Abstract

This study compared physiological, physical and technical demands of Battlezone, traditional cricket training and One-Day matches. Data was initially collected from 11 amateur, male cricket players (age: 22.2 ± 3.3 yr, height: 1.82 ± 0.06 m, body mass: 80.4 ± 9.8 kg) during four Battlezone and four traditional cricket training sessions encompassing different playing positions. Heart rate, blood lactate concentration, rating of perceived exertion and movement patterns of players were measured. Retrospective video analysis was performed to code for technical outcomes. Similar data was collected from 42 amateur, male cricket players (23.5 ± 4.7 yr, 1.81 ± 0.07 m, 81.4 ± 11.4 kg) during One-Day matches. Significant differences were found between Battlezone, traditional cricket training and One-Day matches within each playing position. Specifically, Battlezone invoked the greatest physiological and physical demands from batsmen in comparison to traditional cricket training and One-Day matches. However, the greatest technical demand for batsmen was observed during traditional cricket training. In regards to the other playing positions, a greater physiological, physical and technical demand was observed during Battlezone and traditional training than during One-Day matches. These results suggest the use of Battlezone and traditional cricket training provides players with a suitable training stimulus for replicating the physiological, physical and technical demands of One-Day cricket.

Introduction

Principles of training specificity suggest that training demands should replicate match requirements to ensure optimal adaptation (Reilly, Morris & Whyte, 2009). Further to this, a progressive training stress must be applied to achieve a continued adaptation and improvement in sports performance (Gamble, 2009). To assist with training load prescription, improvements in technology have allowed for the comparison of movement and physiological demands between training and match-play in an array of sports (Dawson, Hopkinson, Appleby, Stewart & Roberts, 2004; Gabbett, Jenkins & Abernethy, 2012; Hartwig, Naughton & Searl, 2011; Spencer et al., 2004). Only recently has the measurement of movement demands been applied to cricket (Petersen, Pyne, Dawson, Portus & Kellett, 2010; Petersen, Pyne, Portus & Dawson, 2011b) and as such, little information exists detailing comparative training and match demands of cricket players. Traditionally, the majority of cricket training has relied upon net-based activities rather than game simulation (Pyke & Davis, 2010). Recently, small-sided game training sessions, referred to as Battlezone; have been suggested as an alternative to net-based training (Renshaw, Chappell, Fitzgerald, Davison & McFadyen, 2010). However, it is unknown if either training method replicates the movement or physiological demands of matches.

Only Petersen, Pyne, Dawson, Kellet and Portus (2011a) have examined the demands of a typical cricket training session. Training sessions were classified as either game simulations or skills sessions, which included net-based training and fielding drills. As stated by Petersen et al. (2011a) game simulations allowed players to practice during simulated match conditions, whereas skill sessions were designed to practice isolated technical skills (e.g. net bowling, net batting, boundary fielding). Interestingly, similar relative distances and mean and peak heart rates were reported between the two types of training methods, despite the differences in duration and aim of the sessions. However, Petersen et al. (2011a) also demonstrated that in

comparison to matches, the physiological demands of players were typically lower when performing game simulations and skill sessions. Unfortunately, no comparison of the technical characteristics between respective versions of cricket training was performed.

Although typically focusing on football-based team sports, past research has suggested that the use of small-sided games allows players to simultaneously develop decision-making and technical ability, along with metabolic conditioning, whilst simulating match conditions (Dellal et al., 2008; Gabbett, 2006; Gamble, 2004). In the game of cricket, despite a prolonged physical demand, a greater emphasis is placed on developing technical proficiency whereas small-sided games (or Battlezone) are used as a form of match-specific training (Renshaw et al., 2010). Initial research suggests that the physical and physiological demands of this training method may be similar to that experienced during a typical cricket match (Vickery, Dascombe, Duffield, Kellett & Portus, 2013). However, it is unclear if Battlezone provides cricket players with a greater physical, physiological or technical load in comparison to a more traditional net-based cricket training session. Furthermore, it remains unknown if this load resembles that of a typical cricket match. As such, the purpose of this study was to compare the physiological responses, physical and technical demands between generic Battlezone sessions, traditional net-based training sessions and competitive One-Day cricket matches within amateur cricket players.

Methods

Participants

Initially, 11 male, amateur cricket players (age: 22.2 ± 3.3 yr, height: 1.82 ± 0.06 m, body mass: 80.4 ± 9.8 kg) volunteered to complete four repeat Battlezone and traditional cricket training sessions. Following this, 42 male, amateur cricket players (age: 23.5 ± 4.7 yr, height: 1.81 ± 0.07 m, body mass: 81.4 ± 11.4 kg) including the training subsample listed above (n=11), volunteered to participate in the one-day match analysis only. Participants were first grade players in a district standard cricket competition and performed two cricket-specific training sessions per week. Each player provided verbal and written informed consent after the study was approved by the University of Newcastle Human Research Ethics Committee.

Procedures

The cohort of 11 participants completed a total of four Battlezone sessions and four traditional cricket-training sessions during the late pre-season period, with at least 48 h recovery between sessions. Prior to each training session, participants completed a standardised 15 min warm-up, which included low-intensity running, dynamic stretches and cricket skill-based exercises. A Battlezone scenario similar to that as used in Vickery et al. (2013) was used during all Battlezone sessions. Each Battlezone session consisted of six repeat bouts of 6-overs on a cricket pitch surrounded by a 0.8 m high cricket net on the 30 yd (27.4 m) inner circle of a standard cricket field. One bout of Battlezone required two bowlers to complete three alternating overs to a batting pair, with the remaining participants placed at specific positions on the Battlezone field (Vickery et al., 2013). All participants performed as they would during a typical one-day cricket match, with normal cricket rules and regulations (International Cricket Council, 2009) being applied to each session. However, due to time constraints each bout consisted of 6-overs (36 overs in total)

98 rather than previously used 8-overs (Vickery et al., 2013) and each respective bout
99 lasted 14 ± 3 min.
100
101 The traditional cricket training sessions were separated into two parts: net session
102 and fielding drills. The net sessions consisted of two batsmen batting for 15 ± 1 min
103 in separate nets whilst a total of 6 bowlers (3 in each net) bowled continuously during
104 the 15 min bout. All players were instructed to bat or bowl, respectively, as they
105 would in a typical cricket match and this procedure was followed until each
106 participant had completed a batting bout. During each bout those participants not
107 required to bat or bowl rested outside the playing area. To ensure consistency
108 between each training session and the different training modalities, the same batting
109 and bowling order was used during each training session. Upon completion of the net
110 session all participants completed fielding drills (21 ± 3 min), which included low and
111 high catching drills, and in-field and boundary ground fielding drills.
112
113 Data collected during both the Battlezone and the traditional cricket training sessions
114 were compared to 50-over (n=10) One-Day cricket matches. The rules and
115 regulations of these One-Day matches followed those as outlined by the International
116 Cricket Council (2009). The duration of each match was categorised by playing
117 position: batsmen: 52 ± 22 min, medium-fast bowlers: 173 ± 40 min, spin-bowlers:
118 175 ± 36 min, fielders: 155 ± 38 min, and wicketkeepers: 176 ± 32 min.
119
120 *Physiological Measures*
121 A Polar Team^2 System (Polar Electro Oy, Kemple, Finland) continuously measured
122 (at 5 second intervals) heart rate throughout each training session and match. Each
123 individual's maximum heart rate (HR_{max}) was determined from the HR_{max} achieved
124 prior to exhaustion from the performance of a Yo-Yo Intermittent Recovery Test Level
125 1 that was completed prior to the commencement of testing sessions. Two heart rate

zones were used to classify intensity: ≤75%$HR_{max}$and >75%HR_{max} : The time spent (absolute and percentage of total time) within each of the heart rate zones during each training session and match was calculated using Logan Plus 4.6 software (Catapult Innovations, Melbourne, Australia).

