INTRODUCTION

- The combination of sprint velocity, sprint momentum and body mass is able to discriminate between playing levels and age categories.
- Describing seasonal changes these physical characteristics may provide perspective on variation in performance across playing positions and age groups.
- We explored the change in acceleration, momentum and body mass over a 15 week in season period within a school RU season across age categories and playing positions.

METHODS

- 34 participants (16-18 years) were assigned as year 12 or 13 based on their academic year and forwards or backs based on their most common playing position.
- Body mass and 10m acceleration was measured once per week over a 15 week in season phase.

RESULTS

- The only significant difference between consecutive weeks for acceleration was for weeks 10 and 11 ($p < 0.05$). The effect of weeks on momentum and body mass was not significant.
- 10m acceleration was statistically significant between forwards vs backs ($p < 0.05$). Body mass and momentum was found to be statistically significant for both Yr12 vs Yr13 and forwards vs backs ($p < 0.05$).

Weekly exposure to **explosive strength and max strength** training stimulus may **maintain acceleration, body mass** and **momentum** during an in season phase

Maintaining Mass in Motion: The Longitudinal Tracking of Acceleration, Body Mass and Momentum in School Rugby Union Through a 15 Week In Season Phase

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PRACTICAL APPLICATIONS

- Weekly strength and speed sessions may maintain acceleration, momentum and body mass during an in-season period in school RU players.
- Given the greater mass in motion of older forwards, physical training practitioners may consider appropriate training formats to drive adaptations within particular age and playing categories, i.e. younger forwards.

	10m Acceleration (s)		10m Momentum		Body Mass (kg)	
Demographic	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Backs	1.80	0.07	419.36	48.81	74.55	90.56
Forwards	1.84	0.10	486.99	61.40	90.56	10.10
Year 12	1.83	0.09	413.40	32.04	76.15	6.48
Year 13	1.82	0.10	476.58	67.50	86.52	12.50

Table 1. Normative data for acceleration, momentum and body mass for backs, forwards, year 12 and year 13

Assessment	Cohen's d: Fwds v Bks	Cohen's d: Yr12 v Yr13
Acceleration	0.46 (Small)	0.08 (Trivial)
Body Mass	1.82 (Large)	0.96 (Large)
Momentum	1.21 (Large)	1.09 (Large)

Table 2. Cohen's d effect size and classification for forwards (Fwds) v backs (Bks) and yr12 v Yr13 for acceleration, body mass and momentum

The perceived intensities and distribution of training modes in mixed martial arts

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1 – University of Derby, 2 – Liverpool John Moores University. Twitter: @ChrisKirk_ASP

Introduction:

- Mixed martial arts (MMA) is a combat sport characterised by striking and grappling based skills in both grounded and standing positions. Maximal length of bouts is 9-25 minutes of high-impulse, intermittent actions[1].
- Training aims to provide a high level of technical skill in addition to the physiological capability of performing within the aerobic-anaerobic transition zone throughout competition[2].
- Understanding the relative intensity and distribution of MMA training modes would enable coaches to plan training load and achieve these goals with avoidance of non-functional overreaching (NFOR)[3].

• Aim of study:

Measure the intensity of different MMA training modes, and how these are distributed during an 8-week period.

Methods:

Participants

- 14 MMA participants took part in this study (age = 22 ± 4.4 years; mass = 71.3 ± 7.7 kg; stature = 171 ± 9.9 cm), taking part in their normal training for 8 consecutive weeks

Measurements

- Participant's perceived intensity of each of the following training categories recorded 10-30 mins after every training session using Foster 0-10 RPE scale [4]:
- warm up; striking drills; wrestling drills; Brazilian jiujitsu (BJJ) drills; striking sparring; wrestling sparring; BJJ sparring; MMA sparring; circuit training; strength and conditioning.
- Intensity zone delineations of low (RPE≤4), moderate (RPE 5-6) and high (RPE≥7) were used [5].

Statistical analyses

- Between category intensities and intensity zone durations within category comparisons were completed via Bayesian ANOVA (BF_{10}) with omega squared (ω^2) effect size using JASP 0.11.1.

Results:

Figure a

- Differences with a large effect between training category intensities (BF_{10}=1.168e^{+134}, ω^2=.40):
  - Wrestling drills were more intense than striking drills and BJJ drills (BF_{10}=5-59);
  - Striking sparring was less intense than wrestling sparring and MMA sparring (BF_{10}=137-986);
  - BJJ sparring was less intense than MMA sparring (BF_{10}=10).

Figure b

- Differences between intensity zone durations within category
  - warm up (BF_{10}=155,619);
  - BJJ drills (BF_{10}=228);
  - wrestling sparring (BF_{10}=3);
  - MMA sparring (BF_{10}=10);
  - striking sparring (BF_{10}=37).

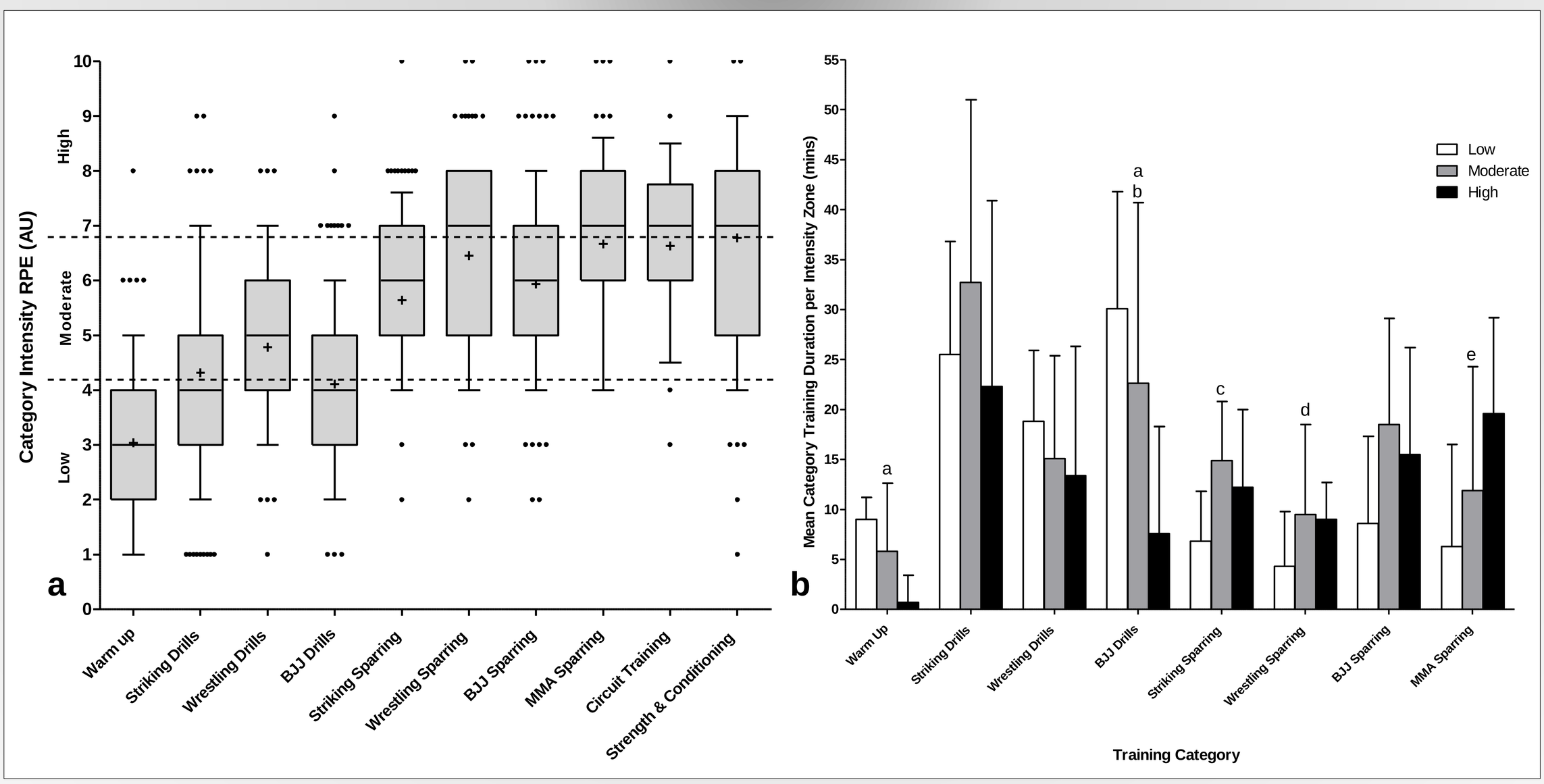
Total Training Time Distribution
20% at High intensity
33% at Moderate intensity
47% at Low intensity

Figure a

Median [10 -90%] RPE per category; Dots show outliers in each category; + = category mean.

Figure b

Mean±SD time spent in each intensity zone per category; a = decisive post-hoc differences between low and high intensity; b = moderate post-hoc differences between moderate and high intensity; c = very strong post-hoc differences between low and moderate intensity; d = moderate post-hoc differences between low and high intensity; e = strong post-hoc differences between low and high intensity.



Conclusions

- MMA sparring and wrestling sparring may be classified as high intensity, with BJJ sparring, striking sparring and wrestling drills being moderate intensity. Striking drills and BJJ drills are perceived as low intensity.
- MMA participants spend most training time at low to moderate intensities, but with more time spent at high intensities than other sports[6].
- Though less total time is spent on high intensity categories, the amount of time spent at high intensity is practically similar between most categories.
- It may be appropriate for MMA coaches to reduce the total amount of time spent at high intensity to avoid NFOR whilst enabling greater cardio-respiratory and metabolic adaptations associated with low-moderate training intensity[3].

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INTRODUCTION

- Greater range of motion (ROM) in the posterior thigh, hip internal rotation, ankle dorsiflexion and hip flexor muscle length have been linked to reduced likelihood of injury and pain in a range of demographics.
- There is a paucity of data in the literature pertaining to the joint range of motions for youth athletes and changes across chronological year groups.
- The aim of this study was to investigate joint range of motion (ROM) and sex, age, and sport type.

METHODS

- 449 datasets collected over 4 years.
- Assessment protocols included: Modified Thomas Test, Knee to Wall test, 90/90 Active Extension and Seated Medial Hip Rotation.

RESULTS

Gender

- Boys demonstrate *possibly lower* ankle, hip flexor and hip IR ROM (Figure 1).

