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1 **MONITORING CHANGES IN POWER, SPEED, AGILITY AND**
2 **ENDURANCE IN ELITE CRICKETERS DURING THE OFF-SEASON**

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1 **ABSTRACT**

2 The purpose of this study was to monitor changes in power, speed, agility and
3 endurance in elite cricketers during the 20-week off-season period. Fourteen elite
4 male cricketers (age 26.2 ± 5.3 years; height 180.8 ± 8.5 cm; mass 83.5 ± 6.7 kg)
5 conducted a physical testing battery in week 1 and week 18 of the off-season period.
6 The testing included a yoyo intermittent recovery test (yoyo IRT), bilateral and
7 unilateral countermovement jumps (CMJ), squat jump (SJ), broad jump (BJ), drop
8 jump (to calculate reactive strength index – [RSI]), pro agility and 5, 10, 20m sprint
9 tests. Results showed significant improvements ($p < 0.05$) in all fitness tests except
10 for the pro-agility test ($p = 0.076$), with effect sizes ranging from 0.26-2.8 across the
11 test battery. The results of this study show the off-season in cricket allows adequate
12 time for significant improvements of physical qualities needed for the demanding in-
13 season schedule of the sport and provide normative values for an elite cricket
14 population.

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16 **Key Words:** Monitoring, Off-season, Speed, Strength, Power

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1 **INTRODUCTION**

2 There has been a rise in popularity over the past two decades in cricket, with over 100
3 nations recognized by the International Cricket Council (ICC) (18). This recent rise in
4 popularity has led to further professionalization within English first-class cricket
5 where the total number of games played spans across approximately 100 days per
6 calendar year (19). The sport is unique in nature with three established formats
7 played, the most intense being the twenty-twenty (T20 – 20 overs per side) matches
8 played over a three-hour period. One-day matches (50 overs per side) are typically
9 played over the course of six-seven hours and multi-day matches (96 overs
10 minimum/day) are played over a similar timeframe across four days domestically or
11 five days at international level (29, 30).

12

13 The physical demands for cricketers have risen dramatically over the past decade with
14 the introduction of T20 cricket. Orchard et al. (28) state there has been a 35% rise in
15 the number of total matches played by the Australian men’s state and national teams,
16 with the increase being almost entirely attributed to T20 fixtures. Similar trends are
17 noted in the English county leagues where it’s common to see five fixture days a
18 week for first class county players. Not only is the volume of matches high, the
19 fixtures may vary between multi-day matches and more intense T20 or one-day
20 matches. Noakes and Durant, (27) affirm this by highlighting a 280% rise in physical
21 demands on South African Cricket players between 1970 and 1998, due to the
22 increased number of test and one-day internationals during this period. As such, this
23 supports the notion for players to be in the correct physical condition to cope with the
24 volume of matches seen in today’s game.

25

1 Cricket is an endurance sport with intermittent bursts of speed and power (2, 22).
2 When looking at the physical demands, most game changing scenarios have an
3 element of speed or explosive action to it. Such examples include fast bowling, taking
4 a diving catch, sprinting to score runs or stop a boundary, or throwing a ball for a run-
5 out opportunity (12, 22, 26, 32). The literature has noted the importance of these
6 components of fitness justifying the requirements for anaerobic qualities such as
7 lower body power and upper body rotational power (6, 8, 35, 36). What is clear is the
8 variation of positional demands in Cricket, which strength and conditioning (S&C)
9 coaches need to be aware of when planning physical preparation programs (30).

