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Repeated Sprint Ability Depending on the Level of Condition among University Soccer Players

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Abstract

The purpose of this study is to investigate the repeated sprint ability (RSA) performance among university soccer players. Twenty-four university representatives were voluntarily recruited as participants of this study and were asked to perform the RSA test that was modified which includes change of direction component in it. Participants were required to perform the RSA test in two conditions, with and without ball. Sprint time, fatigue index (FI) and percentage of decrement score of sprinting (Sdec) were analysed and compared between both protocols. Results showed that the sprint time without ball was significantly faster compared to sprint time with ball. Besides that, the FI and Sdec were shown to be significantly higher in with ball condition compared to without ball condition. Due to the drop of performance seen in the with ball condition, it shown the need for coaches and athletes to enhance the ability to move fast with ball, as this will enhance their team ability to control the ball possession which may affect the outcome of a soccer match.

Keywords: Change Of Direction, Repeated Sprint Ability, Soccer Conditioning, Speed-Agility Development, Fatigue Index

1.0 Introduction

Repeated sprint ability (RSA) is the capability to reproduce maximum speed over a series of sprints (Bishop, Girard and Mendez-Villanueva, 2011). Time motion analysis studies has shown that the team sports' athlete need to sprint for 1-10% of the total distance covered during the game, which also made up 1-3% of effective playing time (Buchheit, Mendez-Villanueva, Simpson and Bourdon, 2010; Spencer, Bishop, Dawson and Goodman, 2005; Spencer, Bishop and Lawrence, 2004; Stølen, Chamari, Castagna and Wisløff, 2005). This finding demonstrated the benefits of having good RSA that would result in greater team-sport physical performance, and that it is important to develop training strategies that can improve this (RSA) fitness component.

While the typically used RSA was performed in straight line manner, it can be further improved to mimic the actual sprint performance performed by players in a soccer match. This kind of modification is made by including change of direction component in the RSA training method used.

While RSA seems to focus on speed as the name implies, the type of speed in aimed for is more specific towards metabolic or endurance based speed. It can simply be stated that RSA developed speed resistance to fatigue, with it usage as a testing method may helps reveal individual's ability to withstand fatigue. Fatigue in RSA refers to the decrement of the maximal power output or speed (i.e. during cycling or running), although the individuals can sustained the task (Girard, Mendez-Villanueva and Bishop, 2011). Study by Mendez-Villanueva, Hamer and Bishop (2008) showed that fatigue during RSA training can rapidly develop as early as just after the first sprint.

Fatigue development in team sports (e.g. soccer) has been shown to be associated with the inability to reproduce maximum speeds during sprinting (Krustrup, Zebis, Jensen and Mohr, 2010). For example, sprinting performance and running speed has been shown to be significantly decrease toward the end of elite soccer matches in men (Mohr, Krustrup and Bangsbo, 2003) and women (Krustrup, Mohr, Ellingsgaard and Bangsbo, 2005).

Researchers have tended to use two terms as a way to quantify the ability to resist fatigue during RSA, which are; i) fatigue index (FI) and/or ii) the percentage decrement score (Sdec) (Girard et al. 2011). The FI has generally been calculated as the drop-off in performance from the best to worst sprint performance during an RSA whereas the Sdec attempts to quantify fatigue by comparing actual performance to an imagined 'ideal performance' (i.e. where the best effort would be replicated in each sprint) (Girard et al. 2011).

With the claim of RSA ability to help resist speed-based fatigue and thus means helps developed speed-endurance, number of scientific studies evaluating RSA effectiveness such as the physiological effects during RSA training has been increasing from year to year (Bravo et al. 2008; Impellizzeri et al. 2008; Perrey, Racinais, Saimouaa and Girard, 2010; Rampinini et al. 2007; Spencer et al. 2005; Spencer et al. 2004) with findings stressed the important of RSA for sports performance. However, while the proofs of RSA effectiveness as training and test modalities, not many studies has compared the RSA performance with and without ball among soccer players. The use of RSA with proper output analysis is also lacking, which may be due to perceptions that the only output is just the duration/time recorded, and the need of more sophisticated equipment such as global positioning system (GPS) with specific software for output can be utilized and understood. As part of the effort to promote and enhance scientific based practiced among university soccer teams, this study was conducted, with it methods and output presentations can be used by practitioners on field without much need of more advanced equipment. This study attempted to investigate the RSA in two conditions, with ball and without ball among university soccer players. The RSA performance were analysed through the sprint time, fatigue index (FI) and percentage of decrement score (Sdec).