Year-group

- Years 11, 12 and 13 showed *possible* to *likely greater* ankle ROM compared to Year 10.
- *Unclear* comparisons in posterior thigh flexibility.
- Year 13 compared to 12 showed *possible* to *likely lower* hip IR (Figure 2).

Sport Categories

- In posterior thigh ROM, Centimetre, Gram, Second (CGS) showed *possibly greater* than team sports and striking sports. (Figure 3).
- Striking sports showed *possibly* to *very likely lower* hip internal rotation compared to invasion and CGS sports.

In **youth athletes**, specific **range of motion** interventions may be required depending on **sport category, age and sex.**

Better to Bend Than to Break: An Analysis of Joint Range of Motion by Sex, Chronological Year Group and Sports Categorisation of Youth Athletes in a Leading Talent Development Programme.

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PRACTICAL APPLICATIONS

- Boys may benefit from an increased emphasis on hip and ankle ROM.
- More junior athletes may benefit from interventions targeting ankle ROM.
- ROM protocols may need to be specific within each sporting category.

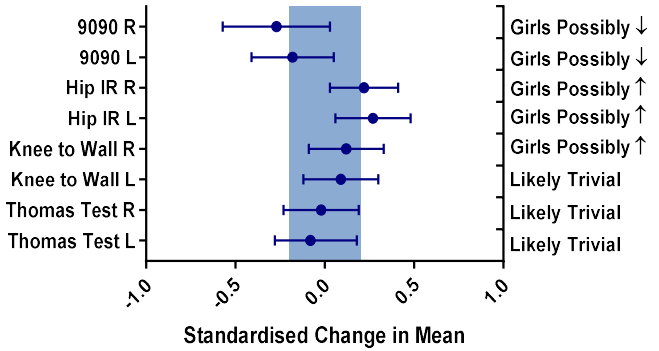

Figure 1. Differences between girls and boys in ROM tests.

Test	Comparison		
Knee to Wall L	**11 vs 10**	**12 vs 10**	**13 vs 10**
Standardised Change in Mean	0.43	0.41	0.43
90% Confidence Limits	0.48	0.42	0.41
Subjective Inference	*Likely +ive*	*Likely +ive*	*Likely +ive*
Knee to Wall R	11 vs 10	12 vs 10	13 vs 10
Standardised Change in Mean	0.44	0.46	0.54
90% Confidence Limits	0.43	0.32	0.32
Subjective Inference	Possible +ive	Likely +ive	Likely +ive

Figure 2. Comparison of ankle mobility between year groups.

ASSESSING NEUROMUSCULAR FATIGUE IN RESPONSE TO AN INTERNATIONAL FEMALE SOCCER MATCH USING THE COUNTERMOVEMENT JUMP

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[1]The Football Association, [2]Liverpool John Moores University, [3]University of Salford

INTRODUCTION

- The countermovement jump (CMJ) is commonly used as a proxy of neuromuscular fatigue (NMF) following exercise.
- There is a lack of consensus regarding which CMJ variables may be sensitive to NMF following soccer match-play and often only jump height (JH) is reported, without considering possible changes in strategy.
- Sex has been reported to influence fatigue response to exercise (1) and CMJ phase characteristics (2), thus females should be investigated separately to males.
- **Aim: To determine the CMJ variables sensitive to NMF following female international soccer match-play.**

METHODS

Participants

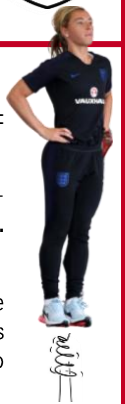
Twelve female international soccer players (age: 25 ± 4 years, height: 1.69 ± 0.07 m, body mass: 63.0 ± 6.0 kg) participated in the research.

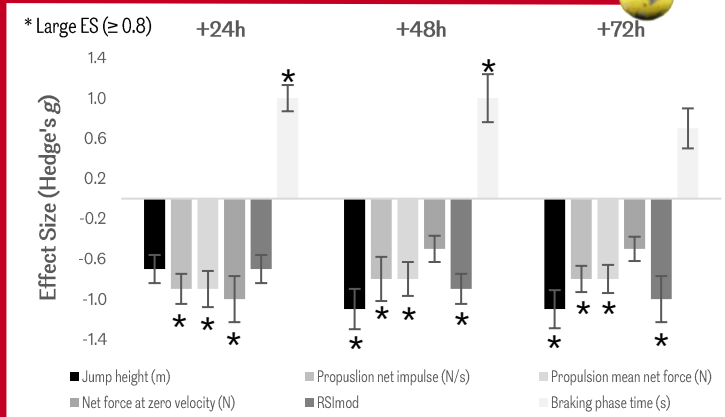
Data collection

Players completed 3 CMJs on two consecutive days pre-match (baseline) and on 3 consecutive days post-match (+ 24, 48 and 72 hours). Data were collected each morning using a force platform (ForceDecks). Players were instructed to jump as high and as fast as possible while keeping their arms akimbo.

Data analysis & statistics

Raw force-time data were exported and analysed using a custom Microsoft Excel template to calculate CMJ variables. Reliability was assessed by calculating the coefficient of variation (CV) and interclass correlation coefficient (ICC). Effect sizes (ES) with confidence intervals (95%) were calculated to determine the magnitude of change in CMJ variables between days.





RESULTS

Reliability: All CMJ variables selected displayed acceptable reliability (CV ≤ 5 %, ICC ≥ 0.9).

Changes in CMJ variables post-match: CMJ performance (JH) and driver variables (propulsion net impulse, propulsion mean net force and net force at zero velocity) were reduced from baseline at all time points post-match (ES 0.5 - 0.9).

CMJ strategy variables (reactive strength index modified [RSImod] and braking phase time) were adversely affected at all time points post-match compared to baseline (ES 0.7 – 1.0).

SUMMARY

Conclusion

CMJ performance (JH) was reduced for 72 hours post-match. This decline was caused by concomitant unfavourable changes in driver and strategy variables. These data suggest players were experiencing NMF that was not resolved by 72 hours post-match.

Practical Application

Practitioners working in female soccer should be aware that match-induced NMF may not be resolved within 72 hours.

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Effectiveness of a 4-week isometric neck strength training programme in amateur rugby league players

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Introduction

Rugby league has one of the highest incidences of concussion in sports (Gardner *et al.*, 2015). Concussions have been proposed to be caused by acceleration-deceleration of the head when under impact from an external force (McCory *et al.*, 2001). As the brain is freely floating within cerebrospinal fluid, it may shift at a different rate from that of the skull, causing it to impact on the underside of the cranium (Viano et al., 2005), triggering the neurometabolic cascade of concussion (Giza and Hovda, 2001). Increases in neck strength may aid head stabilisation when under impact from an external force, in turn reducing risk of sustaining a concussion (Eckner *et al.*, 2018). Despite this, studies on manual neck strength training (NST) programmes in amateur contact sports is limited. The aim of this study was to investigate the effectiveness of a 4-week isometric neck strength training programme in male amateur rugby league players.

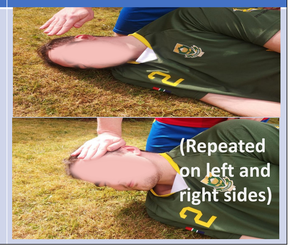
Method

Thirty-one male amateur rugby league players (forwards n = 17, backs n = 14, age: 21.3 ± 2.1 years, mass: 91.7 ± 27.1 kg, height: 175.4 ± 9.9 cm) were randomly assigned to either 4 weeks of isometric neck strength training in the experimental group (NST, n = 19), or the control group (CON, n = 12). Self-reported concussion history, overall isometric neck strength via a handheld dynamometer (mean MVC of; flexion, extension, left and right lateral flexion), neck circumference and head circumference were all collected pre- and post-NST.

Neck Strength Training Sessions:

Week 1-2: 1 set of 12 repetitions (3 s each) at 6/10 RPE on each movement (table 1), two times a week. Week 3-4: 2 sets of 12 repetitions (3 s each) at 7/10 RPE on each movement (Table 1), two times a week.

Table 1. Neck Strength Training Exercises

Flexion	Extension	Lateral Flexion
		

Results

The NST group showed a significant increase of 17-23% post-4 weeks of NST in neck strength flexion, extension, left and right lateral flexion (P < 0.05). Overall neck strength was significantly increased by 20 % post-4 weeks (MD = 32.26 ± 19.75 N, P = 0.000) (Fig 1), inducing a small effect size (Cohen's d' = 0.79). In contrast, no significant changes in overall neck strength were observed in the CON group (MD = 0.44 ± 12.26 N, P = 0.904).

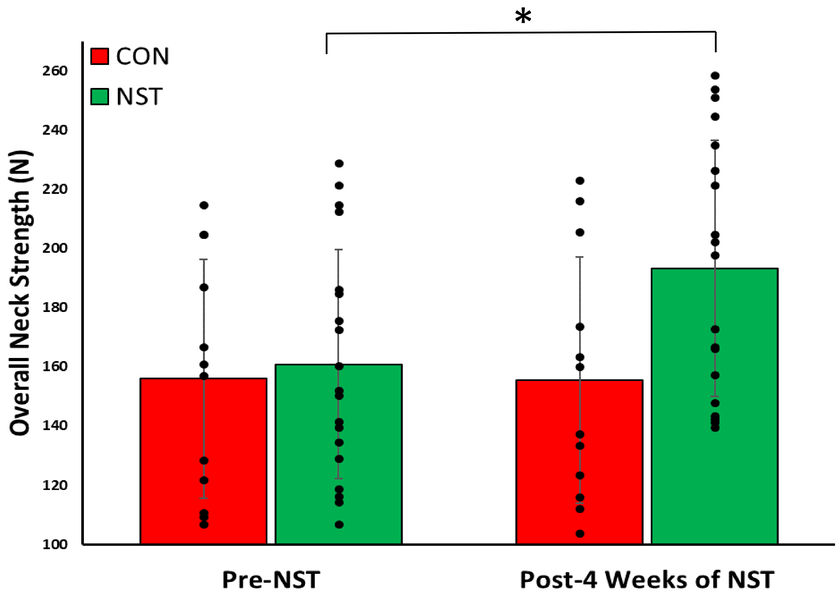


Fig 1. *Overall neck strength pre- and post-NST. * denotes significant difference between pre and post measures.*

A significantly greater neck strength of 33% was seen in players who had no concussion history compared to those who had previously suffered a concussion (MD = 179.27 ± 45.86 Nm, P = 0.001, d' = 1.42) (Fig 2). Players with no concussion history had a significantly greater neck circumference of 8 % (MD = 3.00 ± 1.09 cm, P = 0.010, d' = 1.01). However, no significant changes in neck circumference were observed post-4 weeks of NST.

