILITY AND PRACTICAL APPLICATIONS

Ryan Stewart, University College Dublin; Dr Eamonn Flanagan, Sport Ireland Institute, Dublin; Dr Massimiliano Ditroilo, University College Dublin

PURPOSE: Repeated jumps (RJ) are a frequently prescribed training modality for athletic populations to improve fast stretch shortening cycle capabilities. Testing RJ could provide a simple and accessible assessment of fast stretch shortening cycle performance and fatigue. Despite the extensive use of RJ, there is limited research pertaining to the reliability and usefulness of RJ testing methods (Comyns et al., 2019). The aim of this study is to observe fatigue response and determine reliability of a 30 second repeated jump test (30RJT).

METHODS: Nineteen semi-professional male soccer players (20.2 ± 1.3 years; 76.9 ± 5.6kg; 181.4 ± 4.8cm) completed a maximal 10 repeated jump test (10/5 RJT) (Harper, 2011) and a maximal 30 RJT. Additionally, nine players completed the 30RJT on two separate occasions, with one week between trials. 30RJT data was split into discrete five second phases for analysis. Reactive strength index (RSI) was calculated by dividing jump height (JH) by contact time (CT). A one-way repeated measures ANOVA, with post hoc analysis, determined how fatigue affected RSI, JH and CT. Fatigue was quantified as percentage change between the 10/5 RJT and the final 5 seconds of the 30RJT. Reliability was determined using intraclass correlation coefficient (ICC) and coefficient of variation (CV).

RESULTS: Participants completed 43 ± 2 jumps during the 30RJT. When compared to 10/5 RJT performance, significant differences were detected across all RSI time phases ($p < 0.01$). Similar results were shown for JH, with five out of six time phases differing significantly ($p < 0.01$). CT differences were only detected in the final two time phases ($p < 0.01$). In the final 5 second phase, RSI and JH.

CONCLUSIONS: The 30RJT induced reactive strength fatigue, evidenced by decreases of 15.04% and 10.82% in RSI and JH respectively. Conversely, CT only increased significantly in the final ten seconds of the 30RJT (+4.92%). The 30RJT exhibited strong inter-day reliability (CVs 0.8) for RSI, comparable to recent literature investigating the 10/5 RJT and a five maximal RJT in similar cohorts (Comyns et al., 2019). Due to the fatiguing nature of the 30RJT, it was somewhat surprising to establish similar reliability scores to RJ tests of shorter duration.

A COMPARISON OF A SPORTS-SPECIFIC, FOOT-MOUNTED INERTIAL MEASUREMENT SYSTEM AND THREE COMMERCIAL GLOBAL POSITIONING SYSTEMS TO QUANTIFY SOCCER-SPECIFIC MOVEMENT PATTERNS

Dr Mark Waldron, St Marys University (UK) and University of New England (Australia); Jamie Harding, St Mary's University

PURPOSE: Global Positioning Systems (GPS) are routinely used to quantify the movements of team sports players during training and competition; however, the validity and reliability of GPS devices to measure high- and variable-speed movements in smaller areas has been questioned. Foot-mounted inertial measurement units (IMUs) are an alternative technology, capable of recording inertial motion with greater accuracy and might overcome some of limitations of GPS devices. However, there has been no direct comparison of foot-mounted, sports-specific IMUs to GPS for gross movement tracking. Thus, the aim of this study was to compare a foot-mounted IMU to three commercially available GPS devices for the measurement of team sport movement patterns.

METHODS: 12 elite team sports players (age: 15 ± 2 years; body mass: 54.5 ± 14.9 kg) completed 5-min 20-s of a field-based running course, simulating the movement characteristics of elite soccer players (SAFT90). Participants' left and right feet were instrumented with an IMU PlayerMaker™ device (PlayerMaker A1, PlayerMaker™, UK). Participants were also fitted with three GPS devices (Statsports Apex, Ireland; Catapult S5, Australia; FieldWiz, Switzerland) using a customized vest, placing the units in the region of the scapulae. All files were synchronised, with the following variables compared between systems: Total distance (m), mean speed (m/s), peak speed (m/s), distance in four zones (< 1.5 m/s, 1.5-3.5 m/s, 3.51-5.5 m/s and > 5.5 m/s), acceleration and deceleration counts and distances in three zones (< 1.5 m/s², 1.5-3.5 m/s² and > 3.5 m/s²).