Capillary blood samples (5 μl) were obtained from a hyperaemic earlobe of each batsmen and bowler within three minutes of leaving the playing area after a 6-over or 15 min net session bout. Samples were immediately analysed for blood lactate (Lactate Scout, EKF Diagnostics, Magdeburg, Germany). The blood lactate concentration ([BLa^-]) of players was not measured during a cricket match due to limited access to players. Following each Battlezone and traditional cricket training session, as well as upon completion of each innings of each match; batsmen and bowlers provided a rating of perceived exertion (RPE) using the category-ratio 10 (CR-10) RPE scale (Borg, Hassmen & Lagerström, 1987). Training load (TL) was then calculated by multiplying each player's RPE by the duration (min) of each training session or match (Foster et al., 1995).

Time-Motion Characteristics

The movement patterns of each player during all training sessions and matches were recorded via MinimaxX global positioning system (GPS) devices (v6.65, Catapult Innovations, Melbourne, Australia) sampling at a frequency of 10 Hz. Each GPS unit was situated between the shoulder blades of each participant using a specially designed harness (GPSports, Canberra, Australia). As instructed by the manufacturer, each GPS unit was turned on 15 min prior to player's entering the playing area to ensure a satellite lock was established. The following speed zones were used as categories for further analyses: low-intensity activity (0-3.50 $m \cdot s^{-1}$) and high-intensity activity (≥3.51 $m \cdot s^{-1}$). Further to this, work-to-recovery ratio was defined as the ratio of time spent completing high- (to low-intensity) activity (Petersen et al.,

2010). Data was downloaded to determine movement characteristics of each participant following each session and match using Logan Plus 4.6 software (Catapult Innovations, Melbourne, Australia). Data was then reported as per hour to standardise between sessions of different durations (Petersen et al., 2010). To ensure consistency between training sessions and match play the starting point of each bout was classified as the initial increase in velocity of the bowler delivering the initial delivery, and was completed when no increase in velocity was observed following the final delivery/dismissal using Logan Plus 4.6 software (Catapult Innovations, Melbourne, Australia).

Technical Skills

Each Battlezone and traditional cricket training session was filmed using two fixed video cameras (HDV 1080i/mini DV Handycam, Sony, Japan) which were time aligned for analysis. One was positioned on the cricket pitch behind the stumps at the end each ball was delivered from. The second was placed perpendicular to the pitch outside the Battlezone playing area at a distance which enabled the entire playing area to be in view of the camera. During match-play only one camera, placed perpendicular to the pitch outside the playing area was used. The use of only one camera is acknowledged as a limitation in the accuracy of coding some of the technical outcomes, particularly the batsmen.

The video was retrospectively analysed after each training session and match to examine the technical characteristics of each playing position. Specifically, the number of deliveries faced and hit by batsmen were tallied, along with the number of times dismissed and chances provided. During Battlezone and One-Day matches chances were defined as a missed opportunity for dismissing a batsman by an opposing player. This was either a dropped catch or a missed stumping/run-out. As no fielders were present during traditional cricket training only dropped catches from

bowlers (with no assistance from the surrounding nets) and edges hit directly behind the batsmen were considered a chance. Batting performance was assessed by classifying bat-ball contact as “good’, “bad” or “no” contact, with “no” being separated into “dot balls” and “play/miss” (Houghton, Dawson & Rubenson, 2011; Muller & Abernethy, 2008). The number of balls bowled by fast- and spin-bowlers was also recorded. Further to this, the number of throws completed by each player when fielding was counted.

Statistical Analysis

All data were reported as mean ± standard deviation (SD). As not all players were involved in each 6-over bout or 15 min net session, any data recorded whilst a player was not directly involved in each bout was not included in analyses. Data recorded during breaks in play during a match (e.g. drinks break) were also not considered for analysis. Effect sizes (Cohen’s *d*) (Cohen, 1988) (small= 0.2-0.49, moderate= 0.5-0.79, large= >0.8) were used to quantify the magnitude of difference of the physiological, physical and technical measures within each playing format between the different formats. Confidence intervals (90%) for the (true) mean changes or between-group differences in the playing format were estimated (Hopkins, Marshall, Batterham & Hanin, 2009a). As in Buchheit, Bishop, Haydar, Nakamura and Ahmaidi (2010) quantitative chances of higher or lower values were assessed qualitatively using the following criteria: <1%, almost certainly not; 1-5%, very unlikely; 5-25%, unlikely; 25-75%, possible; 75-85%, likely; 95-99%, very likely; >99%, almost certain. Additionally, if the chance of having both higher and lower values were both >5%, the true difference was deemed to be unclear (Hopkins, Marshall, Batterham & Hanin, 2009b).

Results

Batsmen

A greater peak %HR_{max} was achieved during One-Day matches compared to Battlezone (*d*= 1.28) and traditional cricket training (*d*= 2.62) with a greater peak %HR_{max} rated as 'likely' and 'almost certain', respectively. Similarly, the greatest mean heart rate (HR_{mean}) resulted from Battlezone (Table 1) compared to traditional cricket training (*d*= -1.00) and One-Day matches (*d*= -0.61) which reflected a greater percentage of time spent above 75%HR_{max} (Table 1). There was also a large effect for greater [BLa^-] (*d*= -1.14) during Battlezone training than traditional cricket training, with chances of this being higher considered 'almost certain' (Table 1). Greater RPE and TL measures were reported following Battlezone compared to traditional (*d*= -0.63 and -0.31) cricket training and One-Day matches (*d*= -0.58 and 7.15) (Table 1).

Total distance covered and distance within each movement zone were 'almost certainly' greatest during Battlezone compared to traditional cricket training and One-Day matches (Table 2). Further, relative measures of distances covered ($m \cdot h^{-1}$) were greater between One-Day matches than traditional cricket training, with each measure of distance rated as 'almost certainly' higher during One-Day matches. As such, mean speed was highest during Battlezone (Table 2), which was rated 'almost certainly' higher than traditional cricket training (*d*= -2.69) and One-Day matches (d=-1.24). Large effects were 'almost certainly' greatest during Battlezone in the number of high-intensity efforts and sprints each hour combined with a shorter work-to-recovery ratio, compared to traditional cricket training and One-Day matches (Table 3). Finally, the greatest technical demand for batsmen occurred during traditional cricket training (Table 4), which exceeded that reported for Battlezone and One-Day matches across all technical measures, with chances a greater relative volume of balls were faced and hit by batsmen during traditional cricket training were 100%.