Results

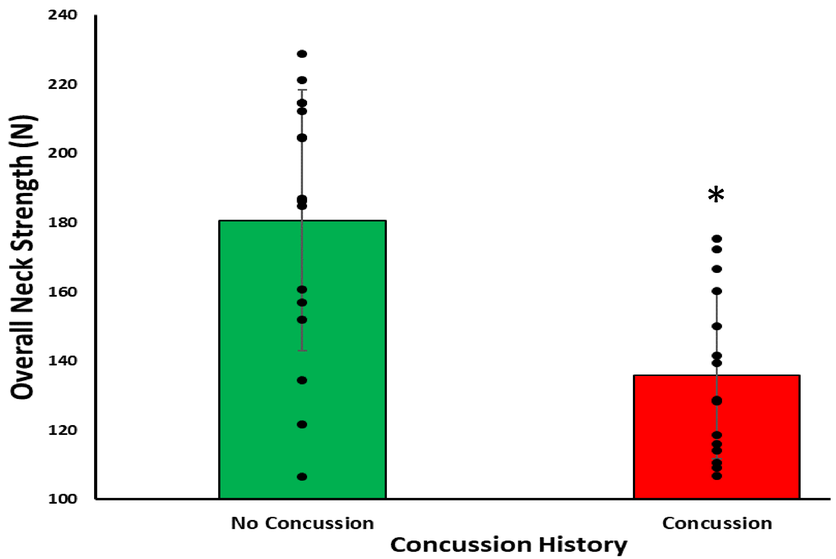


Fig 2. *Overall neck strength pre-NST and concussion history. * denotes significant difference between groups.*

Conclusion

The results of the present study indicate that a 4-week partner-assisted isometric NST programme increases isometric neck strength in amateur male rugby league players. However, an increased training period and intensity may produce greater effects, especially considering the lack of hypertrophic effects event in this study. The partner-assisted NST programme implemented in the present study may offer an easy to apply, cost effective method for amateur contact sports in the development of athletes' neck musculature, which may have implications for screening, rehabilitation and reduction in sports-related concussion risk.

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A Survey of the Use of Attention-Focusing Cues by Strength and Conditioning Coaches during Resistance Training

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INTRODUCTION

Attentional focus is defined as the conscious effort of an individual to focus their attention through explicit thoughts in an effort to execute a motor skill with superior performance.[1] Verbal cues are used by strength and conditioning (S&C) coaches to promote an internal, external or neutral focus of attention.[2]

An internal cue (IC) directs an athlete's attention to the movement process[3], an external cue (EC) directs attention to the movement outcome[3] while neutral cues (NC) direct attention neither internally or externally.[2] However, there is currently limited information available on the attention-focusing (AF) cues (i.e. IC, EC and NC) of S&C coaches for common resistance exercises and how AF cues are modified. The aim of this study was to investigate the use of AF cues by S&C coaches during resistance training.

METHODS

A cross-sectional survey was designed using an online survey generator (Qualtrics, USA). 1342 National Collegiate Athletic Association (NCAA) Division 1 S&C coaches were contacted through the NCAA directory and were emailed the survey. The survey contained three sections. Section one collected participant's background information. Section two investigated the frequency and type of AF cues for three resistance exercises: barbell back squat (BS), barbell deadlift (BD) and barbell bench press (BP). Section three assessed when and how AF cues are modified during resistance training. The survey was pilot tested with an expert panel (4 Division 1 S&C coaches, 1 Powerlifting coach, 1 Olympic weightlifting coach and 2 academics in the area of skill acquisition). Data were reported as percentages of response.

RESULTS

Sixty-seven coaches responded (5%). Coaches were primarily male (74.6%) and held a master's degree (77.6%). Coaches primarily sourced AF cues from personal experience (92.5%). Table 1 summarises the most common IC, EC and NC. The most important AF cue before a resistance exercise was an IC (58.2%) and during a resistance exercise was an EC (40.3%). AF cues are modified for experienced athletes (83.6%).

Table 1. The top 3 most common attention-focusing cues for the barbell back squat, barbell deadlift and barbell bench press

	Internal cue	External cue	Neutral cue
Barbell back squat	Knees out (74.6%)	Spread the floor (53.7%)	Stay tight (74.6%)
	Chest up (67.2%)	Sit back into a chair (44.8%)	Accelerate as fast as you can on the way up (67.2%)
	Core tight (59.7%)	Push the floor away (38.8%)	Drive, drive, drive (62.7%)
Barbell deadlift	Squeeze the shoulders back (71.6%)	Push the floor away (68.7%)	Stay tight (86.6%)
	Core tight (59.7%)	Bend the bar in the start position (38.8%)	Big breath (55.2%)
	Drive the hips through the bar at the top (43.3%)	Spread the floor (16.4%)	Big pull (49.2%)
Barbell bench press	Explode off the chest (61.2%)	Bend the bar (47.8%)	Accelerate as fast as you can on the way up (62.7%)
	Squeeze the shoulders back (52.2%)	Drive the bar to the roof (35.8%)	Slow on the way down/descent (55.2%)
	Elbows in (37.3%)	Pull the bar apart on the descent (25.4%)	Push, push, push (46.3%)

CONCLUSION

The findings of this study provide a practical insight into the most commonly utilised AF cues in an elite cohort of S&C coaches for the BS, BD and BP. In addition, the coaches outlined when and how they modify AF cues during resistance training which provides a valuable resource. The low response rate (5%) is a limitation of this study however this is common in online surveys.[4] Despite this, the sample size is higher than previous surveys on elite S&C coaches.[5,6] Future studies should involve larger sample sizes and a greater variety of resistance exercises.

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The Acute Potentiating Effects of Heavy Deadlifting on Rowing Sprint Performance

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INTRODUCTION

Post-activation potentiation (PAP) can enhance muscular force and power output.[1,2] PAP is defined as an acute increase in a muscle's contractile ability after a bout of maximal or near-maximal muscular contraction.[1] PAP is commonly utilised during warm-ups and complex training but may be more suited to stronger athletes.[1,4] Rowers are endurance athletes who typically have 70–85% type I fibres.[3]

The findings of PAP studies on endurance athletes are unclear[2,4], therefore further research is needed. The aim of this study was to investigate the acute potentiating effect of a heavy deadlift exercise on rowing sprint performance in national level rowers.

METHODS

The study was a randomised crossover and counterbalanced design. Eleven male rowers (26±4 years; 186.0±5.2 cm; 84.3±6.8 kg; 7±3 years of experience) participated. During session one, participants performed a 1 repetition maximum (1RM) hexagonal barbell deadlift (HBD). Session two and three involved performing a baseline seven-stroke maximal effort (7SM) test on a rowing ergometer (Concept2, Model C, USA) custom fitted with a load cell (VPG Transducers, model 615) using an unrestricted stroke rate.[5] The 7SM variables were mean power (MP), peak power (PP), mean force (MF), peak force (PF), mean stroke rate (MSR) and peak stroke rate (PSR). Following this, participants were randomly allocated to a PAP or control (CONT) group. The PAP group performed a 3 repetition HBD at 93% of 1RM while CONT performed a passive rest period. The 7SM was retested at 4, 8 and 12-minutes post.

RESULTS

Normality of the data was checked using a Shapiro-Wilk test ($p>0.05$). The mean 1RM HBD was 167.3±24.6kg (n=11). Descriptive statistics are provided in Table 1. A 2-way repeated measures analysis of variance found no significant interactions between group (PAP vs CONT) and time (baseline vs 4 minutes vs 8 minutes vs 12 minutes) for MP, PP, MF, PF, MSR and PSR ($p>0.05$ for all). A typical error analysis[6] found no evidence of individual responders in each group.

Table 1. Descriptive statistics (m ± SD) of 7SM variables (n=11)

Variables	PAP group				CONT group			
	Baseline	4 mins	8 mins	12 mins	Baseline	4 mins	8 mins	12 mins
Mean power (W)	725 ± 76	720 ± 72	729 ± 83	710 ± 88	715 ± 74	708 ± 81	711 ± 81	699 ± 76
Peak power (W)	766 ± 75	764 ± 72	762 ± 85	747 ± 85	754 ± 75	747 ± 83	752 ± 87	735 ± 83
Mean force (N)	1195.3 ± 106.8	1180.4 ± 94.4	1190.5 ± 96.5	1177.1 ± 103.0	1183.9 ± 100.2	1185.2 ± 103.6	1187.3 ± 112.6	1193.7 ± 111.8
Peak force (N)	1278.6 ± 102.9	1270.1 ± 101.9	1274.4 ± 112.9	1264.5 ± 108.6	1272.4 ± 103.8	1271.2 ± 98.9	1271.8 ± 113.8	1282.0 ± 101.6
Mean stroke rate (s/min)	48 ± 3	49 ± 4	48 ± 4	48 ± 4	48 ± 4	48 ± 5	48 ± 4	47 ± 3
Peak stroke rate (s/min)	50 ± 4	50 ± 4	50 ± 4	50 ± 5	50 ± 4	50 ± 5	50 ± 4	49 ± 4

W = Watt; N = Newton; s/min = rowing strokes per minute

CONCLUSION

The main finding suggests there was no acute potentiating effect of a heavy deadlift exercise at 93% of 1RM on rowing sprint performance, as measured by the 7SM test, in national level senior rowers (2000 m rowing ergometer time: 6:27.8±10.5 mm:ss.ms). This is the first study on rowers to use a PAP procedure involving a loaded resistance exercise therefore caution is advised for coaches who may want to utilise PAP in warm up procedures or complex training in rowing cohorts. Further research with larger sample sizes (>20) and longer duration ergometer tests (>3 minutes) is required.

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Strength and Conditioning Coaching Practice and Positive Youth Athletic Development: Context Specific Application of the Developmental Relationships Framework

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Abstract

Strength and Conditioning (S & C) coaches have an obligation to positively influence sound, holistic athlete development and support long-term engagement in sport. Positive Youth Development (PYD) is an intentional pro-social approach designed to support growth, learning and success. This research focuses on the interpersonal knowledge of the coach to consider how she/he can make and sustain positive connections with athletes. PYD confirms that youth athlete development relies on coaching practice that integrates support for personal, social and emotional growth alongside physical development. Context specific application of the Developmental Relationships Framework (DRF) demonstrates how the coach can initiate and sustain high quality relationships.