RESULTS: The PlayerMaker™ measured higher ($P < 0.05$) total distance (518 ± 15 m) compared to Apex (488 ± 15 m), S5 (486 ± 15 m), FieldWiz (501 ± 14 m). This was explained by greater ($P < 0.05$) distances in the 1.5-3.5 m/s speed zone (356 ± 24 m vs. 326 ± 26 m vs. 324 ± 18 m vs. 335 ± 24 m) and the 3.5-5.5 m/s zone (64 ± 18 m vs. 35 ± 5 vs. 43 ± 8 m vs. 41 ± 8 m) between the PlayerMaker™, Apex, S5 and FieldWiz, respectively. The PlayerMaker™ also recorded higher ($P < 0.05$; 5-8% difference) total and mean distances while accelerating and decelerating.

CONCLUSIONS: The PlayerMaker™ device quantifies demanding aspects of team sports movement, such as high-intensity running and changes in speed, consistently higher than three GPS devices. These data indicate that GPS devices could underestimate some of the work done during team sports movements at high-intensities.

POSTER ABSTRACTS 33/34

HIGH INTENSITY ACCELERATIONS AND DECELERATIONS: WHAT ARE THE DEMANDS OF ELITE TEAM SPORTS COMPETITIVE MATCH PLAY?

Damian Harper, York St John University; Chris Carling and John Kiely, University of Central Lancashire

PURPOSE: High intensity accelerations and decelerations are considered to be particularly important measures of external biomechanical load, yet have distinctive and disparate metabolic and mechanical loading demands. Information gleaned from their analysis during competition contexts can be used to inform player strength and conditioning programmes, which could potentially enhance physical performance and reduce the risk of injury. The purpose was to conduct a systematic review and meta-analysis to quantify and compare the frequency of high intensity accelerations versus decelerations in elite team sports competitive match-play. A further aim was to conduct a review of the methodological procedures used to quantify the occurrence of high intensity accelerations and decelerations during competitive match-play when using GPS devices.

METHODS: A systematic review of four electronic databases (CINAHL, MEDLINE, SPORTDiscuss, Web of Science) was conducted to identify peer reviewed manuscripts published between January 2010 and April 2018 that had reported high intensity ($> 2.5\text{m.s}^{-2}$) accelerations and decelerations concurrently during elite team sports competitive match-play. Meta-analysis was used to compare the standardized mean difference (SMD) in the frequency of high intensity accelerations versus decelerations. Using recent guidelines recommended for the collection, processing and reporting of GPS data a checklist was produced to help inform a judgement about the methodological limitations aligned to 'data collection', 'data processing' and 'normative profile' for each eligible study. For every study, each outcome was rated as either 'low', 'unclear' or 'high' risk of bias (RoB).

RESULTS: A total of nineteen studies met the eligibility criteria, comprising seven team sports including American football ($n=1$), Australian football ($n=2$), hockey ($n=1$), rugby league ($n=4$), rugby sevens ($n=3$), rugby union ($n=2$) and soccer ($n=6$) with a total of 469 male participants (mean age: 18 to 29). Analysis showed only American football reported a greater frequency of high (SMD = 1.26; 95% confidence interval (CI): 1.06 to 1.43) intensity accelerations compared to decelerations. All other sports had a greater frequency of high intensity decelerations compared to accelerations, with soccer demonstrating the greatest difference (SMD = -1.74; 95% CI -1.28 to -2.21). The greatest RoB (40% 'high' RoB) observed across studies was in the 'data collection' procedures. The lowest RoB (35% 'low' RoB) was found in the development of a 'normative profile'.

CONCLUSIONS: The results of this meta-analysis have practical implications to help ensure elite players are optimally prepared for the high intensity biomechanical loading demands of competitive match-play. Future research should consider carefully the methodological procedures used to quantify high intensity accelerations and decelerations during match-play when using GPS devices.