10

11 The requirement for both aerobic and anaerobic qualities would seem important as
12 demonstrated by the fact that fast bowlers can often cover up to 22.6 ± 2.1 km a day
13 during a multi-day match; 13.4 ± 0.7 km in a one-day game and 5.5 ± 0.4 km during a
14 T20 innings (17, 30). From this, 1.1km is characterized as sprinting intensities during
15 a full one-day innings with a vast majority of this either during the bowling action or
16 chasing a ball down when fielding. Fast bowling is the only action where repeated
17 sprinting activities occur (defined as three sprints with < 60 s recovery during
18 matches); therefore, having sufficient anaerobic qualities seems important (26).
19 Furthermore, batsmen require adequate amounts of upper body strength for boundary
20 hitting which has become more important in the modern T20 game, alongside lower
21 body/trunk strength for the transfer of force from distal to proximal points of the body
22 which has been found in rotational power sports (35, 36). It is commonly accepted
23 that speed and power are key attributes of a batsmen for running between the wickets
24 (16), and considering T20 and one-day cricket can be won or lost by fine margins, the
25 necessity of being quick when running between the wickets is paramount (3, 15, 16).

1 The cardiovascular demands of cricket are somewhat modest. Fast bowlers theoretical
2 heart rate (i.e., $220 - \text{age}$) has been reported up to 80.3-84.7% (163 ± 11 to 176 ± 11
3 beats per minute [bpm]) of their maximum (19). Heart rate (HR) in one-day bowling
4 has been reported higher than multi-day matches (78% of age-related maximum one
5 day; 70% of age related maximum multi day). T20 bowling mean HR data has been
6 reported as 133 ± 12 bpm; however, this figure doesn't differentiate the intermittent
7 nature of bowling as well as fielding activities and environmental differences when
8 HR was recorded (cool and warm temperatures) (2, 10, 19). In contrast, mean batting
9 heart rates have been observed between 139 – 167 bpm across T20 and one-day
10 fixtures (7). This perhaps shows that the anaerobic qualities such as strength, power,
11 and speed are critical qualities needed from players. However, the aerobic system's
12 role in these high intensity bouts of exercise will most likely be critical during
13 recovery (38).

14

15 The hectic nature of the in-season period means that there can be as many as 91 days'
16 play for fixtures alongside training 1-3 times/week over a six-month period; thus, it is
17 important that player's physical qualities can match these demands. Consequently, it
18 is essential that during the off-season period, players' fitness is monitored and
19 improved sufficiently, optimizing these physical qualities for the start of the season.
20 Therefore, the aims of this study are to monitor changes in key physical performance
21 indicators of elite cricketers over the off-season period and to provide normative data
22 for a range of physical qualities in elite cricket.

23

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1 **METHODOLOGY**

2 **Experimental Approach to the Problem**

3 This was an observational study, which provided the opportunity to examine elite
4 cricket players; currently little data is available for this population. The study design
5 reported trends in physical fitness testing data during the off-season of elite cricket
6 players. The fitness testing battery was made up of tests which can highlight areas or
7 strength or weakness across all key components of fitness as previously discussed.
8 Testing was completed in week one of the off-season (early November) and retested
9 in week 18 (early March), four weeks before the start of the season. Some of the
10 chosen tests are a requirement as per the guidelines set by the England and Wales
11 Cricket Board (ECB), the national governing body. All physical testing took place in
12 an indoor cricket hall on a synthetic surface and results can be used to guide S&C
13 coaches on expected normative values for an elite cricket sample.

14

15 The ECB have devised a minimum standards grading system for those tests which
16 they deem significant for underpinning physical performance at the highest level of
17 cricket. The grading system is specific to each individual test and implemented on the
18 20m sprint time, the countermovement jump test (CMJ), the yoyo intermittent
19 recovery test (yoyo IRT), and body composition scores. The scale has been devised
20 from fitness testing data captured from England players over previous years, keeping
21 all guidelines specific to elite players within the English cricket system, and act as
22 suitable targets for aspiring county players to aim for. Table 1 shows the guideline
23 used for fitness testing results, for the purpose of this study the guidelines will be used
24 for the 20m sprint, the CMJ and the yoyo IRT with the guide for a 'good' score
25 shown in the results (Table 9) and discussed later.