Positive Youth Development

In order to support holistic development, it is essential that the S & C coach adopts an evidence informed approach to the promotion of psychosocial as well as physical qualities. PYD offers the S & C coach a way of working with young people that focuses on the talents, strengths and potential of each athlete to successfully facilitate upward developmental trajectories. This approach is underpinned by Professional knowledge (knowledge of sport science and pedagogy), Intrapersonal knowledge (knowledge of self, the ability to reflect, and openness to continued learning) and Interpersonal knowledge (knowledge of how to connect with others to create and maintain relations). The purpose of this paper was to focus on the interpersonal knowledge of the coach to explore how, in the youth athlete training environment, the S & C coach may develop positive connections to support PYD.

Methods

Application of the DRF to the S & C context was explored and critiqued in relation to the five critical elements of the framework: Express Care, Challenge Growth, Provide Support, Share Power and Expand Possibilities. Confirmation of how the S & C coach can apply the DRF to deliberately create positive social bonds to support PYD in the athletic training environment was then confirmed through reference to peer reviewed publications in S & C coaching practice using the following search terms: positive youth development; long-term athlete development; holistic athlete development; psychosocial development; athlete empowerment. Empirical and theoretical findings were then discussed in relation to tacit and procedural knowledge acquired through combined author experience in S & C coaching (> 80 yrs).

Results

The DRF offers the S & C coach an evidence-based guide to the development of positive relations with young people. The following examples demonstrate how in the athletic training environment, the S & C coach can apply the DRF to deliberately create positive social bonds to support PYD.

Express Care

The coach's ability to offer understanding is central to the promotion of a caring relationship and athletes report that the emotional feeling of closeness provided by an S & C coach can be both encouraging and motivational. S & C coaches should strive to promote care for youth athlete's needs and feelings by balancing interest in their contribution and achievements with emotional support during times of challenge and disappointment.

Challenge Growth

An athlete is stretched when the S & C coach pushes them to go further and this process is best served by a coaching style that is less prescriptive and more athlete centred, placing an expectation on the youth athlete to strive to do their best and to live up to their potential. When athletes are encouraged to share goals, reflect on behaviours and helped to learn from mistakes and setbacks, relationships are stronger and increased motivation ensues.

Provide Support

The support provided by the S & C coach needs to be constant and the relationship developed in the training environment should not be influenced by performance on the field. If the S & C coach is dependable the youth athlete will learn that she/he is someone they can trust, and a positive connection will result.

Share Power

During the process of long-term athletic development, adolescence represents a period when pressure may be exerted by school, club and state. In this scenario the S & C coach can promote PYD by collaborating with the athlete to help them solve problems, respect their individual goals and include them in planning decisions.

Expand Possibilities

The expansion of possibilities is built upon a dynamic mix of relational elements that includes discussing goals, providing explanations, promoting team concept and expressing confidence in potential. Athletes report that their motivation and sense of purpose is enhanced by the planning, organisation and structure that an S & C coach can bring to their experience.

Further detail and explanation, in relation to application of the five critical elements of the DRF to the S & C context, can be found in:
Turner, G. Rudz, T. & Bertolacci, L. (2018) Strength and Conditioning Coaching Practice and Positive Youth Athletic Development: context specific application of the developmental relationships framework. Strength and Conditioning Journal USA, Vol. 40 Issue 6, pp, 49-55

Conclusion

Long-term athlete development relies upon coaching practice that is underpinned by knowledge of how best to engage with the youth athlete and it is therefore incumbent upon the S & C coach to acquire and learn how to apply interpersonal knowledge (knowledge of how to connect with others to create and maintain relations). The DRF offers the S & C coach a means to support the delivery of engaging practice, develop positive relations and create dynamic environments to support holistic development and psychosocial wellbeing for youth athletes. S & C coaches may strengthen developmental relationships with youth athletes by making intentional efforts to express care, challenge growth, provide support, share power and expand possibilities.

INTRODUCTION

- Evidence suggests job satisfaction (JS) can positively influence employee performance and commitment.
- There is a paucity of evidence identifying the JS of early years strength and conditioning (S&C) coaches.
- The aim of this study was to provide a retrospective analysis of JS in early years S&C coaches in a formalised coach development programme.

METHODS

- 12 S&C coaches completed the Minnesota Satisfaction Questionnaire (MSQ). Participants had graduated through a formalised S&C coach development programme at Millfield School.
- The MSQ is a valid and reliable instrument measuring satisfaction with aspects of work and the work environment.

RESULTS

- Mean general satisfaction was 88.6 ± 11.8.
- Referenced against normative data (employed non-disabled, MSQ manual) this represented a high degree of JS and a score at the 88th percentile.
- Items scoring in the 90th percentile or above against the reference population were supervision – technical , supervision – human relations, co-workers, achievement and responsibility.

PRACTICAL APPLICATIONS

- Overall, participants reported a high degree of satisfaction with their early years S&C coach development programme and identified key criteria that defined high satisfaction with their coach development experience.

High quality supervision, a sense of community and opportunities for successful and independent coaching may contribute to job satisfaction in early years S&C coaches

If Success is Satisfaction, What is Satisfaction? Self-Reported Satisfaction of Early Years Strength and Conditioning Coaches in a Formalised Coach Development Programme

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Scale	Mean	SD	SE	Cronbach's Alpha	Percentile Score
General Satisfaction	88.58	11.83	3.41	0.73	88
Intrinsic Satisfaction	55.17	6.28	1.81	0.33	/
Extrinsic Satisfaction	24.25	4.61	1.33	0.63	/

Table 1. Normative data for the general, intrinsic and extrinsic satisfaction from participants for the MSQ.

Scale	Mean	SD	SE	Cronbach's Alpha	Percentile Score
Co-workers	24.25	1.81	0.52	0.74	90
Supervision - Technical	24.08	1.74	0.50	0.46	95
Activity	24.08	1.92	0.55	0.83	85
Supervision - Human Relations	24.00	2.20	0.64	0.61	95
Achievement	23.67	2.23	0.64	0.53	90

Table 2. Normative data for the top five reported items from participants for the MSQ.

Scale	Mean	SD	SE	Cronbach's Alpha	Percentile Score
Company Policies and Practices	20.08	4.86	1.40	0.93	75
Social Status	20.08	4.14	1.20	0.33	85
Advancement	19.83	4.94	1.43	0.81	85
Authority	18.83	4.57	1.32	0.71	55
Compensation	14.58	5.03	1.45	0.89	20

Table 3. Normative data for the bottom five reported items from participants for the MSQ.

INTRODUCTION

- The importance of fundamental movement skill (FMS) and movement competency (MC) through childhood and adolescence has been well established in the research.
- The constructs of effective talent development environments have also been identified in the literature.
- The aim of this study is to provide retrospective analysis of FMS and MC from Millfield Prep School (MPS) and Non-Millfield Prep School (NMPS) youth athletes as they transition into Millfield Senior School (MSS)

METHODS

- 59 youth athletes aged between 11-12 years old were recruited doe the study. 27 participants from MPS and 29 from NMPS.
- All participants completed an assessment of FMS and MC.
- Both assessments satisfied the criteria for FMS and MC as outlined by Hulteen et al. (2018).

RESULTS

- In order to compare FMS and MC performance between MPS and NMPS, an independent samples *t*-test was conducted.
- NMPS group (M = 22.58, SD = 4.1) performed better, with a low practical significance ($p < 0.05$, d = 0.2) in the FMS assessment than individuals in the MPS group (M = 20.94, SD = 4.62).
- Individuals in the MPS group (M = 3.70, SD = 1.50) performed better with trivial practical significance in the MC assessment than individuals in the NMPS group (M = 3.95, SD = 1.0).

Early and deliberate preparation, effective communication and alignment of expectations may be important for the development of movement skill and competency through talent pathways

Working Together to Make Youth Athletes Move Better: The Importance of Coherence in the Development of Fundamental Movement Skill and Movement Competency within a Talent Pathway

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PRACTICAL APPLICATIONS

- Youth athletes that transitioned within the talent pathway (i.e. MPS to MSS) performed no better in FMS or MC compared to youth athletes transitioning into the talent pathway (i.e. NMPS to MSS).
- Physical training practitioners within a talent pathway should work coherently to ensure the long-term development and quality preparation of FMS and MC for all youth athletes at all ages.
- This process may be enhanced through the early and deliberate preparation of FMS and MC, the effective communication of training aims and an alignment of expectations at each stage of development.

	Fundamental Movement Skill		Movement Competency	
Prep School	**Mean**	**SD**	**Mean**	**SD**
MPS	20.94	4.62	3.70	1.50
NMPS	22.58	4.10	3.95	1.00

Table 1. Normative data for fundamental movement skill and movement competency for MPS and NMPS

Assessment	Cohen's d: MPS v NMPS
Fundamental Movement Skill	0.38 (Small)
Movement Competency	0.19 (Trivial)

Table 2. Cohen's d effect size and classification for MPS v NMPS for fundamental movement skill and movement competency

Contraceptive use and occurrence of primary amenorrhea in senior players from one elite football club

Guy Pitchers[1,2], Kirsty Elliott-Sale[3], Thomas Donelon[1] & Jamie O'Driscoll[1]

[1]Canterbury Christ Church University, UK; [2]Charlton Athletic Women's Football Club, UK; [3]Nottingham Trent University, UK

Introduction

- Athlete monitoring has become integral for strength and conditioning coaches. As more research emerges, it is currently considered best practice to record menarche (onset of the menstrual cycle), contraceptive use and cycle length.

- Oral contraceptives mimic the textbook 28-day menstrual cycle but these terms (menstrual cycle and oral contraceptives) should not be used interchangeably given their differing effects on the body (i.e., different ovarian steroid profiles). Despite hormonal contraceptive use being reported as high amongst athletes (Larsen et al., 2020; Martin et al., 2018), research is yet to determine contraceptive use within elite football.

- Menarche occurs at an average age of 12.7±1.3 years, with approximately two-thirds of girls attaining menarche between 12-14 years, and about 95% of girls reach this milestone between 11 and 15 years (Billewicz, et al., 1980; Malina, et al., 2004; Misra, 2015). Primary amenorrhea (no onset of menstruation by age 15 years) is typically associated with athletes in sports that emphasise thinness and/or weight category sports. As football becomes increasingly popular and professionalised, research is needed to better understand current players at an elite level.