Medium-Fast Bowlers

The lowest peak %HR_{max} occurred during traditional cricket training (Table 1) with a large effect for greater peak %HR_{max} during Battlezone (*d*= -0.99) and One-Day matches (*d*= 1.69). Mean heart rate was greater during Battlezone compared to traditional cricket training (*d*= -1.04) and One-Day matches (*d*=-2.01). A moderate effect existed for time spent within the respective heart rate zones (Table 1), although it was considered 'unclear' as to the true values of these measures. Blood lactate concentration was slightly higher during Battlezone than traditional cricket training (*d*= -0.56) and the difference between formats was rated as 'very likely'. Greater measures of RPE and TL resulted from One-Day matches when compared to Battlezone and traditional cricket training respectively (Table 1).

Similar total relative distances within each movement category were reported between Battlezone and traditional cricket training (Table 2) with most measures reporting a 'possible' difference that true mean was greatest during Battlezone. However, both training formats required greater relative distances within each movement category than One-Day matches (Table 2). Specifically, chances that a greater relative total distance and at a high-intensity was covered was rated as 'almost certain'. Battlezone demonstrated the fastest mean speed when compared to traditional cricket training (*d*=-0.37) and One-Day matches (*d*= --1.01). Similar movement characteristics were completed during Battlezone and traditional cricket training (Table 3)with comparisons between the number of sprints completed per hour and work-to-recovery ratio considered as 'unclear' . Despite comparisons between the relative number of high-intensity activities performed considered unclear, fewer high-intensity activities were performed during One-Day matches (Table 3) than Battlezone (*d*= 2.57) and traditional cricket training (*d*= 2.61), respectively. Differences in the total number of balls bowled during One-Day matches was rated as 'almost certain', thus implying the greatest number of deliveries

completed was during One-Day matches (Table 5). However, when expressed relative to time ($m \cdot h^{-1}$), a large effect for a greater number of balls delivered during traditional cricket training than Battlezone (*d*= 0.99) and One-Day matches (*d*= -5.08) was evident, with this difference considered 'almost certain'.

Spin Bowlers

All differences between the respective formats for physiological and perceptual measures were rated as 'unclear', although this may be due to the small sample of spin bowlers used within the study. Nevertheless, peak $\%HR_{max}$ during One-Day were higher matches than Battlezone and traditional cricket training (Table 1). The lowest HR_{mean} was reported during One-Day matches (Table 1) with a large effect reported when compared to Battlezone (*d*= -1.51) and traditional cricket training (*d*= -1.39). A slightly greater percentage of time was spent above 75%HRmax during traditional cricket training opposed to Battlezone (*d*= -0.21) and One-Day matches (*d*= 0.28). There was a moderate effect (*d*= -0.56) for a greater [BLa^-] in Battlezone than traditional cricket training. Greater RPE and TL measures, were reported following traditional cricket training (Table 1), compared to Battlezone and One-Day matches.

Differences in the relative distance (total, low-intensity, high-intensity) covered by spin bowlers during Battlezone and traditional cricket training was rated 'unclear', indicating similar relative distances were covered. In particular, a small (*d*= 0.37) and moderate (*d*= 0.51) effect existed for relative total distance and low-intensity distance completed between Battlezone and traditional cricket training. A rating of 'almost certain' was reported when comparing both training formats to One-Day matches, with a large effect reported for both Battlezone (*d*= -2.21) and traditional cricket training (*d*= -2.54). The greatest mean speed with a rating of 'almost certain' for the true value of the mean, was reported during traditional cricket training (Table 2),

compared to Battlezone (*d*= -2.18) and One-Day matches (*d*= -2.50) . Differences between the formats were considered 'unclear' for the majority of measures although, a large effect with a rating of 'almost certain' for a greater number of high-intensity activities performed during traditional cricket training existed when compared to Battlezone (*d*= 2.14). The longest work-to-recovery ratio occurred during traditional cricket training (Table 3), which was slightly increased compared to Battlezone and One-Day matches. A greater relative number of balls were bowled during Battlezone (*d*= -1.02) and traditional cricket training (*d*= -3.12) when compared to One-Day matches.

Fielders

Chances that the percentage of peak HR_{max} was greatest during One-Day matches when compared against Battlezone (*d*= 1.21) and traditional cricket training (*d*= 1.29) were considered 100% (Table 1). As indicated by the rating of 'likely' between the training formats, similar HR_{mean} values were reported during Battlezone and traditional cricket training with a moderate effect reported (*d*= -0.47).. Little difference existed between Battlezone and traditional cricket training in the amount of time spent in respective heart rate zones (Table 1), given the rating of 'possible' between the two formats. A moderate effect existed for each heart rate zone (≤75%HR_{max} and >75%HR_{max}) during Battlezone and traditional cricket training when compared to One-Day matches (Table 1).

The 'unclear' rating for total relative distance and distance covered at a high-intensity between Battlezone and traditional cricket training suggest no differences between respective formats (*d*= -0.10 and -0.08, respectively). In comparison however to One-Day matches, the differences in the true mean were considered 'almost certain' for relative total distance and low-intensity distance covered during Battlezone compared to….???. A moderate effect existed for these respective measures between Battlezone and One-Day matches (Table 2). No difference in mean speed was

reported between Battlezone and traditional cricket training (rated as 'unclear') however, a moderate effect existed when both training modes (Table 2) were compared to One-Day matches. It was considered 'almost certain' that a greater number of high-intensity activities were performed during Battlezone and traditional cricket training than One-Day matches (Table 3). Opposing this, an 'unclear' rating suggested a similar number of high-intensity activities were performed during Battlezone and traditional cricket training. Fewer throws, both overall and relative to time, were required during Battlezone and One-Day matches than traditional cricket training (Table 5).

Wicketkeepers

The small number of wicketkeepers may have influenced the chances of the true mean of heart rate measures reporting as 'unclear'. However, One-Day matches (Table 1) were reported to require the higher $\%HR_{max}$ in comparison to Battlezone and traditional cricket training. There was a large effect for a greater HR_{mean} during Battlezone than traditional cricket training (*d*= -2.79) and One-Day matches (*d*= -1.80). As displayed in Table 1, Battlezone led to a greater percentage of time performing above $75\%HR_{max}$ in comparison to traditional cricket training and One-Day matches.

The difference in the relative distances covered by wicketkeepers was considered 'unclear' between Battlezone and traditional cricket training (Table 2). Total relative distance covered was greatest during Battlezone (*d*= -0.96) and traditional cricket training (*d*= -0.65) in comparison to One-Day matches. Increased high-intensity activities were evident during Battlezone (*d*= -1.05) and traditional cricket training (*d*= -2.27) compared to One-Day matches. Mean speed was faster during Battlezone and traditional cricket training when compared to One-Day matches (Table 2). A greater

relative number of high-intensity activities were performed during traditional cricket training than Battlezone (*d*= 1.51) and One-Day matches (*d*= 0.89).

*****INSERT TABLES 1,2,3,4,5 ABOUT HERE*****

Discussion

The aim of this study was to examine the physiological, physical and technical demands of amateur cricket players during Battlezone, traditional net-based training and One-Day matches. Similar to the study of Petersen et al. (2010), position specific responses were evident between that of training- and match-play. Furthermore, in most instances the relative physiological, physical and technical responses of players during Battlezone or traditional cricket training replicated or exceeded that of a One-Day match in amateur players. These results highlight that, both Battlezone and traditional cricket training methods provide cricket players with a match-intensive and match-specific training environment, though the extent of this remains dependent on the playing position.

