Profiling and Relationship between Sprint Time and Cardiovascular Fitness during In-Season's Training among Professional Soccer Players

Nor Ikhrar Madarsa1,2, Nur Ikhwon Mohamad1, Nor Fazila Abd Malek1, Chamnan Chinnasee3 & Ali Md Nadzalan1

1Faculty of Sports Science and Coaching, Sultan Idris Education University, Malaysia
2Perak Football Association, Malaysia
3Faculty of Health and Sports Science, Thaksin University, Thailand

Corresponding: Nur Ikhwon Mohamad (nur.ikhwan@fsskj.upsi.edu.my)

Abstract. The purpose of this study was to examine the sprint time and cardiovascular fitness among professional soccer players during in-season’s training sessions. Thirty participants who officially registered as Perbadanan Kemajuan Negeri Perak Football (PKNP) Club professional soccer players participated in this study. Data were collected during actual in-season training sessions from December 2016 to April 2017. Sprint time performance was determined by the 20m sprint test and 20m Yoyo Intermittent Recovery Test Level 1 was used to determine the cardiovascular fitness level of the players. Repeated Measures and Pearson Correlation Coefficient was used to analyzed the data, there was significant improvement (p<0.05) for sprinting performance from pre-test (3.59 ± 0.36 sec) to post-test (3.20 ± 0.14 sec). There was also a significant improvement for cardiovascular performance from pre-test (68.65 ± 3.88 ml•kg⁻¹•min⁻¹) to post-test (75.40 ± 5.45 ml•kg⁻¹•min⁻¹) throughout the four months of training periods. There was a significant relationship (p<0.05) between sprint time performance and cardiovascular fitness performance for all six series testing. Thus, it can be concluded that throughout the process of monitoring, the player’s performance can be identified, as showed in this study there was an improvement on sprinting performance and cardiovascular fitness performance throughout six series testing, which mean players undergone relevant training program during the in-season training session.

Keywords: speed, cardiovascular endurance, strength and conditioning, monitoring

1. Introduction

Soccer is a complex sport, which requires multiple performance actions in sprinting and running at high intensity, respectively [1]. It also a game that involves various skills, strategies, tactics and physical elements that are required for better performance and in order to enhance these conditions, specialized training should be given to the players [2]. In an intermittent team sports event including soccer, the importance of sprinting ability was hardly express as one of the keys or the main factor contributing to fitness performance [3-5]. To better assess the sprint ability of soccer athletes, a running sprint test should be utilized with shorter sprint distances than 40 meters [6]. In addition, in a modern soccer match, it’s demanding a player to perform a high-speed repeated sprinting in a short
distance and at the same time, this movement needs to be consistently performed at a high pace throughout the match.

To ensure the training program was successful throughout the season and able to sit in and fit every individual ability and needs, the player’s performance needs to be monitored and the strategy has to be laid out from the overall outcome of the monitoring process. The pre-season calendar and in-season match calendar also need to look into in order to not suppress the element of recovery [7]. The fitness test was the most relevant tools in order to monitor an individual’s performance status. Performance monitoring program needs to properly plan as it is a part of chronic or long term outcomes from a training program implemented. A series of fitness testing in a certain duration of the performance monitoring program helps to ensure the training program is on track towards maximal performance achievement.

The player’s performance monitoring process can show the strengths and weaknesses of the players. Besides that, it is also reflected in the training program implemented in the field. From the data and information provided, the proper correction can be made on the training program and a detail calculation on training stimulus can be made. The comparison of the published data can help to improvise the values and contribute towards a better practice on a field [8].

Most of the previous study was prepared with the intervention or treatment or specific procedure and protocol which interrupted the actual practice and application in a professional soccer team, hence, this study was being conducted in an actual study case in order to identify and examine the actual practice in a professional soccer team in performance monitoring program and the outcome of this study can elevate the value of understanding and realistic. The purpose of this study was to determined the relationship between sprint time, cardiovascular fitness and session's rate of perceived exertion (sRPE) on the PKNP FC professional soccer players during an in-season performance monitoring program.