Method

- The analysis was based on data provided by 50 players from the first team (n=37) and U21 squad (n=13) from the same club during 2019-2020 (see Table 1). Players had their age, stature, mass and menarche recorded and gynaecological age was calculated as age – menarche. Players were divided further based upon their current contraceptive use. Methods for the study were approved by the football club and by Canterbury Christ Church University ethics committee.

Conclusions/practical applications

1. Hormonal contraceptive use is highly prevalent in senior football, with combined oral contraceptives being the most common type of hormonal contraceptive used.
2. Coaches working within football should be cautious that age of menarche can vary and recording this is essential to determine primary amenorrhea and other menstrual disorders.
3. With 30% of senior players reporting primary amenorrhea, proactive and coherent procedures need to be implemented to ensure players health is a priority.

Results

- Despite a wide range of contraceptive methods available, only three methods (implant, combined oral contraceptive (COC) and non-hormonal contraceptive (NHC)) were used within the football club. The most common profiles were NHC (58%) and COC (38%) (see Table 1).
- Average age of menarche within the club was 14±1 years, with 15 players (30%) reporting menarche not occurring till ≥15 years (see Figure 1)

Table 1. Contraceptive profiles within the football club

	Total	Age	Mass (kg)	Stature (cm)	Age at menarche (yrs)	Gynaecological age (yrs)
Overall	50	22±3	62±6	165±6	14±1	8±4
COC	19	22±4	64±7	167±5	14±1	9±4
NHC	29	22±3	61±6	164±6	14±1	8±4
Implant	2	23±1	62±3	164±6	14±2	9±1

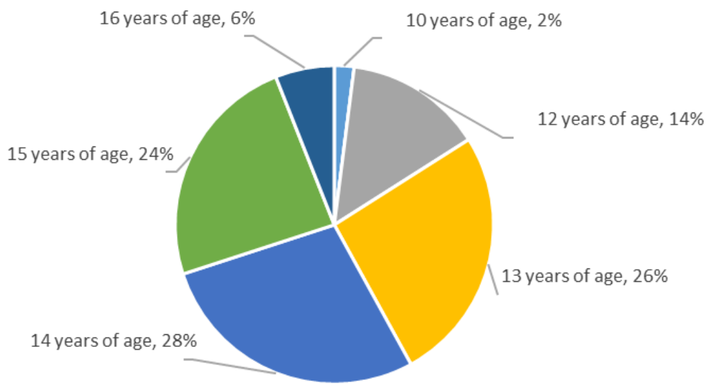

Figure 1: Age at menarche

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INTRODUCTION

- Authors have outlined significant differences in activity profiles, movement demands and injury risk across playing positions and age categories in youth netball.
- This study explored the differences in physical qualities associated to injury risk of the lower extremity. between junior vs senior and attackers vs defenders in youth netball.

METHODS

- 53 youth netballers were recruited (13-18 years) and assigned as an attacker or defender based on their most common playing position and junior or senior based on their school year.
- Assessments were the single leg riser, anterior reach, horizontal hop and lateral trunk hold.

RESULTS

- Single leg riser, anterior reach and horizontal hop were not found to be statistically significant between junior vs senior netballers ($p < 0.05$).
- Anterior reach and horizontal hop were not found to be statistically significant between attackers and defenders ($p < 0.05$).
- Single leg riser and lateral trunk hold were statistically significant for the right leg ($p < 0.05$), with the attackers performing better with moderate practical significance compared to the defenders.

Ensure a **holistic and general physical preparation programme** is implemented with youth netball players to reduce to the **risk of lower limb injury irrelevant of age or playing position**

What's Good for Them Is Good for Us: Physical Differences Related to Lower Limb Injury Risk in Youth Netball Players Across Age Categories and Playing Positions

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PRACTICAL APPLCIATIONS

- There may be little difference in the lower extremity strength, explosive strength, proprioception and trunk strength of youth netballers across divergent age categories and playing positions.
- Physical training practitioners may be warranted in ensuring a holistic and general physical preparation programme is implemented with youth netball players to reduce the risk of lower extremity injuries

	Single Leg Riser				Lateral Trunk Hold (s)			
	Left		Right		Left		Right	
Demographic	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Attackers	20.63	17.12	22.72	17.27	81.87	34.09	88.57	41.35
Defenders	14.43	11.61	14.47	11.52	59.39	17.98	70.39	24.41
Juniors	18.65	16.76	20.77	18.16	66.96	24.32	70.42	23.33
Seniors	17.26	13.79	17.38	12.24	77.07	34.67	90.56	42.97

Table 1. Normative data for single leg riser and lateral trunk hold for attackers, defenders, juniors and seniors

	Anterior Reach %				Horizonal Hop (m)			
	Left		Right		Left		Right	
Demographic	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Attackers	77.18	7.02	73.40	9.78	1.83	0.19	1.81	0.22
Defenders	77.64	5.65	77.14	4.42	1.81	0.19	1.82	0.16
Juniors	77.34	7.26	74.97	10.35	1.86	0.19	1.84	0.20
Seniors	77.40	5.77	75.03	5.86	1.81	0.17	1.78	0.19

Table 2. Normative data for anterior reach % and horizontal hop for attackers, defenders, juniors and seniors

How did the COVID-19 isolation period affect the strength and conditioning behaviours of athletes?

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Loughborough University

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had significant implications upon athletes strength and conditioning (S&C) practices, which have required substantial adjustments due to the closure of most training facilities between 22nd March – 25th July 2020. This is a cause for concern for S&C coaches, due to the possibility that athletes will have experienced detraining effects, which may negatively impact performance and increase injury risk.

METHODS

An online survey was distributed to a convenience sample of athletes to anonymously identify their S&C practices prior to, and during, the COVID-19 isolation period. The survey was open for five weeks (3rd June - 16th July 2020).

Typical S&C practices prior to the isolation period were cross-tabulated with activity during isolation using Chi-squared (χ^2) tests of independence. A Wilcoxon signed-rank test was used to establish the differences between training goals, frequency, and intensity prior to and during the isolation period.

RESULTS

- 70 responses were returned with 66 (female *n*=29, age: 26.5±5.1 years) participants indicating they performed S&C regularly (≥2 times.week-1). Half (*n*=33) were international-level athletes.

- 89.4% of participants continued with S&C during the isolation period and 90.9% of respondents reported modifying their S&C training for a home-based environment.

- Two-thirds (66.7%) received technical feedback from their S&C coach during the isolation period, and 74.1% had access to free weights.

- Training intensity (measured as perceived effort) was significantly reduced compared to before the pandemic (z=-5.812, *p*<0.001).

- Training goals significantly changed from performance related before the isolation period to more health related during this period (figure 1).

- Engagement with the majority of S&C activities and the frequency and duration at which they were performed did not significantly change (table1).

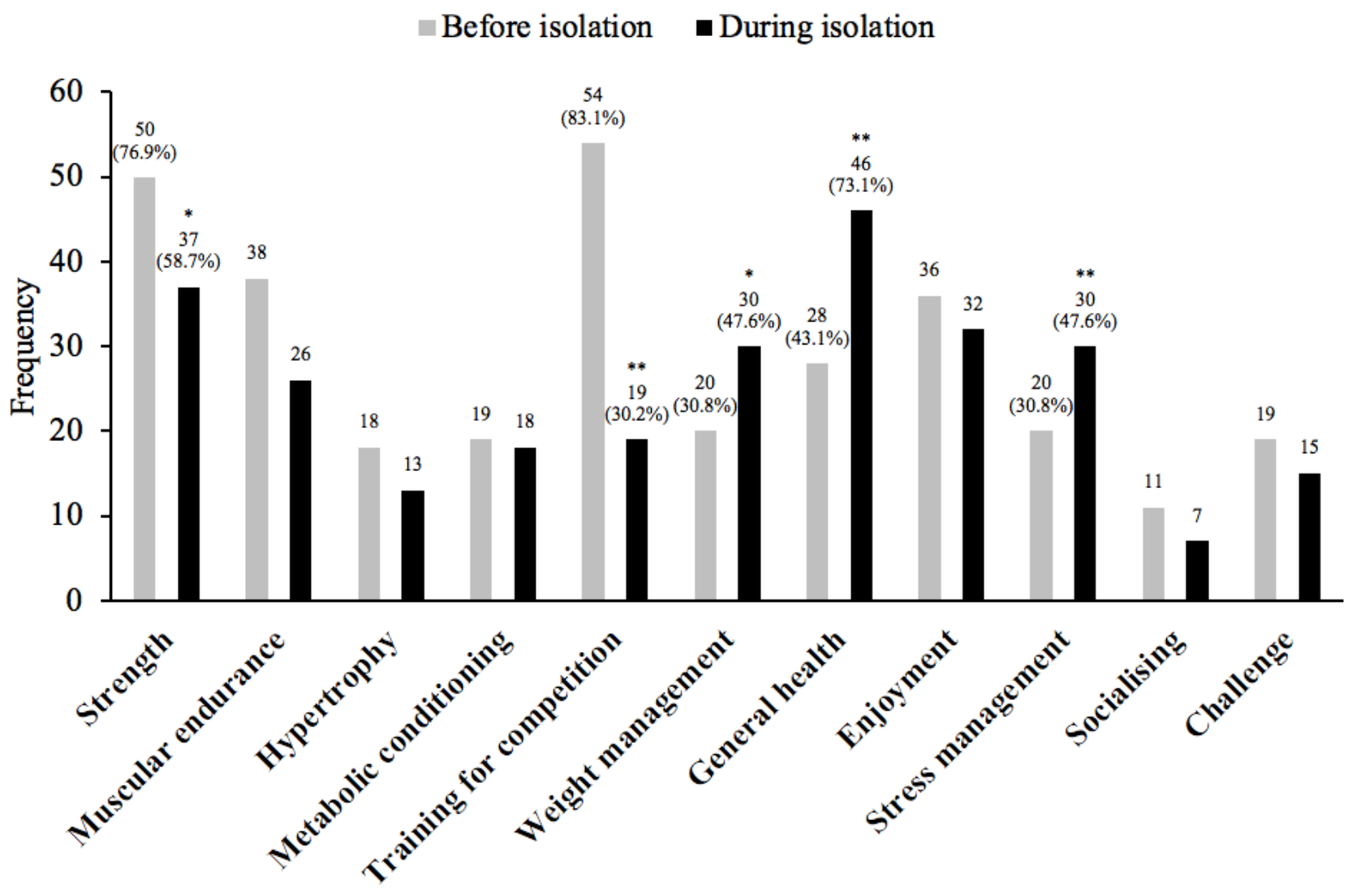

FIG 1. Goals of S&C training prior to and during the COVID-19 isolation period. Significant differences were observed for, strength, training for competition, weight management, general health and stress management. * p<0.05, ** p<0.01.