1

2 *** INSERT TABLE 1 ABOUT HERE ***

3

4 **Subjects**

5 Fourteen elite level cricketers (age: 26.2 ± 5.3 years; height: 180.8 ± 8.5 cm; mass:
6 83.5 ± 6.7 kg) participated in this study. All players were available for selection in the
7 2015 LV County Championship season and were injury free during both rounds of
8 fitness testing taken during week one and week 18. One moderate injury was picked
9 up between the two bouts of testing (resulting in two weeks off training) but the
10 player went through a rehabilitation procedure and was deemed fit for full training
11 participation by the club physiotherapist eight weeks prior to re-testing. Ethical
12 approval was granted from the London Sports Institute ethical committee at
13 Middlesex University, London, UK.

14

15 **Procedures**

16 *Six-Month Training Cycle.* The nature of this study monitoring changes in
17 performance over a six-month period required information outlining how the subjects'
18 training protocols evolved throughout the designated time period. Table 2
19 demonstrates how training was planned throughout the off-season and Table 3
20 portrays an example weekly micro-cycle throughout the anatomical adaptation (AA)
21 phase. Tables 4-6 are example sessions from each phase of training throughout the
22 off-season period, and Tables 7-8 are example cardiovascular and speed sessions from
23 the strength and speed/power phases of the off-season period. Weight room sessions
24 varied depending on the phase of training and proximity to the start of the season, as
25 well as player training age and position. However, two training sessions were

1 typically conducted each week throughout the off-season period. As full-time
2 professionals, all players were instructed to take part throughout the duration of the
3 period, although there were sporadic sessions that some players were unable to attend.
4 As such, there were never more than two training sessions missed by any one player
5 throughout the entire period, with the exception of the previously mentioned injured
6 player who missed a total of four sessions (2x strength sessions, 1x cardiovascular
7 session, 1x speed session).

8

9 *** INSERT TABLES 2-3 ABOUT HERE ***

10

11 *Countermovement Jump (CMJ), Single Leg Countermovement Jump (SLCMJ) and*
12 *Squat Jump (SJ).* Jump height was measured on a jump mat (Kinematic Measurement
13 System Software, Sydney, Australia). Subjects completed familiarization jumps
14 before recording three trials where subject's hands were fixed onto their hips, and the
15 players were asked to maintain hip and knee extension throughout the flight phase of
16 the jump. Any deviation from these instructions resulted in a void trial and the jump
17 was re-taken. During the SLCMJ, subjects were not allowed to use an opposing leg
18 swing and performance was closely monitored. During the squat jump, subjects
19 squatted to a 90° knee angle with hands fixed onto hips where a three-second count
20 was held; from here they then jumped as high as possible. Any further flexion of the
21 hips from the countermovement phase of the jump was closely monitored and trials
22 were retaken if this was observed. Verbal encouragement was provided to all players
23 by instructing them to jump "as explosively as possible". A one-minute recovery time
24 was administered between all jumps with the highest jumps used for data analysis.

25

1 *Drop Jump.* All subjects completed the jump off a standardized 20cm box with hands
2 fixed at the hips. Although all subjects had some experience with the drop jump
3 technique; due to the variance in experience from each height, 20cm was chosen as
4 the procedure height and for this same reason only bilateral trials were taken. A
5 reactive strength index (RSI) score was calculated using the flight time/ground
6 contact time equation, as suggested by Flanagan and Comyns, (11), with the highest
7 RSI value used for data analysis. Players were instructed to “jump as high as possible
8 whilst minimizing ground contact time”.

9

10 *Broad Jump.* Subjects began with the front of their toes in line with the back of a start
11 line where hands were placed on hips to negate any effect of an arm swing. Following
12 a countermovement, the subject then leaped forward as far as possible before landing
13 on both feet, and subjects were asked to ‘stick’ the landing. If there was foot
14 movement from this position the trial was retaken. Measurement was taken from the
15 front of the start line, to the heel of the foot and was taken to the nearest centimeter
16 using a standard measuring tape; no restrictions were given regarding depth of
17 countermovement or body angle. Subjects completed three maximal attempts, and had
18 one-minute recovery between jumps with the furthest jump used for data analysis.

