Performance Indices of Two Different Repeated Ability Tests Based on Playing Positions

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Abstract Soccer is characterized as complex sport which requires high aerobic, anaerobic capacity, and tactical skills. The purpose of this study was to examine the performance indices of repeated sprints ability (RSA) and repeated dribbling ability (RDA) tests among Malaysian University soccer players. A total of fifty-two soccer players were participated (age 21.73 ± 1.82 years, height 171.31 ± 5.27 cm, weight 63.78 ± 7.30 kg, BMI 21.69 ± 2.29 kg m^{-2}) to perform all 4 tests: repeated sprint ability (7 × 34.2 m), RDA (7 × 34.2 m), anaerobic power (vertical jump), and aerobic power (20-m multistage shuttle run test). Significant level was set at $p < 0.05$ according to the player's position in the teams. There were significant differences in VO_{2max}, total time, best time, and mean time of both repeated ability tests. Peak blood lactate of RDA test also showed the significant difference between playing positions. Anaerobic interrelated to aerobic power with greater VO_{2max}, which would speed up recovery from explosive power activities in soccer.

Keywords Aerobic power · Leg strength · Fitness testing · Repeated ability · Soccer

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1 Introduction

Soccer is an intermittent sport which requires high aerobic [1] and anaerobic capacity [2]. Intermittent sports require players' skills incorporate with technical, tactical, and physical fitness to succeed [3]. Studies have shown the anaerobic component in soccer involves sprints, tackles, and jumps in one game. Therefore, sprinting could be the most important skill that determines the success of the game [4]. In order to perform high speed of running, the maximum anaerobic power requires powerful and strength of leg in competitive games [5, 6]. The ability to produce fastest sprint in shortest time separated by recovery known as repeated sprint ability (RSA) [7]. Repeated dribbling ability (RDA) is determined by the ability to dribble at highest speed. Dribbling or running with ball requires the player to control the ball's direction while maintaining high speed of running [8]. Running with the ball is a good skill that provides advantages over opponents in ball possession.

Duration of 90 min of soccer game is important for recovery from any anaerobic activities and to maintain player's performance. The efficiency of cardiovascular system to supply oxygen to all working muscle indicates player having the greatest VO_{2max} level and could optimally perform exercise. The literature reported professional soccer players reached between 55 and 67 ml kg^{-1} min^{-1} [1, 7].

Using match analysis technology, players performed almost 30 % of running and 60 % of sprinting in soccer [9]. Due to anaerobic activities, blood lactate increases and affects blood flow to tissue. The accumulation of the blood lactate will lead fatigue and decrease player's performance. Higher capacity of oxygen consumption tends to delay the concentration of blood lactate.

Studies have shown that there is decline in amount of sprinting [10] as well as decrement in high-intensity efforts in second half of a soccer game [9, 11, 12]. Distance covered by elite players during match play has been reported in range between 10,000 and 14,000 m in mean based on playing position [13, 14]. Midfielders showed the greatest distance covered during the play match with approximately 12,000 m [15]. Strikers performed the highest number of sprints, but the total of distance covered decreased in the second half [15]. There was significant difference of activities such as sprinting, jumping, tackling, and other performance according to their playing position [16]. No significant difference was found between the total of ball possession in a match play with the different playing positions in the team [16].

Therefore, the purpose of this study was to examine the performance indices of two different of RSA and RDA tests among Malaysian University soccer players.

2 Methods

2.1 Participants

Fifty-two, well-trained soccer players (age 21.73 ± 1.82 years, height 171.31 ± 5.27 cm, weight 63.78 ± 7.30 kg, BMI 21.69 2.29 kg m^{-1}) selected participants were enrolled by university students. All participants were members of top three teams from the first division of Malaysian Higher Education Institution Soccer league, 2013. These teams were consistently ranked among the top 3 teams in the league for last 2 years. The players trained 5 days every week (~90 min per session) with the university team for at least 4 months and active in sports within 1 year.

