

Research article

## Reliability of a contact and non-contact simulated team game circuit

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### Abstract

Most team sports are characterised by repeated short maximal sprint efforts interspersed with longer periods of active recovery or rest. Although a variety of testing protocols have been devised to simulate these activity patterns under controlled conditions, a common limitation is the lack of 'body contact' to simulate the tackling efforts seen in contact sports. Therefore, the purpose of this study was to assess the reliability of a simulated team game protocol with and without 'contact'. Eleven male, team-sport athletes (mean  $\pm$  SD; age  $22 \pm 2$  yr; BMI  $23.0 \pm 1.7$  kg·m<sup>-2</sup>) completed four separate testing trials; two 'non-contact' trials (NCON) and two 'contact' (CON) trials of a simulated game to determine the reliability of a range of team sport performance indicators including repeated 15-m sprint time, vertical jump height, heart rate response and ratings of perceived exertion (RPE). The team game protocol involved four sets of 15-min of intermittent running around a circuit replicating the movement patterns observed in team sports, either with or without simulated contact. Within-subject reliability of each performance measure was determined by expressing the typical error of measurement as the coefficient of variation, as well as determining intra-class correlations. Both CON and NCON produced reliable results for a variety of team sport performance indicators including repeated 15-m sprint time, vertical jump height, heart rate response and RPE. Repeated sprint and jump performance declined over time throughout the simulated game ( $p < 0.05$ ), while heart rate and RPE increased. There was no difference in these performance measures between CON and NCON protocols. As such, these simulated game protocols provide reliable options for assessing team game performance parameters in response to training or other interventions under controlled conditions.

**Key words:** Performance, team sports, vertical jump, active recovery, body contact.

### Introduction

Most team sports are characterised by short maximal sprint efforts, interspersed with longer periods of active recovery or rest, repeated over a prolonged period of time (Bishop et al., 2001). In an effort to monitor the effect of various interventions on team sport performance under more controlled conditions than a real game situation, a variety of protocols have been devised to simulate the activity patterns of such sports (Bishop and Claudius, 2005; Drust et al., 2000; Glaister et al., 2008; Sirotic and Coutts, 2007). However, a potential limitation of these protocols is the lack of 'body contact' to simulate the tackling, rucking, shepherding (body checking) and collisions that are commonly involved in contact sports. The inclusion of contact in simulated team game protocols

may be important given that Australian Rules football players tend to complain of greater soreness post-match as compared to post-training (Dawson et al, 2004b). One possible difference between games and training sessions is the level of body contact and the resulting muscle contusions that commonly occur during a match (Dawson et al., 2005; Takarada, 2003). Likewise, it has been suggested that the direct impact between opposing players accounts for much of the muscle damage observed following competitive rugby matches (Gill et al., 2006). This is supported by positive correlations between the number of tackles during a competitive rugby match and blood markers of muscle damage including peak myoglobin concentration ( $r = 0.85$ ) and peak creatine kinase activity ( $r = 0.92$ ; Takarada, 2003). Given that testing and training for team sports should replicate real game activities as closely as possible, protocols are required that incorporate a 'body contact' component. However, there is no data on the reliability of including contact in such protocols. Therefore, the purpose of this study was to assess the reliability of a simulated team game circuit with and without 'contact' to determine whether it may be suitable for monitoring key performance indicators in response to training or other interventions.

### Methods

#### Experimental design

Using a within-subjects experimental design, male team sport athletes attended a grass track (temperature  $24 \pm 3^\circ\text{C}$ , humidity  $60 \pm 1\%$ ) on five occasions, first for familiarisation with the simulated team game protocol (both with and without simulated contact), followed by four testing trials; two 'non-contact' (NCON) and two 'contact' (CON) to determine the reliability of a range of performance measures, including repeated sprint speed and vertical jump height, for each. Trials were conducted seven days apart at the same time of day ( $\pm 1$  h) in a randomised crossover design. Participants maintained their normal diet (self-reported) and abstained from training and caffeine in the 48 h prior to each trial.

#### Subjects

Eleven male, recreational, team-sport athletes (Mean  $\pm$  SD; age  $22 \pm 2$  yr; body mass  $74.4 \pm 7.4$  kg; height  $1.79 \pm 0.06$  m; BMI  $23.0 \pm 1.7$  kg·m<sup>-2</sup>) were recruited as participants. They were involved in a range of sports at the time of testing (rugby, hockey and Australian football), but all had previous experience with contact sports. Testing was conducted during the pre-season period to minimise any



transformed raw data using the online spreadsheet of Hopkins (2000). In addition, differences between protocols (CON and NCON) were assessed using two-way (set x protocol) repeated measures ANOVA, with statistical significance accepted as  $p \leq 0.05$ . Cohen's *d* effect sizes were also calculated for this purpose.