19

20 *Pro Agility Test (5-10-5).* Subjects started straddling an electronic timing gate
21 (Brower Timing Systems, Salt Lake City, Utah, USA). The subject then turned 90° to
22 their right, accelerated out 5m, turned 180° on the turning point and ran back 10m,
23 before turning 180° and sprinting back through the starting timing gate. Subjects were
24 asked to always face one direction when turning (i.e. always face forward when

1 turning), if a subject turned the wrong way the trial was stopped and retaken. Three
2 trials were completed and fastest time was used for data analysis.

3
4 *Sprint Tests.* Subjects were asked to sprint as fast as possible through four sets of
5 timing gates placed on the start line, then one at 5, 10 and 20m. Subjects starting
6 position was 0.5m behind the first set of timing gates and standardized for all.
7 Subjects started in an upright position with one foot in front of the other in which they
8 were free to choose, no body rocking or bouncing was allowed. Three trials were
9 completed for each subject with the fastest time used for data analysis.

10
11 *Yoyo Intermittent Recovery Test (Yoyo IRT).* The protocol as outlined by Krusturp et
12 al. (21) was used for this aerobic test. The test consisted of two 20m runs back and
13 forth between starting, turning, and finishing at the start line with speed controlled by
14 audio beeps on a tape recorder. Between each shuttle the subjects had 10s recovery
15 time slowly jogging between a 10m recovery box but had to be stood still on the start
16 line ready for the next shuttle. Each player had one warning, if they did not reach the
17 corresponding line before the beep, or started a shuttle early before the beep. The
18 second time this happened resulted in the previous shuttle's level being recorded for
19 that player's score. The tests consisted of four running bouts at 10-13km.h then
20 another seven runs at 13.5-14km.h. Thereafter, levels go up in increments of 0.5km.h
21 after every eight running bouts. The test was marked out using cones with a 1m width
22 for each player.

23

24 *** INSERT TABLES 4-6 ABOUT HERE ***

25

1 **Statistical Analysis**

2 Firstly, the data was examined using Microsoft Excel (Microsoft, Redmond, WA) and
3 then evaluated using SPSS Version 21 (IBM SPSS Inc., Chicago, IL). All data were
4 presented as mean scores \pm one standard deviation (SD). Normality was checked
5 using the Shapiro-Wilk method and intraclass correlation coefficients (ICC) and the
6 coefficient of variation (CV) were used to calculate the relative and absolute
7 reliability respectively between trials for all tests. A paired samples *t*-test was used to
8 identify differences between the fitness testing scores at the start and end of the off-
9 season period, with statistical significance set at $p < 0.05$. Cohen's *d* effect sizes (ES)
10 were calculated for changes in performance and results were interpreted in line with
11 suggestions by Hopkins (14) (trivial = < 0.2 , small = $0.2-0.59$, moderate = $0.60-1.19$,
12 large = $1.2-1.99$, and very large = ≥ 2).

13

14 *** INSERT TABLES 7-8 ABOUT HERE ***

15

16 **RESULTS**

17 All data was deemed to be normally distributed ($p > 0.05$) and CV and ICC's
18 demonstrated a strong or acceptable level of reliability (Table 9). Following the six-
19 month off-season training period, significant differences were noted for all
20 performance tests ($p < 0.05$) with the exception of the pro-agility test ($p = 0.076$).
21 Effect sizes were calculated and ranged from 0.26 (small) for the pro agility test to 2.8
22 (very large) for the 5m sprint.

23

24 *** INSERT TABLE 9 ABOUT HERE ***

25

1 **DISCUSSION**

2 The purpose of this study was to report changes in physical fitness scores for
3 professional cricketers throughout a six-month off season period. There were a range
4 of physical tests undertaken with the present sample and significant improvements in
5 performance were noted in all tests, with the exception of the pro-agility test. Despite
6 its lack of significance, mean squad times for the pro-agility did still improve but
7 demonstrated an ES of 0.26, regarded as a small change. A potential reason for this
8 was due to the training schedule during the off-season (see Table 3). The main focus
9 throughout the off-season was strength development and linear speed/acceleration.
10 Although acceleration is a key physical quality needed for change of direction speed,
11 there wasn't a specific turning component focus within the training schedule. It is
12 plausible that by the notion of specificity, had this been integrated into the micro-
13 cycles at different points, pro-agility performance may have improved further.