Batsmen

Previous research on the demands of cricket batsmen suggests heart rate ranges between 139-154 $b \cdot min^{-1}$ (Nicholson, Cooke, O'Hara & Schonfeld, 2009) and cover a total distance of 2476 ± 720 $m \cdot h^{-1}$ whilst batting (Petersen et al., 2010). The current findings demonstrate that when expressed relative to session duration, Battlezone provided batsmen with the greatest physical and physiological demands compared to traditional cricket training or One-Day matches. With a moderate effect shown for time spent above 75%HR_{max}, combined with a higher HR_{mean} ,a greater physiological load was imposed on batsmen during Battlezone. Such outcomes most likely result from the increased distances covered at a higher velocity alongside a reduced work-to-recovery ratio. In contrast, the mean speed, total relative distance covered at a high-intensity and heart rate responses during traditional (net) cricket training did not replicate that typical of a One-Day match. This is likely explained by the reduced relative distances covered. Furthermore, unlike traditional cricket training, in which batsmen only play shots during the duration of the session with limited movement, Battlezone also requires players to run between the wickets after playing a shot. This

in turn, replicates the movement demands of a match. As such, the loads imposed on batsmen during Battlezone seem sufficient at providing a match-intensive physical stimulus.

As highlighted in Table 4, batsmen received more opportunity to train and develop their batting-specific skills in net-based environments, which reflects the increased skill repetition of this form of training. Notwithstanding this increase in technical skill volume (e.g. number of balls faced, number of balls hit), the quality of the shots played by batsmen (percentage of good contacts shots) in Battlezone does not appear to be affected by the smaller volume of technical skills performed, as evident in the similarity in the percentage of good contacts shots made (Table 4). However, batsmen did tend to provide a greater number of chances (i.e. more dismissal opportunities) during traditional cricket training compared to Battlezone and One-Day matches (Table 4). This is most likely explained by less pressure on not being dismissed whilst batting in the nets as opposed to that of a game setting. Therefore, it is possible that by increasing the duration of each Battlezone bout, batsmen may gain not only an increase in technical performance but also increase their physical and physiological demands. As such, the environment in which batsmen are placed during Battlezone training, can replicate the relative physical demands experienced in a typical One-Day match.

Medium-Fast Bowlers

As mentioned previously the demands of medium-fast bowlers are reported to invoke mean heart rates of approximately 135 $b \cdot min^{-1}$ and result in total distances of 3831 ± 839 $m \cdot h^{-1}$ (Petersen et al., 2010). Within amateur medium-fast bowlers in the current study, moderate effects were reported for heart rate responses (amount of time within heart rate zones) between Battlezone and traditional cricket training sessions. Further, large effects existed in the distances covered within each speed zone

between Battlezone and traditional cricket training, whilst also covering a greater distance per hour and achieve a higher mean speed during Battlezone. In both training formats, the physiological and physical demands of medium-fast bowlers exceeded that experienced during the observed One-Day cricket matches, particularly the amount of time spent below 75%HR_{max}, the distance covered above 3.5 $m \cdot s^{-1}$ and the number of high-intensity efforts performed. Interestingly, these findings also exceed the physiological and physical demands of elite and professional medium-fast bowlers (Petersen et al., 2010; Petersen et al., 2011b) during first class One-Day matches. Despite this greater load, there was a tendency for greater perceptual responses of medium-fast bowlers following One-Day matches as opposed to training. The longer duration of a typical One-Day match may have contributed to the increase in perceived exertion and as such, calculated training load (Foster, Daines, Hector, Snyder & Welsh, 1996; Foster et al., 2001). Nevertheless, the results of the current study suggest that the physiological and physical stimuli of medium-fast bowlers were similar between Battlezone and traditional cricket training formats. Accordingly, either could be suitable in providing an appropriate match-simulated load when compared to a relative time-matched duration of a One-Day match.

An important element of training is to ensure sufficient skill repetition or practice (Helsen, Starkes & Hodges, 1998). When expressed as a whole training session (3 x 15 min net bowling bouts per session), the greatest number of balls delivered is during traditional cricket training (69 ± 9) (Table 5). This more than exceeds the average number of balls bowled during a typical One-Day match (47 ± 11) (Table 5). The same observation is also apparent throughout an entire Battlezone session (3 x 15 min bouts/session; 54 ± 3 balls per session) (Table 5). As with the physiological and physical demands of medium-fast bowlers during training, the technical demands of medium-fast bowlers seemed to replicate match-specific demands. As such,

436 medium-fast bowlers within this study seemed to gain a sufficient training load from
437 either training format.
438
439 *Spin-Bowlers*
440 When comparing the physiological responses of spin-bowlers to respective formats a
441 greater HR_{mean} occurred during Battlezone training. This increased HR_{mean} may be
442 due more time spent performing above 75% HR_{max} as opposed to both traditional
443 cricket training and One-Day matches. Despite this greater physiological load during
444 Battlezone, the perceptual responses were less than those reported following
445 traditional cricket training and One-Day matches. No information on the physiological
446 demands of spin bowlers is available to date, though Petersen et al. (2010) has
447 reported that spin bowlers during a One-Day match cover 3166 ± 536 $m \cdot h^{-1}$. In the
448 current study, when compared to a One-Day match, the physical demands differed to
449 both Battlezone and traditional cricket training. In particular there was a moderate
450 effect for a considerably greater mean speed in traditional cricket training and
451 Battlezone. It could be suggested that this was a result of the greater number of high-
452 intensity efforts performed whilst training. Based on this evidence, it appears that
453 both training formats provide relative match-appropriate load. Also, there was a large
454 effect for a greater relative number of balls bowled throughout a training session
455 compared to One-Day matches. Therefore, the volume (technical demands) of spin
456 bowling during either Battlezone or traditional cricket training seems to exceed that
457 which occurs during competition. However, as no extensive research has examined
458 the technical skills of spin bowlers whilst training or competing, it remains unclear if
459 this is a sufficient bowling load. Similar to previous studies (Vickery, Dascombe,
460 Duffield, Kellett & Portus, 2012; Vickery et al., 2013), the small number of spin
461 bowlers used in the current study presents a limitation in interpreting these results,
462 and as such future research should increase the number of spin bowlers used.
463

Fielders

Compared to One-Day matches, it appears that a greater relative physical load is imposed on fielders during both Battlezone and traditional cricket training sessions. Furthermore, the physiological responses and physical demands of fielding were similar during Battlezone and traditional cricket training, even though they were performed in an integrated or isolated fashion, respectively. Fielding during Battlezone and traditional cricket training resulted in coverage of 1381 ± 770 $m \cdot h^{-1}$ and 1054 ± 104 $m \cdot h^{-1}$, respectively, more than One-Day match (2596 ± 828 $m \cdot h^{-1}$). This greater physical demand during training is then reflected within the cardiovascular responses of the fielders, with a small to moderate effect for a greater amount of time spent performing above 75%HR_{max} in both training formats compared to matches. As previously suggested by Vickery et al. (2013), the Battlezone and traditional cricket training sessions in this current study provide fielders with an intensity suitable for training purposes, as well as replicating match intensity.