2.0 Methods

2.1 Participants

Twenty four university soccer players with mean age 21.30 ± 2.14 years old were recruited for this study. Participants participated voluntarily, were currently in their preparation phase for upcoming tournaments and were actively training five times per week during the time of the data collection. Participants had been screened prior to testing using Pre-Exercise Questionnaire (PAR Q) test and each participant has read and signed an informed consent for research participation approved by the Research Management and Innovation Centre, Universiti Pendidikan Sultan Idris (Code: RAGS/2013/UPSI/SG/01/2). All participants received a detailed explanation about the aims and the procedures of the study prior to the data collection.

2.2 Procedures

The RSA test involved 5 repetitions of maximal effort 40 m run with 60 seconds active rest in between. Figure 1 showed the RSA test set-up developed for this study. Participants were needed to run 6 m (60˚ straight to the left) before make the first turn (60˚ straight to the right for 7 m) and then make the second turn (60˚ straight to the left for 7 m) before participants make a 180˚ turn to return back to the starting point. Participants also need to run through the two turns on the way back. Markers were placed at all the points that participants need to make turns.

During the active recovery, participants need to walk around for 40 seconds. Twenty seconds before starting each sprint, participants were asked to get ready at the starting line and await the start signal from an instructor. At the starting point, participants were instructed to stand passively with non-dominant leg were used as a leading foot at the starting line. The start signal involve the instruction of the instructor 'Ready, Set, Go!'.

All participants were needed to perform two RSA test; one with ball and one without ball. For with ball RSA test, participant need to sprint while dribbling the ball until reached the 20 meter point where they were needed to kick the ball to a small goal that had been set up 7 m straight away from the 20 m point. Participants just need to sprint back to starting line without ball.

The sprint time for 20 m was measured using a timing gate (Microgate, Bolzano, Italy) located at the starting line, 1 m above the ground. A hand-held Q&Q Quartz stopwatch (Citizen Watch Co., Ltd., Tokyo, Japan) was used to monitor recovery time. The players commenced each sprint, starting from a standing position 0.5 m behind the sensor. Strong verbal encouragement was provided to each subject during all sprints. Three scores were calculated for the analysis; i) sprint time, ii) FI, and iii) Sdec.

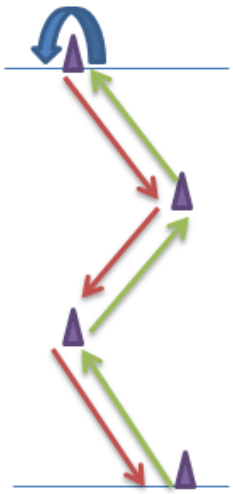

Figure 1. RSA test set-up developed for this study

2.3 Formula

The FI was measured to indicate the drop-off in performance from the best to worst sprint performance while Sdec was measured to quantify fatigue by comparing actual performance to an imagined 'ideal performance'(Girard et al. 2011). Both the formula of FI (eq. 1) and Sdec (eq. 2) were adapted from Girard et al. (2011).

Equation 1

$FI = [(S_{best} - S_{worst}) / S_{best}] \times 100$

Equation 2

$Sdec\ (\%) = [(S_1 + S_2 + S_3 + S_4 + S_5) / (S_{best} \times \text{number of sprints}) - 1] \times 100$

2.4 Statistical analyses

Shapiro-Wilk test was conducted to analyse the normality of data. Descriptive statistics was conducted to analyse the mean of physical characteristics, sprint time, FI and Sdec. Wilcoxon signed rank test was conducted to assess the different of sprint time, FI and Sdec of the CDRSA test performed with ball and without ball.

3.0 Results

Table 1
showed the physical characteristics of participants.

Table 1.
Physical characteristics of participants

	Mean ± SD
Age (years)	21.30 ± 2.14
Body mass (kg)	65.35 ± 3.29
Height (cm)	172.86 ± 3.42

Table 2 showed the time for each sprint in RSA without ball conditions. Sprint 1 and Sprint 2 were shown to be significantly faster compared to Sprint 5 (Sprint 1, $p = 0.012$; Sprint 2, $p = 0.038$).

Table 2.
Sprint time without ball

Sprint	RSA time without ball (s) Mean ± SD
Sprint 1	7.22 ± 0.62
Sprint 2	7.22 ± 0.64
Sprint 3	7.24 ± 0.65
Sprint 4	7.27 ± 0.65
Sprint 5	7.31 ± 0.68

Table 3 showed the time for each sprint in RSA with ball conditions. All Sprint 1, 2, 3 and 4 were shown to be significantly faster compared to Sprint 5 (Sprint 1, $p = 0.001$; Sprint 2, $p = 0.008$; Sprint 3, $p = 0.001$; Sprint 4, $p = 0.04$).