TABLE 1.

The most common responses are displayed and percentages identified are based upon only those who responded to using that activity.

Activity	*n*		Frequency (bouts.week^{-1})		Duration (min)	
	Before	During	Before	During	Before	During
Multi-joint resistance training	59 (93.3%)	45 (76.2%)	2-3 (60.0%)	2-3 (60.5%)	30-45 (31.6%)	15-30 (34.9%)
Bodyweight training	58 (95.1%)	52 (88.1%)	2-3 (56.1%)	2-3 (57.7%)	15-30 (35.1%)	15-30 (43.8%)
Core stability training	53 (86.8%)	49 (83.1%)	2-3 (50%)	2-3 (44.7%)	15-30 (42.3%)	<15 (44.4%)
Stretching	56 (91.8%)	49 (83.1%)	2-3 (40.0%)	2-3 (48.9%)	<15 (47.2%)	<15 (46.7%)
Plyometrics	50 (80.6%)	38 (64.4%)	2-3 (56.9%)	2-3 (51.3%)	15-30 (38%)	15-30 (35.1%)

There was no significant difference in the engagement with the following activities; multi-joint resistance training $\chi^2(1)=7.317$, *p*=0.007; bodyweight training $\chi^2(1)=1.894$, *p*=0.169; core stability training $\chi^2(1)=0.346$, *p*=0.556; stretching $\chi^2(1)=2.101$, *p*=0.147. However, the number of participants that engaged with plyometrics was significantly lower during the COVID-19 isolation period $\chi^2(1)=4.019$, *p*=0.045.

There was no significant difference in the frequency in which key activities were performed (multi joint resistance training z=-1.882 *p*=0.060; bodyweight training z=-0.050 *p*=0.960; core stability training z=-0.484 *p*=0.628; plyometrics z=-1.413 *p*=0.158; stretching z=-1.157 *p*=0.247) and the duration in which these activities were performed (multi joint resistance training z=-1.921 *p*=0.055; bodyweight training z=-5.80 *p*=0.562; core stability training z=-2.622 *p*=0.009; plyometrics z=-1.653 *p*=0.908; stretching z=-0.539 *p*=0.590).

CONCLUSION

A lower training intensity along with a change to more health related training goals suggests that athletes may have experienced a detraining effect to important physical qualities, however, strength training behaviours were unaffected in areas of frequency and duration indicating that the isolation period may not have caused athletes to be as detrained as many coaches expected. It is recommended that S&C coaches conduct a sports-relevant battery of fitness assessments to ascertain the extent of detraining in each individual athlete.

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High-intensity Interval Training in Gaelic Games: A Survey of Current Practices

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INTRODUCTION

High-intensity interval training (HIIT) is the use of repeated high-intensity (≥90% of maximal oxygen uptake [VO_2max]) bouts of exercise, separated by recovery periods.[1] In field sports, HIIT is commonly categorised (Table 1) into long interval training (IT), short IT, repeated-sprint IT (RSIT), sprint IT (SIT)- and game-based conditioning (GBC).[2] The movement demands of Gaelic games involve high-intensity activities (e.g. accelerations, sprinting, etc.), interspersed with recovery periods (e.g. walking, jogging, etc.), thus HIIT may replicate game demands.[3] However, HIIT in Gaelic games needs further research. The aim of this study was to conduct a survey of the HIIT practices of strength and conditioning (S&C) coaches in Gaelic games.

METHODS

A cross-sectional survey was designed using an online survey generator (Qualtrics, USA). Forty-nine S&C coaches currently working with Gaelic games teams were contacted through the lead S&C coach of each region and were emailed the survey. The survey consisted of eight sections, which included coaches' background information, views on HIIT, current HIIT prescription and HIIT monitoring methods. A pilot survey was conducted prior to initiating (n=3), with 3 questions refined to improve clarity. The survey contained fixed-response and open-ended questions. A 6-stage thematic analysis was used to analyse the open-ended questions. [4]

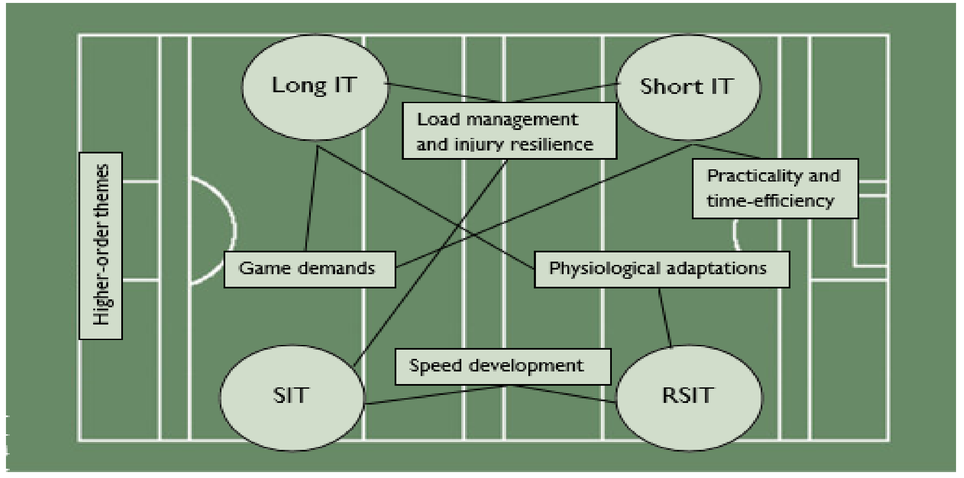

Figure 1. *Higher-order themes from coaches' rationale for using HIIT*

RESULTS

Thirty (61.2%) S&C coaches primarily employed with inter-county (elite) teams in Gaelic games (7.9 ± 5.6 years of experience) participated. All coaches used HIIT, with almost all (n=29) sourcing information from research articles. The use of HIIT varied based on the phase of the season, with the majority of coaches (80%) favouring long IT during pre-season to improve aerobic capacity, and short IT during in-season (76.6%) to replicate game demands. The coaches' rationale for prescribing HIIT included meeting game demands, improving physiological adaptations (e.g. aerobic capacity development), managing training load (e.g. increasing high-speed running distance) and injury prevention (Figure 1). Playing area and number of players were commonly altered in GBC depending on the desired outcome.

Table 1. *HIIT formats*

Format	Work duration	Work intensity	Recovery duration	Work:rest ratio
Long IT	2-4 minutes	≥ 95% VO_2max	2-4 minutes	1:1-2:1
Short IT	≥ 15 seconds	100-120% VO_2max	≤ 15 seconds	1:1
RSIT	> 4 seconds	All-out	< 20 seconds	1:4-1:5
SIT	> 20 seconds	All-out	≥ 2 minutes	1:6-1:8
GBC	2-4 minutes	Self-selected	≤ 2 minutes	2:1

CONCLUSION

This study provides an insight into the HIIT practices of elite level S&C coaches in Gaelic games. Long IT is commonly prescribed during pre-season to improve aerobic capacity. Coaches used short IT in-season to replicate game demands by increasing high-speed running volume. To develop all aspects of the game concurrently, coaches used GBC to replicate game-like running intensities through modifying playing area or number of players. Coaches suggested that exposing players to game intensity in training, may reduce injury risk in competition.

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Context Specific Training Load Measures in Professional Youth Football Players

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Abstract

Purpose of this study was to investigate the effect of match play and training themes on training load relationships. 20 professional youth footballers provided data across an entire season. Pearsons product moment correlation and principal component analysis was used to quantify relationships. Stronger relationships generally reported between sRPE and measures of volume. Distinction between measures revealed by PCA.

Practical Application

- Multiple measures are required to assess the load experienced by players.
- Distincition between measures of 'volume' and 'intensity'.
- sRPE was shown to be primarily a measure of training volume

Introduction

- Load monitoring is common practice in elite sport
- Previous research has shown that training loads experienced by team sport athletes are likely to require multiple measures to characterise appropriately
- Different training themes are likely to create different responses.
- Purpose of this study was to investigate the effect of match play, and training characteristics described by their proximity to match day (MD), on load relationships

Experimental Design

- Data from ratings of perceived exertion, and seven GPS derived measures of external training load were collected across a 46-week season.
- General characteristics of training sessions were categorised based on their proximity to MD.

Participants

n = 20 pro-youth footballers

2827 recordings

Age = 17.4 ± 1.3yrs
Height = 178 ± 8.1cm
Mass = 71.8 ± 7.2kg

Statistical Analysis

- Relationships between sRPE and external training load measures for each training day relative to MD were analysed using Pearson's product moment correlation
- The underlying structure of the data were investigated with principal component analysis followed by varimax rotation.
- An extraction criteria comprising eigenvalues > 1 was used to identify which components to retain.

Variables

sRPE	Total Distance	PlayerLoad™
LI.Running (<14.4km.h^{-1})	Running (19.8 – 24.98km.h^{-1})	Sprinting (>24.98km.h^{-1})
Accelerations	Decelerations	

MD

	Component Loadings *(% of Var.)*		
	1 *(54.2)*	2 *(35.5)*	3
sRPE	0.89		
Tot. Dist.	0.94		
PL	0.91		
LI.Running	0.96		
Running		0.72	
Sprinting		0.94	
Accel.		0.77	
Decel.			

MD-1

	Component Loadings *(% of Var.)*		
	1 *(50.74)*	2 *(20.57)*	3
sRPE			
Tot. Dist.	0.89		
PL	0.91		
LI.Running	0.91		
Running		0.76	
Sprinting		0.92	
Accel.			
Decel	0.71		

MD-2

	Component Loadings *(% of Var.)*		
	1 *(39.6)*	2 *(20.74)*	3 *(19.68)*
sRPE			
Tot. Dist.	0.92		
PL	0.88		
LI.Running	0.95		
Running			0.81
Sprinting			0.88
Accel.		0.86	
Decel.		0.85	

MD-3

	Component Loadings *(% of Var.)*	
	1 *(45.9)*	2 *(28.2)*
sRPE	0.79	
Tot. Dist.	0.89	
PL	0.89	
LI.Running	0.92	
Running		0.72
Sprinting		0.89
Accel.		
Decel.		