14

15 The unique nature of a cricket off-season is such that there is ample time to plan and
16 devise individualized programs to improve the desired physical qualities for
17 performance. The 6-month period allows for a structured block-periodized approach
18 to programming and is a key factor when discussing the results from this study. It is
19 known that strength and power are physical qualities that underpin speed (1, 4) and
20 these qualities were targeted throughout the programming to support this theory for
21 speed development (see Table 8 for example sessions). As mentioned previously,
22 speed is a key performance indicator in cricket whether it's for scoring runs as a
23 batsman by running between the wickets or when fielding to restrict run scoring
24 opportunities and aid in possible run out opportunities (3, 23). The mean sprint
25 distances noted in cricket (17m) stress the importance of acceleration; therefore, the

1 ability to increase velocity in the early acceleration phase to overcome inertia is
2 considered essential (4, 30). Thus, during the off-season period, training was focused
3 around longer stretch shortening cycle (SSC) ground contact times (GCT) and
4 forceful concentric hip extension movements to facilitate the development of this
5 speed quality (9, 34) (see Tables 4-6). Although there were improvements in
6 performance of all speed and lower body power qualities, the speed test with the
7 greatest improvement was the 5m sprint test (ES = 2.8), which demonstrated a very
8 large change. This may be explained by the gym-based programming, which again
9 had a focus on concentric hip extension and longer GCT. Furthermore,
10 acceleration/linear sprinting (< 20 m) and derivative drills were a main focus for
11 conditioning sessions (see Table 8), previously reported to be important for Cricket
12 (9, 24, 34).

13

14 The standing broad jump (BJ) showed the biggest improvements in the lower body
15 strength and power tests (ES = 2.33), unsurprisingly perhaps, due to the emphasis on
16 horizontal force production in the training program. As well as this, the BJ test was a
17 relatively novel test for the group of players used in this study so there may have been
18 improvement merely due to specificity of integrating derivatives of longer GCT
19 horizontal force production movements into their training program. This may explain
20 why the BJ showed greater improvements than the CMJ, SLCMJ and SJ as these tests
21 have a vertical force production bias (25). Another potential reason for the large
22 improvement may be the fact that the baseline scores were somewhat modest within
23 the group. This is unsurprising as it was a novel test to the players so improvement
24 was likely, although novelty alone wouldn't explain the large effect size, a
25 combination of familiarity through training specificity and training methods most

1 likely the reason for the improvements seen. The rationale behind the acceleration
2 focus may also highlight why the effect size for the pro agility test was small (ES =
3 0.26). Although there is an acceleration emphasis in the pro agility test, it relies
4 heavily on sound change of direction and deceleration mechanics, as well as more
5 reactive GCT (33). Although there were elements of change of direction and reactive
6 conditioning during the off-season, the dose was noticeably less than that of linear
7 movement and perhaps coincides with results from the RSI testing (ES = 0.83) which
8 is also heavily linked to change of direction ability (20, 33).

9

10 When looking at the results compared to the ECB minimum standards guidelines for a
11 'good' score, the improvements move the collective group closer to the desired level
12 for the international standard of the game. Although the standards aren't used on all
13 tests in this study, they are implemented on tests of holistic athletic performance
14 (CMJ, 20m Sprint and yoyo IRT) and give players and coaches a good indication
15 where player strengths and weaknesses are. Therefore, having these cricket specific
16 guidelines are beneficial for county players aspiring to play at the highest standard
17 possible. The CMJ results show that the group average scores have improved moving
18 from 'average' to 'good', the same can be seen for the speed scores while the yoyo
19 IRT scores have moved between 'average' and 'good' (see Tables 1 and 9). These
20 results show an effective improvement towards the elite standards of international
21 cricket, giving context to the relevance of the scores. In addition, these targets also
22 allow for future targets to be set so players can push to achieve what would be
23 deemed excellent scores for an elite cricketer. Although these tests do not directly link
24 to on-field performance, those players who have higher physical capabilities, and
25 those which are closer to international player standards, stand a better chance of

1 success from an athletic performance stance than those who score lower. Therefore, it
2 is clear that county cricketers should aim to score within the ‘good’ category or
3 above. Although there is limited research pertaining to how enhanced athletic
4 performance impacts Cricket, Gabbett et al. (13) noted a trend for greater on-field
5 performance in professional rugby league players to be associated with better lower
6 body power/speed scores. Further research could look at similar longitudinal studies
7 to find associations between physical fitness and on-field performance in cricket.