YOU CAN'T POUR FROM AN EMPTY CUP: RETROSPECTIVE ANALYSIS OF READINESS AND WELLNESS IN YOUTH ATHLETES AND SPORT SCIENCE PRACTITIONERS IN A LEADING UK TALENT DEVELOPMENT ENVIRONMENT

Graham Williams, Adam Greenslade, Millfield School

INTRODUCTION: Evidence is supportive of the relationship between subjective reporting measures, the moderation of training load and performance. However, there is a paucity of literature portraying the stresses associated to youth athletes and more so, their sport science (SS) practitioners. The aim of this case study is to provide a retrospective analysis of readiness to perform (RTP) and its relative correlates in each population. It is hoped the findings of this analysis support a more targeted approach to optimising the holistic wellness of youth athletes and their SS practitioners. In doing, this may help support the performance enhancement of each demographic.

APPROACH: 98 youth athletes across 6 sports and 8 practitioners across 2 SS disciplines (strength & conditioning, physiotherapy) completed daily wellness logs for a period of 31 weeks. Daily wellness logs were recorded via specialised online software (Metrifit, Health and Sport Technologies Ltd), consisting of subjective ratings (1-5) for mood state, sleep quality, energy, muscle readiness, nutrition quality, stress and health. In addition, sleep duration from the previous day was recorded via self-reported total hours. All subjects received instruction on how to utilise the software. Compliance was supported by optional prompts, reports and online support features.

RESULTS: Mean RTP for youth athletes was $74.1\% \pm 1.8\%$. Mean RTP for SS practitioners was $78.4\% \pm 2.7\%$. RTP for the youth athletes was most likely lower compared to their SS practitioners (-1.63 ± 0.34). For youth athletes, there was a strong positive correlation between subjective energy ($r=0.78$), stress ($r=0.77$) and mood ($r=0.70$) and RTP. There were moderate to weak positive correlations for all other wellness markers ($r=0.58-0.12$) and RTP. For SS practitioners, there was a strong positive correlation between subjective stress ($r=0.77$), health ($r=0.74$) and RTP. There were moderate positive correlations for all other wellness markers ($r=0.66-0.44$) and RTP.

APPLICATIONS: These results provide a novel insight into the RTP and correlated markers of subjective wellness in youth athletes and their SS practitioners in a leading UK talent development environment. In this context, it may be that the interventions applied to elevate RTP in youth athletes may not be as effective for SS practitioners. As such, demographic specific interventions may be required. For youth athletes, interventions to decrease perceived psychological load, such as positive coping strategies and supportive social networks may be advantageous. In SS practitioners, interventions to decrease perceived biopsychological load, such as safeguarding against work intensification and promoting sustainable careers may be advantageous.

POSTER ABSTRACTS 35/36

AN ANALYSIS OF HEAD AND NECK CIRCUMFERENCE, ISOMETRIC NECK STRENGTH AND CONCUSSION IN YOUTH RUGBY PLAYERS IN A LEADING UK INDEPENDENT SCHOOL

Graham Williams, Aaron Ryan, Millfield School

INTRODUCTION: Concussion incidence within youth rugby union can be as high as 14.7 concussions per 1000/hrs of exposure. Studies have evaluated targeted strength training protocols in adult sport to reduce concussion risk. There has been a lack of replication within youth sport. As such, an understanding of the potential risk factors for concussion that present themselves in this population may support more targeted interventions. The purpose of this study was to investigate the relationship between head and neck circumference, isometric neck strength and concussion occurrence in independent school rugby players and propose strategies to reduce injury risk based on these relationships.

APPROACH: 58 males from years 9-13 completed head and neck circumference and isometric neck strength assessments during the 2018-19 academic year. Measurement protocols consistent with reported protocols in the literature, assessed isometric cervical flexion, extension, left/right lateral flexion, left/right rotation and combined left/right rotation with lateral flexion strength, head and neck circumference. Isometric neck strength data were collected using a Mirco-fet 2 Dynamometer. Subjects completed a familiarisation session on the assessment protocol. Subjects were assigned to concussion or non-concussion groups based on the occurrence of concussion in the 12-month period preceding data collection.