MD-4

	Component Loadings *(% of Var.)*	
	1 *(51.35)*	2 *(21.52)*
sRPE		
Tot. Dist.	0.91	
PL	0.91	
LI.Running	0.93	
Running		0.86
Sprinting		0.90
Accel.	0.7	
Decel.	0.76	

Results

- 1st component generally characterised by 'volume'
- 2nd/3rd components generally characterised by 'intensity'

Conclusions

- Multiple measures should be used to assess the load experienced by players. Across all modes of training assessed in the present study
- Split between traditional measures of training volume (sRPE, total distance, PlayerLoadTM, LI.Running) and intensity (running, sprinting, accelerations, and decelerations) was identified.
- sRPE was shown to be primarily a volume based measure, practitioners seeking to monitor intensity should select alternative measures

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UK Soccer Academies perceive psychological attributes as the most important contributor to development

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1 - Introduction

Understanding the desired attributes for talented soccer players may give insight into the process of (de)selection and player development. This study aimed to explore soccer academy personnel's perceptions of attributes associated with talent and development.

2 - Methods

Thirty English and Scottish academy personnel (managers, coaches, recruitment, sports scientists) provided perceptions into what attributes contribute to 'talent', via an online survey. Utilising an eDelphi method, 7 experts refined these inputs over several rounds until a consensus was reached, resulting in 82 agreed terminology. This terminology was resubmitted via a second online survey, where 45 academy personnel rated each using a Likert scale.

Statistical Analysis

Consistency of responses was measured with Cronbachs Alpha, and Inter-Rater agreement by job role was determined using intraclass correlation coefficients. The data was not normally distributed so a Kruskal Wallace was used to determine variations between academy personnel.

3 – Results

A ranking of attributes by importance was produced, finding psychological and technical attributes considered of greatest importance (table.1). Differences were observed, whereby recruitment personnel consistently over-emphasised the importance of several attributes compared to other personnel (P = 0.02 to 0.04). When analysed within each age phase, 11 variations in the perceived importance of attributes were demonstrated in the youth phase (11-16 years, P = 0.01) compared with 5 in the professional phases (17-23 years, P = 0.01 to 0.05). Good consistency (α = 0.94) and excellent inter-rater reliability (ICCs = 0.85-0.92) was reported.

Table.1 Ranked attributes by mean score

	Attribute	Mean Score ± SD		Attribute	Mean Score ± SD
Most Important	Attitude	9.2 ± 1.0	Most Important (cont.)	Environmental Influence	8.1 ± 1.3
	Work Ethic	9.2 ± 0.9		Tactical Development	8.1 ± 1.2
	Decision Making Skills	9.2 ± 0.9		Personality	8.1 ± 1.1
	Competitive	9.1 ± 0.9		Psychological Profile	8.0 ± 1.9
	Character	9.0 ± 0.8		Confidence	7.9 ± 1.5
	Determination	9.0 ± 1.0		Goal Driven	7.9 ± 1.1
	Drive	9.0 ± 0.9		Independence	7.9 ± 1.6
	Mental Resilience	8.9 ± 1.1		Team Player	7.8 ± 1.6
	Game Intelligence	8.9 ± 1.0		Playing Forward	7.8 ± 1.4
	Desire	8.9 ± 1.2		Phase Specific Development	7.8 ± 1.9
	Ball Control	8.8 ± 1.0		Physical Attributes	7.7 ± 1.5
	Perseverance	8.8 ± 1.1		Parental Support	7.7 ± 1.5
	Game Impact	8.8 ± 1.6		Experience	7.7 ± 1.6
	Commitment	8.7 ± 1.3		Stamina	7.6 ± 1.6
	Motivation	8.7 ± 1.3		Creativity	7.5 ± 1.2
	Mentality	8.7 ± 1.2		Strength	7.3 ± 1.3
	Effectiveness	8.6 ± 1.8		Inventive	7.3 ± 1.6
	Situational Awareness	8.6 ± 1.0		Innate Gifts	7.2 ± 2.0
	Coachable	8.6 ± 1.2		Physical Development	7.2 ± 1.5
	Technical Ability	8.5 ± 1.1		Physicality	7.2 ± 1.5
	Technical Skills	8.5 ± 1.0		Dribbling Skills	7.2 ± 1.3
	Challenged Regularly	8.5 ± 1.2		Humility	7.0 ± 2.2
	Opportunity	8.5 ± 1.3		Development Process	7.0 ± 1.9
	Speed	8.4 ± 1.2		Philosophically Aligned	7.0 ± 1.7
	Technical Mastery	8.4 ± 1.3		Natural Aptitude	6.9 ± 2.2
	Adaptability	8.4 ± 1.0		Genetic Predisposition	6.9 ± 1.6
	Growth Mindset	8.3 ± 1.5		Ego	6.6 ± 1.8
	Positive Mindset	8.3 ± 1.2		Position Specificity	6.6 ± 1.9
	Passing	8.3 ± 1.2		Maturation	6.3 ± 2.3
	Individual-Developments	8.3 ± 1.4		Late Developers	6.1 ± 2.1
	Problem Solving	8.3 ± 1.4	Moderately Important	Peak Height Velocity	6.0 ± 2.0
	Holistic Developments	8.3 ± 1.2		Relative Age Effect	5.9 ± 2.2
	Disciplined	8.3 ± 1.2		Locality	5.9 ± 2.0
	Outstanding Attribute	8.3 ± 1.2		Predicted Future Height	5.8 ± 2.1
	Athleticism	8.2 ± 1.1		Learning Style	5.6 ± 2.8
	Open-minded	8.2 ± 1.1		Height	5.2 ± 1.9
	Outplay 1 vs. 1	8.2 ± 1.4		Laziness	5.1 ± 3.8
	Tactical Ability	8.2 ± 1.2		Overconfidence	4.7 ± 2.6
	Global Skill-Development	8.1 ± 1.1		Early Developers	4.3 ± 2.2

4 - Conclusion

The present study demonstrates that 'talent' requires multifaceted developments, with academy personnel perceiving psychological attributes the most important contributor to development.

The results demonstrated an over-estimation of attribute importance from recruitment staff, to that of others. This may have potential implications towards academy recruitment and player development, with recruitment staff placing values in attributes that other staff deem as less important.

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QUANTIFYING PATTERNS OF COORDINATION AND PATTERNS OF CONTROL DURING THE CLEAN AND SNATCH IN A NATIONAL LEVEL WEIGHTLIFTER: A CASE STUDY

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INTRODUCTION

Several biomechanical degrees of freedom are available for the execution of goal-orientated movements such as the snatch and clean. Through technical instructions and practice the number of degrees of freedom reduce which leads to the development of coordinative structures [1]. These preferred coordination patterns, which are organised from past experiences and the interaction between constraint parameters [1-2], may determine the efficiency of lifting performance. The coordination pattern between body segments/joints can be qualitatively illustrated on an angle–angle diagram (Fig. 1a). Alternatively, a modified vector coding technique calculates the vector orientation between adjacent data points on an angle-angle diagram relative to the right horizontal. The outcome measure is referred as the coupling angle (Fig. 1b) and based on the vector orientation, each coupling angle over a movement cycle can be assigned to a coordination pattern classification (Fig. 1c) [3]. This case study uses novel data visualisations in vector coding to detail patterns of coordination and control during the snatch and clean in a national level weightlifter.

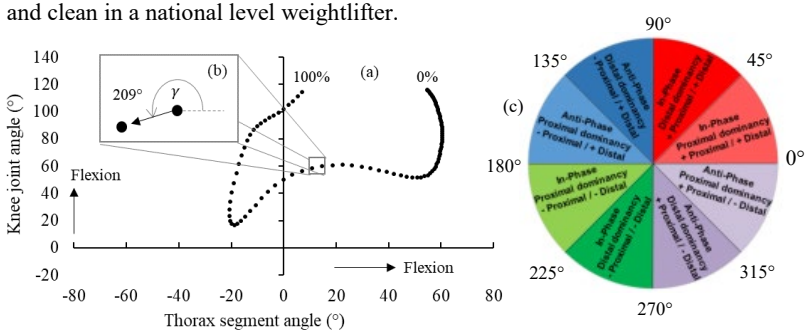


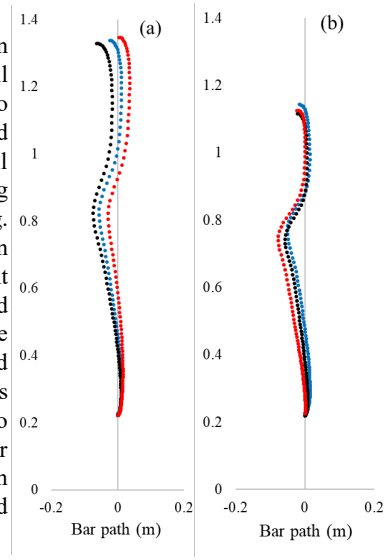
Figure 1. (a) angle–angle plot representing time normalised (0-100%) angle of the thorax segment and knee joint during the clean lift; (b) the inset provides an expanded view of one coupling angle; (c) coordination pattern classification adapted from Needham et al. (2020) [3] illustrating a colour-scale for each classification. In the inset example, a coupling angle of 209° is assigned to in-phase coordination (both the thorax and knee joint angle are extending at that instant in time) with proximal dominancy (thorax segment has a greater change in angle at that instant in time).

METHODS

Following ethical approval by the University Ethics Committee, one male national level weightlifter performed the snatch and clean at 80% of 1RM. A 17-camera motion capture system collected kinematic data at 200Hz, and two force platforms collected kinetic data at 1000Hz. Data were filtered at frequencies of 6Hz and 25Hz, respectively [4]. Three trials were collected and data was normalised for time (0-100%) from when the barbell left contact with the ground and the maximum height of the barbell. Readers are directed elsewhere for further information on vector coding calculations, coordination pattern classification, and data visualisations [3].

RESULTS

During the pull phases of the snatch, an incremental increase in vertical barbell velocity was observed that corresponded to positive barbell accelerations, while reduced vertical barbell velocity and negative barbell acceleration was noted for the clean during the transition and start of the second pull (Fig. 2c). For both lifts, similar coordination patterns between thorax angle and knee joint angle were observed across phases and between trials, although there were differences in segmental/joint dominancy and temporal offsets in the timing of transitions between coordination patterns. Compared to the snatch, control patterns highlighted greater knee and thorax extension during the clean towards the end of the first pull, and reduced extension during the second pull (Fig. 3).