8

9 Results from this study were similar to those presented by Carr et al. (5), in elite
10 cricketers. Subjects undertook testing at the start and end of the off-season as well as
11 during the season. Results specifically looking at the off-season (20 weeks) showed
12 significant improvements in lower body power and strength (measured using a CMJ
13 test and 1-3 RM tests) but not in 20 m sprint times. However, during the in-season
14 and post-season testing scores there were significant improvements in speed. The
15 procedure states that small volumes of speed technique training were incorporated
16 into skill-based warm ups (5), yet specific high intensity speed sessions are not
17 mentioned. As maximal sprinting is a physical skill, improvements are less likely to
18 be seen without regular practice. The in-season improvements in speed come as no
19 surprise due to the natural doses of sprinting completed during training and games.

20

21 With the intense in-season fixture list it is also important that these physical qualities
22 are maintained throughout this period, as key fixtures in competitions occur later in
23 the season so physical performance during this time will be important for winning
24 teams. Research has shown the importance of in-season resistance training for the
25 maintenance of these qualities (37) and this study adds to that. Thomas et al. (37)

1 noted improvements in both change of direction performance and strength
2 characteristics during the course of the season in Lacrosse players. The study aimed to
3 examine physical performance changes over a 24-week competitive season of 11
4 national lacrosse players following a periodized resistance training program
5 consisting of two-three resistance sessions and one-two conditioning sessions per
6 week. Significant changes were seen in sprint and change of direction performance;
7 thus, highlighting how physical qualities can improve or at least be maintained in-
8 season with a periodized resistance training plan. It has been reported that a reduction
9 in volume whilst maintaining 80-85% 1RM is optimal for strength maintenance, when
10 completing eight sets per muscle group, twice a week (31). However, it is important
11 to note in this study that as many as three resistance sessions and two conditioning
12 sessions were completed per week in-season. This is because competitive lacrosse
13 matches were played only once a week with more of a traditional training plan
14 followed for the remainder of the week. During a cricket season this may not be
15 feasible and would need to be taken onto account when planning for maintenance of
16 physical qualities.

17

18 The growing playing demands for international cricketers playing globally means that
19 to play at the very top of the sport includes a 12 month playing season travelling from
20 one continent to another. This adds to the growing demands when developing athletic
21 qualities needed to play at the highest level as there is little time to structure a
22 periodized off-season to enhance this. This limitation makes it increasingly difficult
23 for players to get the volume of training needed to improve athletic performance and
24 something that further research should look to address. An English county season has
25 similar difficulties for maintenance of physical qualities. As well as this, minimizing

1 the inevitable drop-off in performance between the end of the season and the start of
2 the following off-season, which is typically 4-6 weeks (albeit at the discretion of
3 individual county teams) can be challenging. A limitation to this study was the
4 number of participants used for statistical analysis ($n = 14$). Due to the nature of
5 cricket, where players can choose to play in the southern hemisphere during the
6 English off-season, the squad size was reduced as is what's common to see. With that
7 in mind, statistical significance from the results should be viewed with some caution,
8 although the nature of the sport dictates the number of participants that can be used in
9 studies (i.e. the small number of teams within the professional game). Further
10 research could look at the changes during an off-season across a number of county
11 teams to increase the sample size, although as natural in professional sport, sharing of
12 results between competing teams is unlikely. Another limitation to the study is the
13 lack of a control group to compare with. The addition of a control group would
14 precisely show if the details of the training program itself are the cause for changes in
15 physical performance or if merely the participation of generic training methods would
16 adhere similar results. However, the nature of professional sport simply doesn't allow
17 for a coach to actively seek to benefit some players more than others when the end
18 goal is optimal performance from each individual within a team.