During the session, participants were competed every weekend. This study was performed in the middle of the soccer season, when the players were assumed to be in their best physical fitness. Player who was free from any injuries was selected for this study. Exclusion criteria consisted of history of any cardiovascular, metabolic disorders, musculoskeletal, and neurological problem. Subjects answered a demographic or injury history questionnaire which was used to obtain background information from each participant.

All the procedures were approved by the Institutions Ethic and Research Committee (Ref: 600-RMI 5/1/6) of Universiti Teknologi MARA, Malaysia. The testing procedures were explained to participants, and a written informed consent was obtained before testing started. All participants were fully familiar and clearly understood with the procedures used in this testing. They were informed that they could withdraw from the testing at any time without penalty.

2.2 Procedures

Participants started the tests varying between 1,630 and 1,900 in order to maintain their performance similar to the routine training and to avoid any circadian variability. On the RSA and RDA testing day, the reading of temperature and wind velocity was recorded to ensure both factors were controlled. The temperature was about 33 °C and wind velocity was 1.2 mps. All tests were conducted in two sessions after at least 48 h which last performed match or vigorous exercise to prevent unnecessary fatigue accumulation. First session was comprised of anaerobic power test (vertical jump) and aerobic power test (20-m multistage shuttle run test). Second session was comprised of RSA and RDA tests. All tests were conducted outside on a grass training field, using regular soccer shoes to replicate playing condition.

Before testing, a standardized warm-up consisted of jogging and stretching for 20 min was conducted.

2.3 Vertical Jump Test

Vertec is testing device, where steel frame construction has horizontal vanes and would be rotated out of the way by the hand to indicate the height reached. For starting, participants had their standing reach measured, and then, they pointed of the arm fully extended upward of the dominant arm against the Vertec apparatus. The Vertec standing reach height marker was adjusted to the tip of their dominant hand's middle finger. Participants performed the test with feet flat on the ground and about shoulder width apart, ready position to perform. Then, they started the projectile motion, and participants were on the upward phase of the jump where they extended their dominant hand into the air in attempt to displace the Vertec measuring vanes. The displacement of the vanes was used to measure a participant's vertical jump height, per 1/2 inch increments; the jump height was the difference between standing height and jumping height.

All power output measurements were based on the highest point deduction to the lowest height. The Sayer's equation was used to calculate peak anaerobic power output in the vertical jump was (60.7 × height (cm) squat jump + (45.3 × body mass (kg) – 2,055 [17].

2.4 20 m Multistage Shuttle Run Test

The 20-m multistage shuttle run test was conducted according to established procedures. When the participants were ready, the CD was started and the participant commenced the test. Participants had to follow the procedures and performed their maximal effort. If the participant arrived at the end of a shuttle before the beep, the participant had to wait for the beep and then resume running. If the participants failed to reach the end of the shuttle before the beep, they should be allowed two or three further shuttles to attempt to regain the required pace before being withdrawn. Researcher recorded the level and number of shuttles completed at that level either when the participant withdraws voluntarily from the test failed to be within 3 m of the end lines on two consecutive tones [18].

2.5 Repeated Sprint and Repeated Dribbling Ability Tests

The RSA and RDA tests were conducted after 48 h from the first session. Blood sample was taken at rest as baseline prior to warm up. Before RSA test, each subject was allowed to perform two sprints, and for RDA test, participant allowed to perform two repetitive dribbling skills along the test course for familiarization purposes. Although in the absence of any learning effects from this type of multiple sprint protocol [19], all subjects completed a familiarization trial of both protocols.

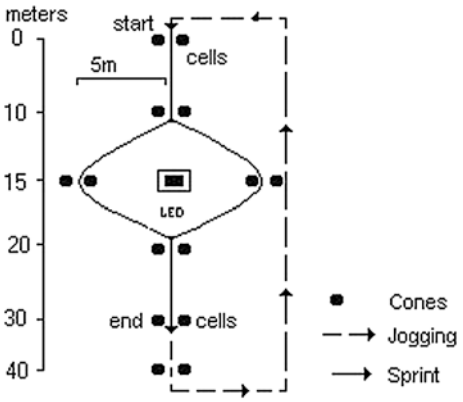

Fig. 1 Diagram of Bangso test protocol [21], adapted by Aguiar et al. [20]