In regards to the number of throws performed by fielders, when expressed over the entire Battlezone session (3 x 15 min bouts), a greater number of throws were completed during Battlezone (21 ± 15) and traditional cricket training (17 ± 3) compared to One-Day matches (7 ± 5). A similar finding was reported by Saw, Dennis, Bentley and Farhart (2009), whereby a substantially greater number of throws were completed during fielding training (42 ± 26) compared to an actual match (10 ± 10). Therefore both training formats, either in isolation or integrated into small-sided games, may allow fielders to perform skill-specific training which can exceed match demands.

Wicketkeepers

The HR_{mean} of wicketkeepers during One-Day matches and traditional cricket training in the current study is similar to that reported previously by Petersen et al. (2010)

(HR_{mean}: ~135 $b \cdot min^{-1}$; HR_{max}: ~165 $b \cdot min^{-1}$). When compared to One-Day matches a large effect for a higher HR_{mean} of wicketkeepers occurred during Battlezone. It could be suggested this is the result of less time spent below 75%HR_{max} during Battlezone. Consequently, this higher physiological load may be explained by the increased movement demands during Battlezone. Of both training formats wicketkeepers covered substantially more distance per hour than during One-Day matches (Table 2). A greater relative distance was covered at a high-intensity during both training formats, translating into a greater mean speed when compared to One-Day matches (Table 2). In regards to the technical characteristics of wicketkeepers, during both training formats wicketkeepers threw considerably more times (when expressed for a full session for Battlezone) compared to One-Day matches. However, given that throwing is not typically a priority for wicketkeepers during a match, this may not be the most appropriate measure of skill and should be considered in future research.

Conclusion

This study quantified and compared the physiological, physical and technical demands of small-sided cricket games, traditional cricket training methods and One-Day matches. Overall, it appears that across all playing positions the physiological, physical and technical demands of Battlezone and traditional cricket training are suitable for replicating the relative demands of a One-Day match in amateur players. Particularly for batsmen, the loads imposed on players during Battlezone exceed that of a typical match. In regards to the other playing positions, it appears that a similar match-appropriate load can be gained from either Battlezone or traditional cricket training. As such, cricket coaches may want to consider the use of Battlezone more frequently in their training programs as it appears that this method provides a similar, and in some cases, a greater training load to more traditional cricket training methods to exceed the relative demands of an actual One-Day cricket match.

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615 **Table 1:** Comparison of the physiological and perceptual responses by position during Battlezone (BZ), traditional cricket training (TCT) and One-Day matches (mean ± SD).

Position and Format	Peak %HR_{max} (%)	Mean Heart Rate ($b \cdot min^{-1}$)	Percentage Time ≤75%HR_{max} (%)	Percentage Time >75%HR_{max} (%)	[BLa^-] ($mmol \cdot L^{-1}$)	RPE (CR-10)	Training Load ($A.U. \cdot h^{-1}$)
Batsman							
Mean ± SD							
BZ (n= 33)	93 ± 5§	164 ± 12	24 ± 28	73 ± 28	3.2 ± 1.4	5.3 ± 1.5	318 ± 90
TCT (n= 40)	87 ± 10§	153 ± 15§	43 ± 38†	56 ± 38†	1.8 ± 1.0§	4.5 ± 1.2‡	261 ± 81†
OD Match (n= 12)	97 ± 4§#	159 ± 12‡	27 ± 18†	63 ± 30‡¶		4.9 ± 2.1‡¶	293 ±126§#
Effect Size (CI)							
BZ-TCT	-1.21 (-1.91; -0.50)[c]	-1.00 (-1.42; -0.57)[d]	0.30 (-0.23; 0.83)[e]	-0.23 (-0.69; 0.23)[e]	-1.14 (-1.42; -0.85)[d]	-0.63 (-0.96; -0.30)[c]	-0.31 (-0.62; -0.01)[a]
BZ-OD	1.28 (0.08; 2.47)[b]	-0.61 (-1.30; 0.08)[b]	0.28 (0.05; 0.51)[a]	-0.58 (-1.19; 0.23)[b]		-0.58 (-1.15; -0.01)[b]	7.15 (3.68; 10.61)[d]
TCT-OD	2.62 (1.36; 3.87)[d]	0.18 (-0.43; 0.80)[e]	0.04 (-0.84; 0.92)[e]	-0.56 (-1.63; 0.52)[e]		0.62 (0.06; 1.19)[b]	7.93 (4.47; 11.39)[d]
Medium-Fast Bowler							
Mean ± SD							
BZ (n= 23)	95 ± 6	152 ± 32	36 ± 24	63 ± 24	2.7 ± 1.5	6.2 ± 1.4	371 ± 83
TCT (n= 26)	87 ± 10§	147 ± 31§	48 ± 37‡	51 ± 37‡	1.8 ± 0.6‡	5.2 ± 1.2§	312 ± 73‡
OD Match (n= 5)	97 ± 4#	142 ± 5§#	67 ± 11§	33 ± 12§		7.4 ± 0.9‡#	447 ± 53§#
Effect Size (CI)							
BZ-TCT	-0.99 (-1.38; -0.15)[b]	-1.04 (-2.49; 0.42)[e]	0.45 (-0.71; 1.60)[e]	-0.41 (-1.57; 0.76)[e]	-0.56 (-0.91; -0.21)[c]	-0.85 (-1.34; -0.37)[c]	-0.54 (-0.99; -0.09)[b]
BZ-OD	0.09 (-1.01; 1.20)[e]	-2.01 (-2.81; -1.21)[d]	1.13 (-2.44; 4.71)[e]	-1.28 (-4.80; 2.23)[e]		0.56 (-0.14; 1.26)[b]	45.98 (37.79; 54.17)[d]
TCT-OD	1.69 (0.42; 2.96)[c]	-1.00 (-3.09; 1.09)[e]	-0.95*	0.34*		1.68 (0.85; 2.52)[d]	47.08 (38.51; 55.66)[d]
Spin Bowler							
Mean ± SD							
BZ (n= 9)	86 ± 8	152 ± 19	41 ± 43	59 ± 37	1.9 ± 0.8	4.2 ± 1.4	253 ± 84
TCT (n= 11)	85 ± 12†	143 ± 16‡	64 ± 33†	36 ± 35	1.3 ± 0.4‡	5.2 ± 1.4†	311 ± 84‡
OD Match (n= 3)	93 ± 1#	121 ± 19§#	76 ± 36§‖	24 ± 28§‖		4.8 ± 2.1†¶	285 ± 124§#
Effect Size (CI)							
BZ-TCT	0.21 (-1.91; 2.34)[e]	-0.42 (-1.74; 0.89)[e]	0.36*	-0.21*	-0.56 (-1.34; 0.21)[e]	0.48 (-1.38; 2.33)[e]	0.71 (-0.94; 2.37)[e]
BZ-OD	*	-1.51 (-8.43; 5.41)[e]	1.00 (-5.12; 7.19)[e]	-0.79 (-6.23; 4.64)[e]		-0.36 (-11.68; 10.96)[e]	20.88 (-124.54; 66.31)[e]
TCT-OD	1.16 (-2.09; 4.40)[e]	-1.39 (-3.96; 1.17)[e]	-0.33*	0.28*		0.72 (-3.47; 4.91)[e]	25.62 (-14.77; 66.01)[e]
Fielder							
Mean ± SD							
BZ (n= 56)	85 ± 10	137 ± 26	69 ± 31	31 ± 30			
TCT (n= 31)	88 ± 5	138 ± 10†	67 ± 21†	33 ± 20†			
OD Match (n= 15)	93 ± 7§#	130 ± 10‡	82 ± 11†¶	18 ± 11‡¶			
Effect Size (CI)							
BZ-TCT	-0.15 (-0.52; 0.22)[e]	-0.47 (-0.83; -0.12)[b]	-0.27 (-0.68; 0.13)[a]	0.27 (-0.13; 0.67)[a]			
BZ-OD	1.21 (0.57; 1.85)[d]	-0.55 (-0.91; -0.19)[b]	0.45 (0.12; 0.79)[b]	-0.61 (-1.02; -0.20)[c]			
TCT-OD	1.29 (0.35; 2.24)[d]	-0.09 (-0.56; 0.39)[e]	0.60 (0.24; 0.96)[c]	-0.61 (-0.98; -0.24)[c]			
Wicketkeeper							
Mean ± SD							
BZ (n= 19)	90 ± 8	154 ± 11	59 ± 25	40 ± 24			
TCT (n=4)	85 ± 5	141 ± 16§	65 ± 28§	35 ± 29§			
OD Match (n= 4)	94 ± 7¶	140 ± 14§¶	73 ± 33§¶	27 ± 33§¶			
Effect Size (CI)							
BZ-TCT	-2.52*	-2.79 (-5.06; -0.52)[e]	2.54*	-2.28*			
BZ-OD	0.00*	-1.80 (-4.29; 0.70)[e]	1.97 (-3.93; 7.87)[e]	-1.78 (-7.07; 3.51)[e]			
TCT-OD	0.60 (-2.23; 3.43)[e]	-0.75 (-3.42; 1.92)[e]	0.36*	-0.34*			