RESULTS: Head circumference was very likely greater in the non-concussion vs concussion groups. Isometric left and right rotation strength was likely greater in the non-concussion vs concussion groups. Isometric strength, circumference and circumference ratios were unclear between the concussion and non-concussion groups for all other tests. There were strong positive correlations between isometric extension ($r=0.70$), lateral flexion ($r=0.83$), lateral flexion and rotation ($r=0.89$) and isometric rotation strength in the non-concussion group. There was a moderate positive relationship between head circumference and isometric lateral flexion ($r=0.56$), lateral flexion and rotation ($r=0.60$), and rotation ($r=0.53$) in the concussion group.

PRACTICAL APPLICATIONS: These findings provide a novel insight into the head and neck circumference and isometric neck strength of concussed vs non-concussed rugby players in a leading independent sports school. As such, neck-training interventions targeting the development of isometric rotation strength may have the potential to reduce concussion occurrence. The development of isometric rotation strength may be supported by the development of isometric strength through a variety of planes of motion. Given the fact that an enhanced girth profile of the neck may not warrant specific development, a lowered risk of concussion in youth rugby players may be achieved via neurally driven adaptations to neck strength training.

INFLUENCE OF DIFFERENT CLUSTER SET CONFIGURATIONS ON FORCE PRODUCTION DURING THE NORDIC HAMSTRING EXERCISE IN FEMALE RUGBY UNION ATHLETES

Ben Drury, Lewis Tooley, Hartpury University

PURPOSE: High levels of eccentric hamstring strength has been demonstrated to reduce hamstring injury risk. Therefore, training prescription that can further support the development of this quality is necessary for practitioners. However, although the nordic hamstring exercise (NHE) is commonly prescribed for athletes, information detailing the effects of acute training variables such as rest periods is limited. This is important to consider as rest periods have been shown to influence responses to strength and power training. Therefore, the purpose of this study was to investigate the differences between cluster sets (CS) vs traditional sets (TRD) on force output measures during the nordic hamstring exercise (NHE).

METHODS: Twelve amateur female rugby players (mean \pm SD; age: 17 ± 1.0 y; height: 165.3 ± 7.3 cm; mass: 68 ± 10.0 kg) performed 1 set of 10 repetitions of the NHE under four different conditions: TRD (1 set x 10 repetitions continuously), CS-2x5 (2 sets x 5 repetitions), CS-5x2 (5 sets x 2 repetitions) and CS-10x1 (10 sets x 1 repetitions). All CS conditions included 15 seconds of passive rest between each set. Peak force (PF), mean force (MF) and a measure of fatigue using rate of decline (ROD) were analysed for the NHE using the NordBord.

RESULTS: For PF, compared to TRD (293.79 ± 51.19 N), CS-2x5 (298.00 ± 50.07 N), CS-5x2 (299.59 ± 49.46 N) and CS-10x1 (297.96 ± 45.44 N) were almost certainly not different. For MF, compared to TRD (267.79 ± 49.75 N), CS-2x5 (274 ± 53.42 N), CS-5x2 (265.79 ± 43.03 N) and CS-10x1 (273.38 ± 45.21 N) were almost certainly not different. When analysing ROD, compared to TRD (-2.06 ± 2.21 N), CS-10x1 (-0.29 ± 2.27 N) was possibly different whilst CS-2x5 (-3.44 ± 3.35 N) and CS-5x2 ($-2.34 \pm 2.59 \pm 3.07$ N) were almost certainly not different.

CONCLUSIONS: These findings provide evidence that the use of CS-10x1 during the NHE may be beneficial for maintaining force output. Therefore, it is suggested that practitioners wishing to develop eccentric hamstring strength or endurance via using the NHE can include inter-rep rest durations of 15 seconds. However, we also suggest that such an approach should also take into account the athletes strength level, objectives of the training cycle and logistical aspects.

POSTER ABSTRACTS 37/38

'WHAT DOES GOOD COACHING LOOK LIKE?': YOUTH ATHLETE PERCEPTIONS OF EFFECTIVE STRENGTH AND CONDITIONING COACHING IN A LEADING UK TALENT DEVELOPMENT ENVIRONMENT

Adam Greenslade, Graham Williams, Millfield School

PURPOSE: Coach-athlete relationships (CAR) within sporting performance has gained popularity within academic publications and strength and conditioning (S&C) events. Senior elite athlete research (Szedlack et al., 2015, 2018) suggests higher order psychosocial behaviour dimensions contributes significantly to the S&C CAR, athlete cognitions and behaviours. Surprisingly, a paucity of research surrounding perceived effectiveness of S&C coaching behaviours in youth athletes remains. Given the potential significance of early CAR experiences in respect to long term athlete performance and behaviours, this study aims to offer a novel insight into the perceived importance of the S&C CAR dimensions within a youth talent development setting.