Testing was started with RSA followed by RDA test. Same participant would perform the next testing after 1-h rest interval. The protocol comprised of seven maximal 34.2 m sprints [4, 20]. Participant sprint along a distance of 10 m changes direction and sprint between an obstacle along 14.2 m and sprint along 10 m as showed on Fig. 1. Electric timing gates were used to measure participant's performance. Following each sprint, there was a period of active recovery (25 s to cover a distance of 40 m), which consisted of jogging to return to the initial point. Recovery was taken using stopwatch in order to ensure subject return to initial point of course between 23rd and 24th s. Verbal feedback was given by assistants at 5, 10, 15, 20, and 25 s of recovery [4, 20]. Similar protocols were used to perform RDA test except participant while dribbling a ball.

2.6 Peak Blood Lactate and Lactate Removal Rate

Blood sample was collected from fingertip at the end of RSA and RDA tests (zero time recovery) and at 1st, 3rd, 5th, 7th, 9th, and 12th minutes of recovery [13]. The participant's finger was washed with water and dried, then it was disinfected by alcohol-contained cotton, and using single use of disposable lancet device, participant's finger was pricked. Laboratory assistant would swab alcohol-contained cotton again at the participant's finger to ensure the hygiene of blood sample. The blood sample was collected into lactate strip and analyzed using an automated lactate analyzer (Accutrend). After 1 min, the analyzed blood sample was recorded.

2.7 Statistical Analyses

Descriptive statistics were reported as mean ± SD for all measures with different playing position in team. A one-way ANOVA with Tukey's post hoc test was used to examine possible differences between four playing position: goalkeepers,

Table 1 Anthropometric measures, aerobic and leg power ($N = 52$)

Measures	Mean ± SD
Age (years)	21.73 ± 1.82
Height (cm)	171.31 ± 5.27
Weight (kg)	63.78 ± 7.30
BMI (kg m^{-2})	21.69 ± 2.29
Leg power (W)	3,473.93 ± 3,473.93
VO_{2max} (ml min^{-1} kg^{-1})	47.91 ± 6.378

strikers, midfielders, and defenders. All data were tested for assumptions of normality, homogeneity of variance and covariance matrices. The results were not violated the assumptions. The alpha level of statistical significance was set at $p < 0.05$.

3 Results

The anthropometric characteristics of the players, aerobic, and leg strength power are summarized in Table 1. The aerobic and leg power by playing positions are summarized in Table 2. The results of the performance indices of two different repeated ability tests by playing position are summarized in Tables 3 and 4.

4 Discussion

The purpose of this study was to examine the performance indices of repeated sprints ability, RDA, anaerobic and aerobic power by playing positions among Malaysian University soccer players. The significant difference was showed between maximal oxygen consumption and positions in Table 2. This would be expected that the midfielders (50.67 ± 5.65 ml min^{-1} kg^{-1}) would have the highest VO_{2max} and slightly difference between strikers and defenders. Moreover, VO_{2max} was the main factor would maintain performance players [21]. An increase in VO_{2max} blood transport oxygen efficiency will improved athlete's performance [22]. Limitation of oxygen delivery to muscle due to decrease of oxygen supply during the test activities [23].

There was no significant difference of leg power of different positions. The same result from previous studies reported no significant difference of leg power among players [24]. However, the highest leg power (3,779.56 ± 404.46 W) was found among goalkeeper compared to other positions. The probable reason is that goalkeepers had the highest mean may due to body structure as goalkeeper and their difference of training role.