Difference in comparison to BZ († small; ‡ moderate; § large); Difference in comparison to TCT (‖ small; ¶ moderate; # large). True difference between formats: [a]possible, [b]likely, [c]very likely, [d]almost certain, [e]unclear. *Insufficient data.

618 **Table 2:** Comparison of the physiological and perceptual responses by position during Battlezone (BZ), traditional cricket training (TCT) and One-Day matches (mean ± SD).

Position and Format	Total Distance ($m \cdot h^{-1}$)	Low-Intensity Distance ($m \cdot h^{-1}$)	High-Intensity Distance ($m \cdot h^{-1}$)	Total Overall Distance (m)	Mean Speed ($m \cdot min^{-1}$)
Batsman					
Mean ± SD					
BZ (n= 46)	3895 ± 1236§	2619 ± 1173	1235 ± 422	851 ± 222	65 ± 21
TCT (n= 45)	560 ± 470§#	552 ± 452§	4 ± 15§	139 ± 119§	9 ± 8§
OD Match (n=16)	1919 ± 793	1632 ± 794‡#	271 ± 12§¶6	1716 ± 1315§#	34 ± 1§#7
Effect Size (CI)					
BZ-TCT	-2.69 (-2.97; -2.41)[d]	-1.76 (-2.03; -1.48)[d]	-2.91 (-3.17; -2.66)[d]	-3.21 (-3.50; -2.93)[d]	-2.69 (-2.97; -2.42)[d]
BZ-OD	-1.32 (-1.72; -0.93)[d]	-0.53 (-0.97; -0.08)[b]	-2.38 (-2.86; -1.90)[d]	4.04 (1.46; 6.64)[c]	-1.24 (-1.70; -0.79)[d]
TCT-OD	1.15 (0.82; 1.48)[d]	0.97 (0.63; 1.31)[d]	0.64 (0.51; 0.77)[d]	7.18 (4.54; 9.82)[d]	1.23 (0.82; 1.64)[d]
Medium-Fast Bowler					
Mean ± SD					
BZ (n= 28)	4970 ± 1735	3837 ± 1437	1053 ± 397	1196 ± 477	93 ± 29
TCT (n= 36)	4249 ± 1125†	3128 ± 934‡	1090 ± 459	1061 ± 272†	71 ± 19†
OD Match (n=9)	3389 ± 1038§#	2927 ± 935‡#	441 ± 121§#	9530 ± 2654§#	54 ± 15§#
Effect Size (CI)					
BZ-TCT	-0.37 (-0.78; 0.05)[a]	-0.42 (-0.83; -0.02)[b]	0.03 (-0.49; 0.55)[e]	-0.21 (-0.59; 0.15)[a]	-0.37 (-0.78; 0.05)[a]
BZ-OD	-0.94 (-1.39; -0.49)[d]	-0.51 (-0.95; -0.08)[b]	-2.14 (-2.51; -1.77)[d]	17.23 (13.78; 20.68)[d]	-1.01 (-1.39; -0.63)[d]
TCT-OD	-1.15 (-1.67; -0.64)[d]	-0.80 (-1.43; -0.16)[b]	-2.10 (-3.00; -1.14)[d]	17.18 (13.83; 20.52)[d]	-1.22 (-1.70; -0.74)[d]
Spin Bowler					
Mean ± SD					
BZ (n=12)	3172 ± 658	2900 ± 500	261 ± 226	698 ± 222	53 ± 11
TCT (n=12)	3419 ± 951†	3196 ± 861‡	209 ± 332	904 ± 120§	61 ± 7‡
OD Match (n=4)	1749 ± 338§#	1689 ± 324§#	57 ± 16§¶	5044 ± 1018§#	30 ± 5§‡
Effect Size (CI)					
BZ-TCT	0.37 (-0.40; 1.15)[e]	0.51 (-0.55; 1.57)[e]	-0.11 (-1.24; 1.03)[e]	0.93 (0.35; 1.51)[c]	0.74 (0.17; 1.32)[c]
BZ-OD	-2.21 (-2.92; -1.51)[d]	-1.44 (-7.82; 4.94)[e]	-0.09 (-2.05; 1.87)[e]	19.40 (13.73; 25.07)[d]	-2.18 (-2.80; -1.56)[d]
TCT-OD	-2.54 (-2.69; -2.39)[d]	-2.44 (-4.95; 0.06)[b]	0.53 (-1.32; 2.39)[e]	18.92 (13.93; 23.90)[d]	-2.50 (-2.63; -2.37)[d]
Fielder					
Mean ± SD					
BZ (n= 68)	3977 ± 1598	3321 ± 1232	620 ± 510	917 ± 460	66 ± 27
TCT (n= 32)	3650 ± 724	3072 ± 616†	548 ± 446	1257 ± 304‡	61 ± 12
OD Match (n= 26)	2596 ± 828‡¶	2370 ± 698‡	214 ± 153‡¶	6970 ± 2788§#	43 ± 14‡¶
Effect Size (CI)					
BZ-TCT	-0.10 (-0.40; 0.20)[e]	-0.42 (-0.78; -0.08)[b]	-0.08 (-0.49; 0.34)[e]	0.77 (0.43; 1.12)[d]	-0.10 (-0.40; 0.20)[e]
BZ-OD	-0.65 (-0.92; -0.38)[d]	-0.59 (-0.85; -0.33)[d]	-0.59 (-0.89; -0.30)[c]	11.89 (9.75; 14.03)[d]	-0.65 (-0.92; -0.38)[d]
TCT-OD	-0.52 (-0.85; -0.19)[c]	-0.02 (-0.45; 0.40)[e]	-0.56 (-0.87; -0.24)[c]	11.54 (9.24; 13.85)[d]	-0.52 (-0.84; -0.20)[c]
Wicketkeeper					
Mean ± SD					
BZ (n=24)	2685 ± 865	2439 ± 756	227 ± 129	605 ± 203	45 ± 14
TCT (n=4)	2303 ± 694	1969 ± 455‡	326 ± 285§	766 ± 110	38 ± 12
OD Match (n=6)	1658 ± 351§¶	1594 ± 332§‖	60 ± 55§#	4763 ± 822#	28 ± 6‡¶
Effect Size (CI)					
BZ-TCT	0.14 (-7.72; 8.00)[e]	-0.22 (-6.02; 5.57)[e]	2.40 (-17.72; 22.52)[e]	-0.03 (-13.13; 13.08)[e]	0.14 (-7.73; 8.01)[e]
BZ-OD	-0.96 (-1.54; -0.39)[c]	-0.92 (-1.59; -0.24)[c]	-1.05 (-1.74; -0.35)[f]	16.59 (1.72; 31.47)[c]	-0.64 (-1.54; -0.39)[c]
TCT-OD	-0.65 (-2.98; 1.69)[e]	-0.36 (-2.16; 1.44)[e]	-2.27 (-7.65; 3.10)[e]	11.25 (-4.62; 27.13)[b]	-0.65 (-2.99; 1.70)[e]