METHODS: 33 student athletes, across 7 sports aged 14-18 participated in this study. Inclusion criteria was exposure to a minimum of one weekly athletic development session delivered by an S&C coach over a minimum period of 2 years (range 2-5 years). Participants completed an online questionnaire for each pre-identified higher order coaching dimension (relationship, coaches' actions and coaches' values). Within each form, subjects independently ranked each of the dimension's first order themes and their corresponding raw data themes in order of importance considering their S&C coaching experiences. Athletes were also encouraged elaborate on what they felt was important in each dimension.

RESULTS: First order theme results were extracted and collated from the questionnaire outputs. Relationship dimension results showed; (1) trust and respect, (2) encouragement and support, (3) approachability, to be the highest ranked themes. With, (8) flexible, (9) balanced, and (10) role model being the three lowest ranked. Coach action results ranked; (1) feedback, (2) Communication skills, (3) Instruction, and (4) planning and organisation. Finally, the top ranked themes in the coach's values dimension being; (1) motivation and inspiration, (2) belief, (3) high performance expectations, and (4) confidence. Athlete comments also provided frank, insightful and reflective thought processes around S&C coach interactions.

CONCLUSIONS: These findings provide novel insight into youth athlete preferences of S&C coaching. Consistent with elite populations, analysis suggest that youth athletes' value psychosocial qualities centred around a coach's ability to engage and connect on a personal level. The lower ranked qualities such as role modelling, planning and organisation reinforce the notion that an S&C coach's defining qualities extend beyond technical, tactical and performance outcomes. Results suggest that, to optimise coaching, a multi-faceted approach and the ability to occupy various roles that exceed traditional perceptions of S&C coaches may be required to enhance the CAR and better optimise athletic potential.

BEWARE OF THE HAZARD PHASE; A RETROSPECTIVE ANALYSIS OF ACCELERATION AND CHANGE OF DIRECTION PERFORMANCE ACROSS YEAR GROUPS IN UK INDEPENDENT SCHOOL TENNIS PLAYERS

Adam Greenslade, Graham Williams, Millfield School

PURPOSE: Due to the high incidence of change of direction (COD) in tennis, the ability to express the physical capacities that underpin COD performance through combination of acceleration, deceleration and turning mechanics is critical within competitive match play. Additionally, the literature suggest biological changes within youth can impact the expression of physical capacities. As such, the department aimed to compare academic year groups performance of 5m acceleration and 505 COD deficit (Codd) within tennis athletes.

METHODS: Data was analysed retrospectively from a testing battery undertaken termly over three academic years from 2017-2019. 142 data sets were collected across 5 academic year groups. Linear Acceleration performance was assessed via 5m time, measured via Brower timing gates. Scores were expressed as an average of 3 attempts within each participant. Codd was assessed through a 505 assessment where Codd represented the difference between average 505 and 10m time, where the mean 10m time was taken from the linear speed assessment. Data was analysed via magnitude-based inferences, where consecutive year group performances were compared.

RESULTS: In 5m performance, year 13 was most likely lower than years 9, 10, 11 and 12 ($-1.75 \pm 0.26s$, $-2.51 \pm 0.40s$, $-2.88 \pm 0.44s$ and $-3.80 \pm 0.13s$ respectively). Year 10 showed very likely lower 5m times than year 9 ($-0.68 \pm 0.31s$). Years 11 and 12 displayed a very likely increase and unclear difference when compared to year 10 ($0.73 \pm 0.28s$ and $0.07 \pm 0.44s$ respectively). In Codd performance, Years 10, 11 and 12 were all very likely lower than year 9 ($-1.45 \pm 0.91s$, $-0.49 \pm 0.28s$ and $-0.50 \pm 0.25s$ respectively). Year 13 were most likely lower than years 11 and 12 ($-0.66 \pm 0.05s$ and $-0.67 \pm 0.19s$ respectively). Year 11 and 12 Codd time showed a possible increase compared to year 10 (0.21 ± 0.26 and 0.20 ± 0.29 respectively).