## Results

The CV between trials for best sprint time was 0.9% (90% CL, 0.7–1.4%; ICC  $r = 0.97$ ) for CON and 2% (90% CL, 1.4–3.1%; ICC  $r = 0.93$ ) for NCON (Table 1). For mean sprint time, the CV was 1.7% (90% CL, 1.3–2.7%; ICC  $r = 0.89$ ) for CON and 3.7% (90% CL, 2.7–6.0%; ICC  $r = 0.75$ ) for NCON. There was a main effect of set on both best sprint time ( $p < 0.001$ ) and mean sprint time ( $p < 0.001$ ) within protocols, but no difference between CON and NCON protocols. Small effect sizes were observed for the differences in best sprint time and mean sprint time for CON (0.12 and 0.01 respectively) and NCON (0.21 and 0.36 respectively).

For best vertical jump, the CV between trials was 3.1% (90% CL, 2.3–4.9%; ICC  $r = 0.97$ ) for CON and 2.7% (90% CL, 2.0–4.3%; ICC  $r = 0.99$ ) for NCON (Table 1). For mean vertical jump, the CV was 4.1% (90% CL, 3.0–6.4%; ICC  $r = 0.96$ ) for CON and 4.3% (90% CL, 3.1–6.9%; ICC  $r = 0.96$ ) for NCON. Best vertical jump was maintained across sets, while mean vertical jump declined ( $p = 0.024$ ); however, there was no difference between CON and NCON. Small effect sizes were observed for the differences in best vertical jump and mean vertical jump for CON (0.00 and 0.37 respectively) and NCON (0.00 and 0.12 respectively).

For heart rate, CV was 1.2% (90% CL, 0.9–1.8%; ICC  $r = 0.88$ ) for CON and 1.0% (90% CL, 0.7–1.6%; ICC  $r = 0.97$ ) for NCON (Table 1). Heart rate increased ( $p = 0.002$ ) across sets within both protocols, and there was a significant interaction between protocols and sets ( $p < 0.001$ ), although post hoc analysis failed to reach sig-

nificance. The CV of RPE was 2.7% (90% CL, 2.0–4.3%; ICC  $r = 0.86$ ) for CON and 3.4% (90% CL, 2.5–5.5%; ICC  $r = 0.77$ ) for NCON (Table 1). RPE increased across sets ( $p = 0.000$ ), but was not different between CON and NCON protocols. Similarly, small effect sizes were observed for both HR and RPE in both conditions.

## Discussion

The purpose of this study was to evaluate the reliability of both a contact (CON) and non-contact (NCON) version of a simulated game protocol based on a circuit originally developed by Bishop and colleagues (2001). Both CON and NCON produced reliable results for assessing a variety of team sport performance indicators including sprint time, vertical jump height, heart rate response and ratings of perceived exertion. Furthermore, the reliability of CON and NCON is comparable to other team sport simulations. Sirotic and Coutts (2007) reported a CV of 2.0% and 2.7% for total distance and sprint distance covered in their protocol utilising a non-motorised treadmill. Similarly, Bishop and Claudius (2005) reported a CV of 2.5% for mean sprint power output during their cycle ergometer team game simulation. In addition, the RPE during CON and NCON is comparable to that observed by Drust and colleagues (2000) with their soccer-specific protocol, although the heart rate response was higher in the present study compared to previous research (Bishop and Claudius, 2005; Drust et al., 2000; Sirotic and Coutts, 2007).

Of interest, there was no statistical difference in performance measures between CON and NCON. This was surprising given the greater amount of work involved in CON. It is possible that the addition of contact does not acutely impair performance measures, but rather results in a greater decrement in subsequent performance (i.e. after limited recovery 24 or 48 hours later) due to the resulting muscle damage (Gill et al., 2006; Takarada, 2003). Alternatively, it must be acknowledged that the 'contact'

**Table 1.** Mean ( $\pm$ SD) performance measures during a simulated game protocol with 'contact' (CON) and without 'contact' (NCON) ( $n=11$ ).