19

20 **PRACTICAL APPLICATIONS**

21 The challenging fixture schedule and physical demands required to be successful in
22 T20 and one-day cricket have increased the need for athleticism in modern day elite
23 county cricket compared to more traditional style of play seen a decade ago. With
24 most game-changing situations requiring a level or combination of speed, power, and
25 agility; it is essential for players to be in the best physical condition for the start of the

1 season. It is important to note the importance of a continual S&C program running
2 through the competitive season to maintain and improve on these physical qualities to
3 ensure optimal performance in game-changing situations. S&C coaches should focus
4 on improving players' speed, with a focus on longer SSC actions to improve the
5 acceleration phase of the sprint with explosive strength and power qualities also being
6 fundamental. Turning ability is also critical for batting and fielding performance, and
7 technique should be practiced during the off-season to enhance this skill.
8 Consequently, S&C coaches can use this program as a guide on how to periodize their
9 training schedule during the off-season for elite cricket athletes. Further research
10 should look to replicate a similar study design with a larger sample size (where
11 possible), as well as looking at an in-season period of a county cricket season to
12 reveal how to maintain or improve associated athletic qualities for Cricket.

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1 Table 1: Guidelines for ECB minimum standard scores of fitness testing results

Guidelines		20m Sprint (s)	CMJ (cm)	Yoyo IRT (level)
10	Excellent	Sub 2.80	≥ 55	≥ 21
9	Excellent	Sub 2.85	≥ 50	≥20.3
8	Good	Sub 2.95	≥ 45	≥19.5
7	Good	Sub 3.00	≥ 40	≥18.7
6	Average	Sub 3.05	≥ 38	≥18.4
5	Average	Sub 3.10	≥ 36	≥17.7
4	Poor	Sub 3.15	≥ 35	≥17.4
3	Poor	Sub 3.20	≥ 34	≥17.1
2	Poor	Sub 3.25	≥ 33	≥16.6
1	Poor	Sub 3.30	< 32	<16.3

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1 Table 2: A 6-month macro-cycle for the elite cricketer during the off-season

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Phase	Rest	AA		Str		Max Str / Pwr / Spd	
Intensity		70-80% 1RM		80-90% 1RM		Dependent on Exercise Choice	
AA = Anatomical Adaptation; Str = Strength; Pwr = Power; Spd = Speed Green block represents rest periods for the players Yellow block represents the start of the season							

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4 Table 3: Typical meso-cycle during the anatomical adaptation phase during the off-
5 season

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
AM	Rest	Str/AA	CV	Str/AA	Fitness Skills	Rest	Rest
PM		Speed/Pwr	Skills/ Fielding	Speed/Pwr	Rest		
CV = Cardiovascular training							

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1 Table 4: Example weight room sessions from the anatomical adaptation phase (Weeks
2 1-6)

Session 1: 3 x 10-12 @ 70-80% 1RM 1-1.5 mins rest between sets	Session 2: 3 x 10-12 @ 70-80% 1RM 1-1.5 mins rest between sets
Box Step Ups Single Arm DB Overhead Press Single Arm DB Row Core Exercise	Tempo Back Squats Landmine Press Weighted Chin Ups Core Exercise

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5 Table 5: Example weight room sessions from the strength phase (Weeks 9-16)

Session 1: 3/4 x 4-6 @ 80-90% 1RM 3 minutes rest between sets	Session 2: 3/4 x 4-6 @ 80-90% 1RM 3 minutes rest between sets
Box Squat Plyometric Box Exercise Barbell Bent over Row Abdominal Body Saws	Trap Bar Deadlift Single Arm KB TRX Row Single Leg Isometric Glute/Ham Holds Rotational Wall Ball Slams

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8 Table 6: Example weight room sessions from the max strength and power/speed
9 phase (Weeks 17-23)