CONCLUSIONS: These results highlight the importance of early integration of acceleration and COD skill development within youth tennis. The authors highlight a possible 'hazard phase' between years 10-12, where 5m and COD performance appears to be compromised. It is speculated this phase may coincide with normative onset of peak weight velocity, which may inhibit expression of physical capacities associated with 5m and 505 COD performance. This may highlight the need for analysis of maturational data collection within this time frame to further investigate the effects of maturation on acceleration and COD performance in youth tennis players.

UKSCA's 15th Annual Conference programme at a glance

SATURDAY 15 JUNE

08.30–09.15 **CONFERENCE REGISTRATION**

09.15–09.30 **WELCOME ADDRESS** UKSCA Chair of the board

09.30–10.20 **TRAVIS TRIPLETT** Training female athletes: is it really that different?

10.30–11.20 BREAKOUT PRESENTATIONS 1

JASON LAKE KEYNOTE ROOM

Force plate assessment

MARK RUSSELL BREAKOUT ROOM–SOUTH

Match-day strategies

EDWARD BAKER PLAYERS' ROOM

Problem solving: learning from wheelchair rugby

11.20–11.50 **COFFEE BREAK POSTERS AND EXHIBITION**

11.50–12.40 BREAKOUT PRESENTATIONS 2

ROB AHMUN PLAYERS' ROOM

Implementing a S&C strategy in international cricket

DEBBY SARGENT BREAKOUT ROOM–SOUTH

The missing pieces of the female athlete puzzle

EAMONN FLANAGAN KEYNOTE ROOM

Re-thinking reactive strength

12.40–14.00 **LUNCH BREAK POSTERS AND EXHIBITION**

14.00–14.50 PANEL DISCUSSION WITH KEVIN PAXTON

DEAN RIDDLE AND PETE MCKNIGHT Developing the practitioner skillsets to work in various sports across different international cultures

15.00–15.50 **MEMBER ORAL PRESENTATIONS / SHORT TALKS** Assessing and understanding change of direction skills / Training high performing athletes / Injury, recovery and rehabilitation / Developing the youth athlete / Optimising training interventions

15.50–16.20 **COFFEE BREAK POSTERS AND EXHIBITION**

16.20–17.10 **RICH HUNWICKS** From business class to cattle class: optimal performance and preparation in team sports

17.30–18.15 **UKSCA'S ANNUAL GENERAL MEETING**

19.30–CLOSE **GALA DINNER**

SUNDAY 16 JUNE

08.30–09.15 **REGISTRATION** (day 2 delegates only)

09.20–10.10 **DAN JOHN** Things I have learned, re-learned, re-re-learned and re-re-re-learned

10.10–11.00 **STEVE MAGNESS** Obsession and performance: The slippery slope to performance enhancing drugs

11.00–11.30 **COFFEE BREAK POSTERS AND EXHIBITION**

11.30–12.20 BREAKOUT PRESENTATIONS 1

NEIL GIBSON KEYNOTE ROOM

High intensity interval testing and training

KEVIN TILL BREAKOUT ROOM–SOUTH

Understanding youth talent: how can we help?

EMILY NOLAN PLAYERS' ROOM

S&C for the para athlete

12.20–13.40 **LUNCH BREAK POSTERS AND EXHIBITION**

13.40–14.30 **DAVE COLLINS** Psycho considerations for strength coaches

14.40–15.30 BREAKOUT PRESENTATIONS 2

SCOTT DRAWER PLAYERS' ROOM

The true value of sport

RICH BLAGROVE BREAKOUT ROOM–SOUTH

Enhancing performance and maintaining health in distance runners

JAMES WILD KEYNOTE ROOM

Enhancing team sport initial sprint acceleration: an individualised approach

15.30–16.00 **COFFEE BREAK POSTERS AND EXHIBITION**

16.00–16.50 **MIKE YOUNG** Science and practice of elite speed development

16.50–17.00 **DAY TWO CLOSE**