Trial	SET 1		SET 2		SET 3		SET 4		Mean	
	CON	NCON								
<b>Best Sprint Time (s)*</b>										
T1	2.56 (.13)	2.60 (.19)	2.56 (.14)	2.62 (.21)	2.61 (.14)	2.67 (.22)	2.64 (.14)	2.69 (.21)	2.59 (.13)	2.64 (.20)
T2	2.54 (.13)	2.58 (.19)	2.55 (.12)	2.60 (.19)	2.59 (.11)	2.62 (.18)	2.63 (.14)	2.63 (.17)	2.58 (.12)	2.61 (.18)
<b>Mean Sprint Time (s)*</b>										
T1	2.70 (.14)	2.79 (.22)	2.78 (.15)	2.82 (.21)	2.80 (.17)	2.83 (.22)	2.88 (.18)	2.87 (.23)	2.79 (.15)	2.83 (.21)
T2	2.70 (.14)	2.69 (.17)	2.76 (.14)	2.74 (.20)	2.81 (.14)	2.77 (.21)	2.88 (.17)	2.82 (.21)	2.79 (.14)	2.76 (.19)
<b>Best Vertical Jump (cm)</b>										
T1	46 (7)	47 (10)	45 (8)	45 (10)	45 (9)	46 (11)	44 (8)	46 (11)	45 (8)	46 (10)
T2	46 (7)	45 (8)	45 (8)	46 (10)	43 (8)	47 (10)	44 (9)	47 (10)	45 (8)	46 (9)
<b>Mean Vertical Jump (cm)*</b>										
T1	41 (7)	43 (9)	41 (7)	41 (9)	40 (8)	41 (9)	40 (8)	41 (9)	41 (7)	41 (9)
T2	42 (7)	42 (7)	41 (8)	42 (8)	40 (7)	43 (9)	40 (8)	41 (10)	40 (8)	42 (8)
<b>HR(bpm)* †</b>										
T1	177 (6)	181 (10)	180 (6)	178 (10)	180 (6)	180 (9)	182 (6)	180 (11)	180 (6)	180 (9)
T2	178 (7)	178 (1)	181 (6)	181 (9)	181 (7)	180 (11)	182 (6)	183 (11)	181 (6)	181 (10)
<b>RPE*</b>										
T1	15 (1)	14 (1)	16 (1)	15 (2)	17 (2)	16 (1)	17 (1)	17 (2)	16 (1)	16 (1)
T2	15 (1)	14 (1)	16 (1)	15 (1)	17 (1)	16 (1)	18 (1)	17 (1)	16 (1)	15 (1)

\* Indicates significant main effect of sets on performance. † Indicates significant interaction effect of set and trial on performance. HR: Heart Rate, RPE: Rating of Perceived Exertion, T1: trial 1, T2: trial 2.

involved in the current study was simulated. Despite our best efforts to ensure that each tackle was maximal, it is likely that the 'contact' experienced with a tackle bag and bump pads may be less physically damaging than actual body-on-body contact. However, true contact is not feasible within the context of a simulated performance test and the current protocol should be preferable to previous protocols used to simulate the activity patterns of team games that have neglected to include any contact component at all. Perhaps future studies could attempt to quantify the degree of impact experienced with simulated (i.e. tackle bags and bump pads) versus actual body-on-body contact. If found to be lacking, the number of simulated contacts in the current protocol could be increased to compensate for any possible reduction in the 'intensity' of contact. Nonetheless, both CON and NCON appear reliable for assessing aspects of team sport performance. As such, these tests may provide additional options for assessing team game performance parameters, with the type of test used depending on the specific sport itself and whether 'contact' is involved.

## Conclusion

A variety of protocols have been devised to simulate the activity patterns of team sports. These protocols may be used by the coach and athlete in training to replicate game demands, or at intervals throughout the season to monitor key performance indicators in response to training or other interventions (i.e. ergogenic aids, dietary manipulations, recovery strategies) under more controlled conditions than a real game situation. The protocol used in the current study is unique in that it includes an aspect of 'contact', which has been lacking from previous protocols. Given that testing and training for team sports should replicate real game activities as closely as possible, together with the evidence that the direct impact between opposing players accounts for much of the muscle damage observed following contact sports, our study provides a reliable option for assessing team game performance parameters for both contact and non-contact sports, with the choice of test depending on the specific sport itself and whether contact is involved.

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## Key points

- A variety of protocols have been devised to simulate the activity patterns of team sports.
- The protocol used in the current study is unique in that it includes an aspect of 'contact', which has been lacking from previous protocols.
- Both the 'contact' and 'non-contact' protocols tested appear reliable for assessing team game performance parameters
- These protocols provide a reliable option for assessing team game performance parameters for both contact and non-contact sports.

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