Session 1 4 mins rest between sets	Session 2 4 mins rest between sets
Block Clean Pull – 4 x 3 @ 80% 1RM Drop Jumps – 4 x 3 (30cm box) Rotational Med Ball Toss – 4 x 4 each side (M/B 10% B-W) Band Resisted Trap Bar Deadlift – 3 x 6 @ 55% 1RM ('Light' resistance bands)	Hang Clean – 4 x 3 @ 75-80% 1RM Broad Jumps – 4 x 3 Med Ball Overhead Toss – 4 x 4 (M/B 10% B-W) Back Squat – 3 x 3 @ 90% 1RM Box Jump – 3 x 5 @ 100%

1 Table 7: Example maximum aerobic speed (MAS) program completed during a
2 cardiovascular session

3 Week four of off-season (Dec) Week 15 of off-season (Feb)

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MAS 30:30 @ 105%	MAS 15:15 @ 115%
Distances individualized and set based off most recent yoyo level.	Distances individualized and set based off most recent yoyo level.
RAMP style warm up leading into four desired session intensity shuttles	RAMP style warm up leading into four desired session intensity shuttles
2 x 8 mins, 2 mins recovery	2 x 8 mins, 3 mins recovery

1 Table 8: Example speed development sessions (completed 2 x per week)

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Option A (AA Phase)	Sets/Reps/Rest	Option B (Pwr,Spd Phase)	Sets/Reps/Rest
RAMP style warm up including running mechanic exercises: A skips, High knee skips, split squat jumps, scissor jumps,	20-30 minutes	RAMP style warm up including running mechanic exercises: B skips, wall drills, dynamic singles and doubles, half kneeling starts.	20-30 minutes
Stick running variations Fall forward starts Band resisted walks/marching	2-4 sets, 2-5 reps, 3 mins recovery between sets	Fall forward starts Resist and release 10m Resisted 10m	1-3 sets 2-3 reps, 3 mins recovery between sets
Falling 10m Falling 20m Falling 30m	3 x 2 reps (60m) 2 x 2 reps (80m) 2 x 2 reps (120m) 3-5 mins recovery between sets total distance 260m	Sled tows with 10% body weight attached Unresisted 20m sprints Repeat x2 (Modified from West et al. (39))	3 x 20m, 3 mins recovery between efforts 8 mins active recovery, light jogging and dynamic stretches 3 x 20m, 3 mins recovery between efforts

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1 Table 9: Mean and standard deviations for all physical testing scores at the start and
 2 end of the off-season (November – April)

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Physical Test	Start of off-season (SD)	End of off-season (SD)	ICC	CV (%)	Effect Size	ECB minimum standards guideline for 'good' score
CMJ (m)	0.37 (0.04)	0.40 (0.04) **	0.798	4.09	0.75	≥ 40
SLCMJ_D (m)	0.20 (0.04)	0.22 (0.04) *	0.811	7.90	0.5	N/A
SLCMJ_ND (m)	0.19 (0.03)	0.21 (0.03) *	0.778	5.76	0.67	N/A
SJ (m)	0.34 (0.04)	0.38 (0.04) **	0.801	4.49	1.0	N/A
BJ (m)	1.92 (0.24)	2.42 (0.19) **	0.898	4.53	2.33	N/A
RSI	2.51 (0.43)	2.87 (0.44) **	0.792	8.50	0.83	N/A
Pro Agility (s)	4.75 (0.18)	4.70 (0.21)	0.852	1.35	0.26	N/A
5m (s)	1.08 (0.06)	0.94 (0.04) **	0.788	4.01	2.8	N/A
10m (s)	1.83 (0.06)	1.68 (0.06) **	0.814	2.67	2.5	N/A
20m (s)	3.12 (0.08)	2.96 (0.11) **	0.843	2.04	1.68	Sub 3.00
Yoyo (level)	17.35 (1.31)	18.59 (1.40) **	-	-	0.92	18.7
* Denotes significance at $p < 0.05$						
** Denotes significance at $p < 0.01$						

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