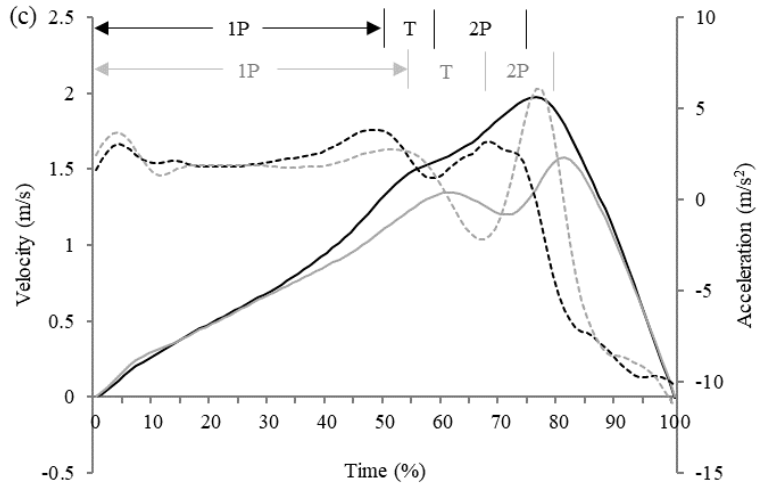


Figure 2. Barbell path for the snatch (a) and clean (b) across 3 trials (trial 1 – black / trial 2 – blue / trial 3 – red). Group mean (c) barbell vertical velocities illustrated on the left vertical axis for the snatch (black solid line) and clean lift (grey solid line); barbell vertical accelerations illustrated on the right vertical axis for the snatch (black dashed line) and clean lift (grey dashed line). Note: phases of each lift (Black – snatch / grey – clean) are noted as follows; 1P – first pull / T – transition / 2P – second pull.

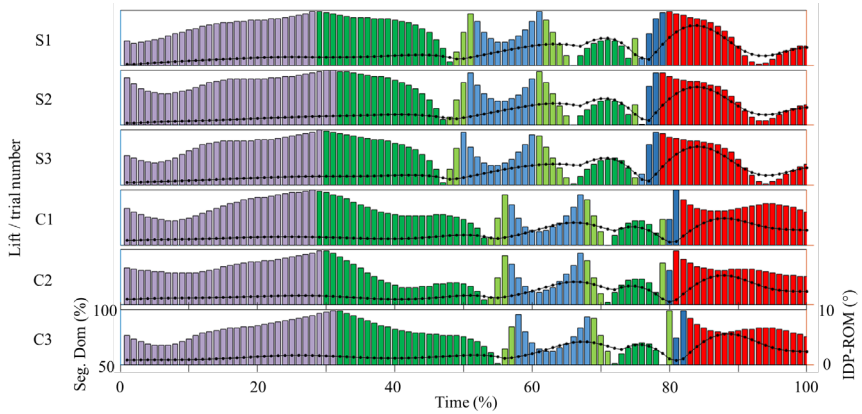


Figure 3. Coupling angle mapping, segmental dominancy and IDP-ROM profiling representing thorax segment (proximal) – knee joint (distal) coordination in the sagittal plane during the snatch (S) and clean (C) lift across trials (1,2,3). Coupling angle mapping signifies a colour-scale approach to display changes in coordination pattern classifications (See Fig. 1c for colour-scale legend); data bars denotes segmental/joint dominance, which refers to a greater change in the angular range of either the thorax segment or knee joint at each instant in time (50-100% left vertical axis); the dotted line refers to "inter-data point range of motion" (IDP-ROM) profiling of the dominant segment (0-10° right vertical axis) that was superimposed over coupling angle mapping and segmental dominancy data.

DISCUSSION

The coordination between thorax and knee angle was chosen due to the respective triphasic sequence of segment and joint rotations during the clean and snatch (knee extension, thorax extension-knee flexion, thorax-knee extension). Vector coding quantified this coordination strategy in detail over time and highlighted similar coordination patterns between lifts. However, compared to the snatch lift, there was a decrease in knee joint extension dominancy (dark dark) for the clean lift during the first pull (Fig. 3 – from 30% of time). This subtle difference in dominancy suggests undesired thorax extension during the first pull. In addition, the extended duration of the first pull for the clean lift highlights greater extension at the thorax and knee. This may suggest incorrect posture at the start of the second pull and reduced extension ability that may not maximise the contribution from the back and hip extensors. Indeed, poor execution of the first pull as described above may explain the differences in barbell kinematic data between lifts [5].

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Test-Retest Reliability of Reactive Strength Index Variants Obtained from the Countermovement-Rebound Jump

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Introduction

The vertical jumps extensively researched include the countermovement jump (CMJ), squat jump, drop jump and repeated jumps (2, 3, 4, 5, 6). Of these jumps, the CMJ has been included in extensive research to show its reliability and repeatability as well as its sensitivity to fatigue among other factors (4,5). The countermovement rebound jump (CMJ-R) is a method of vertical jumping that will hypothetically achieve a reliable drop height in comparison to a drop jump test (1) via first performing a maximal CMJ followed by an immediate rebound allowing further assessment of reactive strength. The purpose of this study was to assess if the CMJ-R test is an appropriate test to utilise within testing batteries of athletes through assessing its test-retest reliability.

Methods

Seventeen jump-trained subjects (height = 174.4 ± 7.2 cm, body mass = 79.9 ± 11.9 kg and age = 26.5 ± 7.3 years) performed three trials each of the CMJ and CMJ-R; nine of them performed an additional three trials of each test seven days later under identical conditions. The CMJ consisted of a quick triple flexion of hips, knees and ankles with hands on hips throughout to a self-selected depth then a jump as fast and high as possible with the intention of achieving maximal jump height. The CMJ-R included an immediate rebound following the CMJ. All jumps were performed on a force platform sampling 1000 Hz. The variables analysed were reactive strength index (RSI), RSI modified (RSImod) and their respective components.

Results

The results showed acceptable intraclass correlation coefficients of between 0.515-0.972, with all but two variables (within-session time to take-off (TTO), between-session rebound ground contact time) being >0.75 and deemed good or excellent for the CMJ-R within- and between-sessions. The coefficient of variation values for all variables for within- and between-session CMJ-R were reported at <10% (see Table 1). The paired Hedges' *g* between CMJ and CMJ-R is -0.227 for RSImod and-0.207 for TTO (see Figures 2 and 3). The p value of the two-sided permutation t-test was 0.0846 and 0.179, respectively, indicating no significant differences in RSImod or TTO between the CMJ and CMJ-R. The paired Hedges' *g* between average CMJ JH and average CMJ-R JH was -0.438 (see Figure 1). The p value of the two-sided permutation t-test was 0.001, indicating significant differences between the JHs.

Table 1. Means, standard deviation, coefficient of variation and intraclass correlation coefficients of within session subject variables.

Exercise	Variable	Mean	SD	ICC	CV {range}
CMJ	JH (m)	0.34	0.07	0.974	1.9% {0.0-5.1%}
CMJ	RSImod	0.51	0.10	0.916	4.0% {1.01-10.6%}
CMJ	TTO (s)	0.68	0.10	0.819	4.0% {0.7-12.5%}
CMJ-R	CMJ JH (m)	0.31	0.05	0.972	1.6% {0.0-5.0%}
CMJ-R	CMJ RSImod	0.48	0.09	0.842	4.5% {1.1-8.9%}
CMJ-R	CMJ TTO (s)	0.66	0.14	0.657	3.7% {0.4-8.1%}
CMJ-R	Rebound GCT (ms)	263.43	55.60	0.771	5.2% {1.0-11.1%}
CMJ-R	Rebound RSI	1.07	0.28	0.760	6.0% {0.2 – 17.5%}
CMJ-R	Rebound JH (m)	0.27	0.05	0.878	3.7% {0.3-13.0%}

SD=standard deviation, ICC=intraclass correlation coefficients, CV= coefficient of variation, CMJ=countermovement jump, CMJ-R=countermovement jump rebound, JH=jump height, RSImod=reactive strength index modified, TTO=time to take-off, RSI=reactive strength index, GCT= ground contact time

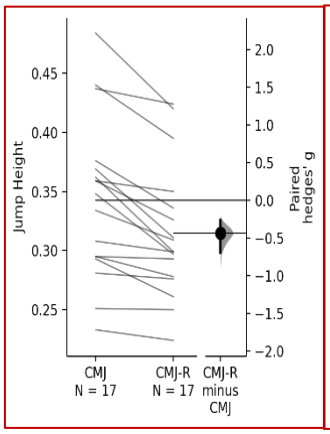

Figure 1. Left: The differences between CMJ and CMJ-R JH within session. Right: The paired mean difference (hedge' g) plotted on a floating-axes as a bootstrap sampling distribution.

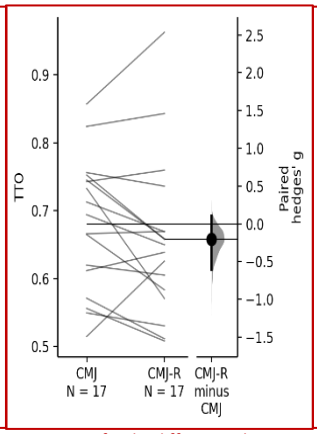

Figure 2. Left: The differences between CMJ and CMJ-R TTO within session. Right: The paired mean difference (hedge' g) plotted on a floating-axes as a bootstrap sampling distribution.

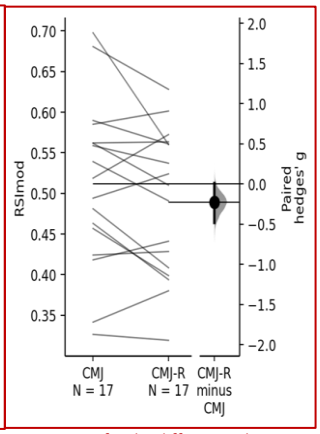

Figure 3. Left: The differences between CMJ and CMJ-R RSImod within session. Right: The paired mean difference (hedge' g) plotted on a floating-axes as a bootstrap sampling distribution.

Summary and Conclusion

The main aim of the present study was to assess the reliability of the CMJ-R within and between sessions. Having illustrated its reliability within and between sessions, the CMJ-R would be a suitable test to utilise in testing batteries. However, practitioners should be aware of potential changes of CMJ strategy, particularly if athletes are unfamiliarised with the testing procedures. Practitioners may benefit from the CMJ-Rs ability to provide data that can assess athletes' slow and fast stretch shorten cycle ability in a singular test rather than having to do separate tests.

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