Difference in comparison to BZ († small; ‡ moderate; § large); Difference in comparison to TCT (‖ small; ¶ moderate; # large). True difference between formats: [a]possible, [b]likely, [c]very likely, [d]almost certain, [e]unclear.

623 **Table 3:** Comparison of the movement characteristics by position during Battlezone, traditional cricket training and One-Day matches (mean ± SD).
624

Position and Format	# High-Intensity Efforts ($\cdot hr^{-1}$)	# Sprints ($\cdot hr^{-1}$)	Mean Sprint Distance (m)	Maximal Speed ($m \cdot s^{-1}$)	Work-to-Recovery Ratio (1:x)
Batsman					
Mean ± SD					
BZ (n= 46)	224 ± 73	23 ± 19	8 ± 4	5.8 ± 1.0	13 ± 7
TCT (n= 45)	10 ± 34§	0 ± 1§	0 ± 2§	1.9 ± 1.5§	779 ± 865§
OD Match (n=16)	50 ± 21§¶	8 ± 8§¶	9 ± 4§¶	6.5 ± 1.2§#	66 ± 65§#
Effect Size (CI)					
BZ-TCT	2.93 (-3.21; -2.64)[e]	1.25 (-1.50; -1.00)[e]	1.91 (-2.19; -1.63)[e]	3.85 (-4.28; -3.41)[e]	107.37 (-35.36; 250.09)[e]
BZ-OD	2.45 (-2.96; -1.94)[e]	1.04 (-1.50; -0.58)[e]	1.07 (-1.55; -0.58)[e]	0.80 (0.13; 1.48)[c]	7.34 (3.34; 11.33)[e]
TCT-OD	0.49 (0.16; 0.82)[c]	0.41 (0.277; 0.55)[e]	0.72 (0.51; 0.94)[e]	4.85 (4.18; 5.53)[e]	8.37 (-5.01; 21.78)*
Medium-Fast Bowler					
Mean ± SD					
BZ (n= 28)	184 ± 61	29 ± 29	7 ± 5	5.7 ± 1.2	23 ± 31
TCT (n= 36)	219 ± 59‡	32 ± 39	5 ± 5‡	5.2 ± 1.0‡	21 ± 33
OD Match (n=9)	62 ± 17§#	12 ± 6§#	13 ± 5§¶	7.5 ± 1.6§#	13 ± 6¶
Effect Size (CI)					
BZ-TCT	0.52 (-0.3; 1.07)[c]	0.12 (-0.38; 0.62)[f]	0.50 (-0.95; -0.05)[c]	0.40 (-0.82; 0.01)[c]	0.03 (-0.56; 0.50)[f]
BZ-OD	2.57 (-2.80; -2.34)[e]	1.34 (-1.90; -0.78)[e]	1.35 (-1.66; -1.03)[e]	1.01 (-0.07; 2.08)[c]	0.03 (-0.09; 0.15)[a]
TCT-OD	2.61 (-0.03; 1.07)[e]	1.37 (-2.27; -0.47)[d]	0.40 (-1.00; 0.20)[b]	1.40 (0.52; 2.28)[d]	0.67 (-1.97; 0.64)[f]
Spin Bowler					
Mean ± SD					
BZ (n=12)	40 ± 41	6 ± 7	6 ± 7	5.3 ± 1.1	109 ± 81
TCT (n=12)	135 ± 53§	1 ± 5†	4 ± 8‡	4.1 ± 0.7§	231 ± 278§
OD Match (n=4)	7 ± 2#	1 ± 1§#	23 ± 9§#	7.0 ± 0.8§#	92 ± 150§#
Effect Size (CI)					
BZ-TCT	2.14 (1.03; 3.25)[e]	0.38 (-1.05; 0.29)[f]	0.54 (-1.33; 0.25)[f]	1.02 (-1.75; -0.30)[d]	0.97 (-0.53; 1.56)[f]
BZ-OD	0.01 (-1.53; 1.56)[f]	0.82 (-3.13; 4.76)[f]	0.81 (-3.32; 4.95)[f]	1.66 (-3.58; 6.90)[f]	1.40 (-6.55; 9.35)[f]
TCT-OD	1.93 (-7.01; 3.15)[f]	1.14 (-1.78; 4.06)[f]	0.87 (-1.21; 2.96)[f]	2.61 (1.14; 4.80)[d]	1.26 (-3.90; 1.37)[f]
Fielder					
Mean ± SD					
BZ (n= 68)	97 ± 70	14 ± 15	8 ± 6	5.5 ± 1.2	38 ± 31
TCT (n= 32)	102 ± 52	6 ± 5†	7 ± 2‡	5.6 ± 1.3†	42 ± 30†
OD Match (n= 26)	29 ± 18‡#	4 ± 3†#	15 ± 4§‖	7.3 ± 1.2§#	42 ± 34†
Effect Size (CI)					
BZ-TCT	0.02 (-0.35; 0.40)[f]	0.24 (-0.13; 0.62)[b]	0.65 (-1.02; -0.27)[d]	0.20 (-0.64; 0.24)[f]	0.36 (-0.87; 0.14)[b]
BZ-OD	0.76 (-1.06; -0.47)[e]	0.48 (-0.76; -0.20)[d]	1.12 (-1.14; -0.82)[e]	1.36 (0.93; 1.78)[e]	0.36 (-0.92; 0.21)[f]
TCT-OD	0.90 (-1.23; -0.56)[e]	0.74 (-1.19; -0.29)[d]	0.20 (-0.64; 0.25)[d]	1.58 (0.99; 2.16)[e]	0.03 (-0.10; 0.17)[a]
Wicketkeeper					
Mean ± SD					
BZ (n=24)	46 ± 28	6 ± 5	6 ± 5	5.2 ± 1.0	89 ± 55
TCT (n=4)	90 ± 34§	5 ± 9§	3 ± 3§	4.9 ± 0.5§	72 ± 49§
OD Match (n=6)	31 ± 41§#	1 ± 1‡#	5 ± 6†¶	5.4 ± 0.7‡	95 ± 81†‖
Effect Size (CI)					
BZ-TCT	1.51 (-10.58; 13.60)[f]	1.85 (-7.41; 11.10)[f]	1.20 (-0.62; 3.02)[f]	0.83 (-1.80; 3.47)[f]	1.39 (-19.19; 16.41)[f]
BZ-OD	0.89 (-1.46; -0.31)[d]	0.42 (-1.82; 0.97)[f]	0.28 (-1.50; 0.94)[f]	0.57 (-0.37; 1.52)[f]	0.29 (-3.61; 3.04)[f]
TCT-OD	0.89 (-5.38; 3.60)[f]	1.14 (-4.31; 2.04)[f]	0.60 (-1.46; 0.27)[f]	0.17 (-1.60; 1.25)[f]	0.46 (-0.43; 1.35)[f]