Table 2 Aerobic and leg power by playing positions

Characteristics	Position				
	GK ($n = 4$)	ST ($n = 11$)	MID ($n = 14$)	DF ($n = 23$)	F value $p < 0.05$
Leg power (W)	3,779.56 ± 404.46	3,395.16 ± 430.99	3,324.42 ± 338.89	3,549.93 ± 490.30	1.55
VO_{2max} (ml min^{-1} kg^{-1})	38.99 ± 6.49	48.47 ± 5.50	50.67 ± 5.65	47.53 ± 6.03	4.20*

Values are (mean ± SD), * significance value set at $p < 0.05$

Table 3 Performance indices of RSA (mean ± SD) by playing positions

Indices	Position				
	GK	ST	MID	DF	*F* value $p < 0.05$
Total time (s)	46.50 ± 2.34	38.97 ± 1.88	40.55 ± 4.76	42.21 ± 3.21	5.41*
Fastest time (s)	6.31 ± 0.26	5.34 ± 0.21	5.58 ± 0.65	5.70 ± 0.47	4.21*
Mean time (s)	6.64 ± 0.34	5.57 ± 0.27	5.79 ± 0.68	6.03 ± 0.46	5.43*
Performance decrement (%)	5.26 ± 1.86	4.31 ± 2.02	4.23 ± 1.73	5.30 ± 2.37	1.04
Peak blood lactate (mmol L^{-1})	13.80 ± 1.10	13.21 ± 1.71	11.81 ± 2.23	12.62 ± 1.80	1.75
Removal rate (mmol L^{-1} min^1)	0.39 ± 0.28	0.37 ± 0.15	0.34 ± 0.21	0.34 ± 0.19	0.11

* Significance value set at $p < 0.05$

Table 4 Performance indices of RDA (mean ± SD) by playing positions

Indices	Position				
	GK	ST	MID	DF	*F* value $p < 0.05$
Total time (s)	67.97 ± 6.77	57.52 ± 4.64	58.62 ± 7.88	62.91 ± 4.88	4.66*
Fastest time (s)	8.86 ± 0.67	7.39 ± 0.64	7.76 ± 1.23	8.28 ± 0.75	4.15*
Mean time (s)	9.35 ± 0.76	8.21 ± 0.66	8.37 ± 1.13	8.87 ± 0.76	2.82*
Performance decrement (%)	9.56 ± 3.21	10.42 ± 4.19	7.83 ± 4.45	8.72 ± 3.91	0.88
Peak blood lactate (mmol L^{-1})	13.95 ± 2.26	11.99 ± 1.91	10.08 ± 1.90	11.06 ± 3.13	2.81*
Removal rate (mmol L^{-1} min^1)	0.35 ± 0.30	0.48 ± 0.23	0.37 ± 0.11	0.47 ± 0.24	1.05

* Significance value set at $p < 0.05$

The probable reason is that goalkeepers had the highest mean may due to body structure as goalkeeper and their difference in training intensity compared to other position. Although the mean of fastest time was showed slightly difference, the statistical analysis confirmed strikers' (5.34 ± 0.21 s) sprint was the fastest. The fastest time would influence mean time of players [10]. Thus, the mean time was significant difference among strikers. Sprinting, jumping, and tackling were used to test anaerobic power in soccer [25].

The RDA would explain players' skill of controlling the ball possession as well as maintaining high running speed [8]. Strikers showed to have good dribbling skill among positions. They reported to have lowest mean in total time, fastest time, and mean time. An interesting observation of the fastest time was performed by player during the 6th and 7th in repeated sprinting and dribbling ability. Similar result from 5th to the 7th sprint players met to speed up their running pace [26].

The peak blood lactate was significant difference among goalkeepers (13.95 ± 2.26 mmol L^{-1}) followed by strikers (11.99 ± 1.91 mmol L^{-1}) and defenders (11.06 ± 3.13 mmol L^{-1}). The extended performed of anaerobic activities of sprinting or dribbling during match play may cause the elevation of blood lactate [27]. Performance decrement was indicator of fatigue; however, the rest intervals were induces oxygen uptake.

5 Conclusion

In improving aerobic power, implementing specific soccer training would be beneficial. The identical total work, RSA, and RDA with rest intervals demonstrate different physiological implications. In this context, players' positions present the best method to identify and propose specific soccer training. Both tests attribute different fitness and address abilities of strength and condition among players. The aerobic power that addressed midfielders was the highest VO_{2max} with greatest distance covered. The tests replicate the playing game of tests where it stimulates optimal performance. The fastest time indicates running as quickly over the opponents for scoring goals. Therefore, dribbling and sprinting are interrelated skills in soccer.

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