Table 3.
Sprint time with ball

Sprint	RSA time with ball (s) Mean ± SD
Sprint 1	8.02 ± 0.60
Sprint 2	8.06 ± 0.61
Sprint 3	8.11 ± 0.61
Sprint 4	8.14 ± 0.62
Sprint 5	8.28 ± 0.68

Table 4 showed the comparison of average sprint time, FI and Sdec between RSA without ball and with ball. Results showed the sprint time without ball was significantly faster compared to sprint time with ball, $p < 0.001$. Besides that, FI and Sdec were found to be significantly higher in with ball condition, $p < 0.01$.

Table 4.
Comparison of average sprint time, FI and Sdec between CDRSA without ball and with ball

	Time (s) Mean ± SD	FI Mean ± SD	Sdec Mean ± SD
RSA without ball	7.25 ± 0.64	3.63 ± 2.90	1.87 ± 1.58
RSA with ball	8.12 ± 0.60	5.57 ± 4.17	2.67 ± 1.84
% difference	12%	53.44%	42.78%
sig	0.000	0.008	0.006

i) Time = average sprint time, ii) FI = fatigue index, iii) Sdec = percentage decrement score of sprinting, iv) % difference = percentage difference of score between without ball and with ball, v) sig = p-value.

4.0 Discussion

This study was conducted to examine the RSA in two conditions; with ball and without ball. Major findings in this study were the sprint time without ball was shown to be significantly faster compared to sprint time with ball. Additionally, performing RSA with ball was shown to induce greater FI and Sdec.

During without ball condition, participants perform the same speed in the first and second sprint but start to drop performance in the third sprint. However, the drop in performance was not found to be significantly different thus showed that participants able to maintain their speed throughout the five series of sprint. During with ball condition, it was found that participant start to drop in performance as early as in the second sprint. The drop in performance continued until the fifth sprint. Participants marked drastic drop in speed in the fifth sprint in which all the other sprints (Sprint 1-4) were shown to be faster compared to the fifth sprint.

Looking at the differences between with ball and without ball, it was found that the average sprint time without ball (m = 7.25 ± 0.64 s) was significantly faster compared to sprint time with ball (m = 8.12 ± 0.6 s), $p < 0.001$. This showed that soccer players' speed significantly decreased when they are with ball. FI without ball (m = 3.63 ± 2.9) was shown to be significantly lower compared to FI with ball (m = 5.57 ± 4.17) with mean difference was shown to be high (53.44%) between the two conditions, $p < 0.01$. Besides that, the Sdec without ball (m = 1.87 ± 1.58) was also shown to be significantly lower compared to the Sdec with ball (m = 2.67 ± 1.84) with mean difference was shown to be 42.78% between the two conditions, $p < 0.01$. In practical or real situation, decrease in speed when the players are in the possession of the ball may provide opportunity to competing players to catch up and obtained the ball.

It is important for the coaches and athletes to plan on the training to improve the players' sprint ability. Speed, agility and quickness (SAQ) training was found to be effective in improving sprint ability with and without ball (Milanović, Sporiš, Trajković, James and Šamija, 2013). However, training should not only focus on sprint alone but also have to look at other methods of training. Previous study has shown the coordination training was more effective than traditional repeated sprint training on improving sprint ability with ball among pre-adolescent soccer players (Venturelli, Bishop and Pettene, 2008). The slower sprint time when with ball condition in this study can be said as an indicator of weak ball control ability among the players. As a solution, more training aiming at improving basic ball control skills combined with sprint training such as used in this study is suggested.

Besides that, coaches and players also should be aware of the warm up session before the soccer match. Zois, Bishop, Ball and Aughey (2011) in their study found leg-press and small-sided game warm-up were more effective compared to traditional warm up in improving sprint ability among soccer players. The reason behind this should be due to the leg press and small sided games activities were able to improve the soccer players' coordination with ball (ball control).

Different techniques on carrying the ball was shown to affect the sprint ability in rugby (Grant et al. 2003; Walsh, Young, Hill, Kittredge and Horn, 2007) thus showed soccer players need to enhance their skills in ball controlling to avoid drop in sprint ability. Training with ball should be increased as the ball is the one that should be controlled in a soccer match. Nevertheless, sprint training while carrying a rugby ball is as effective as sprint training without carrying a rugby ball for improving the sprint performance of elite rugby league players (Seitz, Barr and Haff, 2015).

5.0 Conclusion

As a conclusion, it can be seen from this study that no matter how fast a player's single sprint ability, they may not have the ability to repeat it as many time as possible, which will be required during the actual games. Apart from that, it can be concluded that RSA apart from it known used as speed-endurance development method, it can also be used as a test and training method to enhance speed-endurance in combination with change of direction component. It is important to be noticed that this combination has taken into account the specific requirement of soccer players in the real match. However, future studies need to be conducted on different RSA protocols on sprint time performance and fatigue index and the methods of training to improve sprint ability with ball among soccer players of various level of performance (i.e., beginners, amateurs, elite groups etc).

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