Difference in comparison to BZ († small; ‡ moderate; § large); Difference in comparison to TCT (‖ small; ¶ moderate; # large). True difference between formats: [a]very unlikely, [b]possible, [c]likely, [d]very likely, [e]almost certain, [f]unclear. *Insufficient data.

Table 4: Comparison of the technical characteristics of batsmen during Battlezone, traditional cricket training and One-Day matches (mean ± SD).

	# Balls Faced (hr^{-1})	# Balls Hit (hr^{-1})	# Dot Balls (hr^{-1})	# Play-Miss (hr^{-1})	# Defensive Shots (hr^{-1})	# Attacking Shots (hr^{-1})	# Times Dismissed (hr-1)	# Chances (hr^{-1})	% Good Contact Shots
Mean ± SD									
BZ (n= 46)	82 ± 18	66 ± 17	17 ± 10	14 ± 8	7 ± 6	57 ± 19	2 ± 3	2 ± 3	81 ± 12
TCT (n= 45)	303 ± 26§	248 ± 34§	120 ± 29§	37 ± 17§	76 ± 23§	172 ± 39§	1 ± 1†	8 ± 7§	82 ± 7
OD Match (n=16)	47 ± 9§#	33 ± 6§#	33 ± 8§#	7 ± 3§#	12 ± 5#	21 ± 4§#	1 ± 1	1 ± 1‡#	75 ± 8#
Effect Size (CI)									
BZ-TCT	12.59 (12.14; 13.04)[d]	10.76 (10.21; 11.30)[d]	10.44 (9.64; 11.24)[d]	2.70 (2.14; 3.25)[d]	11.08 (10.12; 12.04)[d]	6.18 (5.65; 6.72)[d]	0.49 (0.21; 0.78)[e]	1.74 (1.09; 2.38)[d]	0.11 (-0.31; 0.53)[c]
BZ-OD	-2.12 (-2.74; -1.50)[d]	1.87 (-2.56; -1.18)[d]	1.27 (0.46; 2.08)[d]	-1.14 (-1.60; -0.67)[d]	0.04 (-0.57; 0.65)[e]	-1.69 (-2.36; -1.01)[d]	-0.09 (-0.50; 0.29)[e]	-0.60 (-1.19; -0.02)[b]	0.12 (-0.29; 0.52)[e]
TCT-OD	-13.83 (-14.74; -12.92)[d]	11.76 (-13.29; -10.24)[d]	-9.35 (-11.11; -7.59)[c]	-3.64 (-4.85; -2.43)[d]	-10.15 (-12.54; -7.76)[d]	-7.34 (-8.69; -6.00)[d]	-0.15 (-0.38; 0.09)[b]	-1.57 (-2.64; -0.49)[d]	-1.02 (-2.11; 0.07)[a]

Difference in comparison to BZ († small; ‡ moderate; § large); Difference in comparison to TCT (‖ small; ¶ moderate; # large). True difference between formats: [a]possible, [b]likely, [c]very likely, [d]almost certain, [e]unclear.

Table 5: Comparison of the technical characteristics of medium-fast bowlers, spin bowlers, fielders and wicketkeepers during Battlezone, traditional cricket training and One-Day matches (mean ± SD).

Position and Format	Total # Balls Bowled	#Balls Bowled ($\cdot hr^{-1}$)	Total # Throws	# Throws ($\cdot hr^{-1}$)
Medium-Fast Bowler				
Mean ± SD				
BZ (n= 28)	18 ± 1	78 ± 14	2 ± 1	9 ± 5
TCT (n= 36)	23 ± 3§	90 ± 11§		
OD Match (n=9)	47 ± 11§#	17 ± 5§#	10 ± 3§	3 ± 1§
Effect Size (CI)				
BZ-TCT	9.86 (8.29; 11.44)[b]	0.99 (0.62; 1.36)[b]		
BZ-OD	53.14 (39.93; 66.35)[b]	-3.61 (-3.88; -3.34)[b]	7.72 (5.11; 10.33)[b]	-1.04 (-2.05; -0.02)[a]
TCT-OD	44.70 (30.78; 58.62)[b]	-5.08 (-5.42; -4.75)[b]		
Spin Bowler				
Mean ± SD				
BZ (n=12)	18 ± 1	85 ± 16	3 ± 2	12 ± 9
TCT (n=12)	23 ± 3§	88 ± 25†		
OD Match (n=4)	37 ± 20§#	14 ± 10§#	3 ± 2	1 ± 1
Effect Size (CI)				
BZ-TCT	*	-0.20 (-1.61; 1.22)[c]		
BZ-OD	*	-1.02 (-18.53; 16.49)[c]	1.12 (-5.96; 8.20)[c]	0.02 (-4.33; 4.38)[c]
TCT-OD	*	-3.12 (-10.21; 3.97)[c]		
Fielder				
Mean ± SD				
BZ (n= 68)			7 ± 3	30 ± 16
TCT (n= 32)			17 ± 3§	49 ± 9‡
OD Match (n= 26)			7 ± 5‡‖	29 ± 20§#
Effect Size (CI)				
BZ-TCT			1.35 (0.76; 1.95)[b]	0.52 (0.10; 0.95)[a]
BZ-OD			0.46 (-0.15; 1.07)[a]	-1.53 (-2.00; -1.07)[b]
TCT-OD			-0.24 (-1.00; 0.52)[c]	-1.60 (-1.97; -1.22)[b]
Wicketkeeper				
Mean ± SD				
BZ (n=24)			10 ± 6	10 ± 6
TCT (n=4)			26 ± 11§	26 ± 11§
OD Match (n=6)			0 ± 1‡#	0 ± 1§#
Effect Size (CI)				
BZ-TCT			2.17 (-6.96; 11.30)[c]	1.05 (-19.48; 21.58)[c]
BZ-OD			-0.54 (-2.00; 0.91)[c]	-1.27 (-2.71; 0.18)[a]
TCT-OD			-5.30 (-11.44; 0.83)[c]	-3.53 (-8.57; 1.51)[c]

Difference in comparison to BZ († small; ‡ moderate; § large); Difference in comparison to TCT (‖ small; ¶ moderate; # large). True difference between formats: [a]likely, [b]almost certain, [c]unclear.