2. Methodology
The study was a descriptive case study. All data in this study were recorded during an actual session of the player’s performance monitoring process. All of the players have gone through a six series of fitness testing during in-season performance monitoring. This player’s performance monitoring process, which included the testing battery and the time periods of the monitoring process, was decided by the head coach and advised by the physical conditioning coach of the club.

2.1. Participant
This study involved thirty professional soccer players from PKNP’s FC. All participants were actively participated in a team training program and clear from any major injuries which need a rest for more than one week.

2.2. Instruments and Procedure
A multi-weight and height (Kyoto, Japan) scale was used in this study to measure the height and weight of the players. To measure a distance of 20m sprint and YYIR1, a 50m normal measurement tape was used. In order to measure a sprint time, a handy sport Casio stopwatch was used. The cardiovascular fitness performance test was conducted using the Yoyo Intermittent Recovery Level 1 test protocol [9].

Firstly, All participants were brief on the study conducted on the first fitness testing session and the inform consent form was provided. In every fitness testing session, the participants underwent a standardized 10 minutes warm-up protocol before fitness testing. During the 20m sprint test. The timekeeper standing parallel with the 20m finishing line. The players were in a ready position at the starting line. Once the players take off from the starting line, automatically the timekeeper starts the stopwatch and stop the watch once the torso of the player
reaches the finishing line. All participants underwent three trials and the best time was recorded to be analysed. The resting time in between trials was 1 minute 30 seconds. Thirty minutes after the sprint test completed, the Yoyo Intermittent Recovery Level 1 (YYIR1) test was conducted. YYIR1 protocol was an incremental speed of 2 x 20-meter shuttle run with the recovery of 5-meter distance in 10 seconds. The speed between the beep sounds progressively increased throughout the test. The participants need to place at least one foot on the starting line before start with beep sound. They had to reach the starting line before the beep sound and only can leave the starting line after the beep sound. The participants performed a shuttle run as much as possible according to the sound recorded and given one time warning before being eliminated if unable to reach the starting line according to running speed for the second time. Once eliminated or withdrawn from the test, their shuttle score were recorded.

2.3. Statistical Analysis
Descriptive statistics were performed to determine the mean and standard deviation (SD) of demographic data. Repeated Measures were used to measures the significant improvement in 20m sprint performance and cardiovascular fitness performance throughout the six series of testing. Whereas, the Pearson Correlation Coefficient was used to find out the significant relationship between 20m sprint performance with cardiovascular fitness performance. All statistical analyses were conducted using Statistical Package for Social Science (SPSS) version 22 (IBM, USA).

3. Result

3.1. Descriptive Statistic of Demographic Data
The average age for the participants in the study was (24.68±3.12 years), followed by height (176.15±7.48 cm) and weight (69.38±8.45 kg).

| Test 1 | Test 2 | Test 3 | Test 4 | Test 5 | Test 6 |
|--------|--------|--------|--------|--------|--------|
| 3.59±0.36 | 3.31±0.25 | 3.18±0.16 | 3.19±0.15 | 3.23±0.15 | 3.20±0.14 |
| 68.65±3.88 | 72.57±3.81 | 74.62±5.03 | 75.40±5.45 | 75.40±5.45 | 75.40±5.45 |

3.2. Mean and Standard deviation for 20m Sprint (sec) & YYIR1 (ml•kg⁻¹•min⁻¹)

| Test | 20m Sprint | YYIR1 |
|------|------------|-------|
| Test 1 | 3.59±0.36 | 68.65±3.88 |
| Test 2 | 3.31±0.25 | 72.57±3.81 |
| Test 3 | 3.18±0.16 | 74.62±5.03 |
| Test 4 | 3.19±0.15 | 75.40±5.45 |
| Test 5 | 3.23±0.15 | 75.40±5.45 |
| Test 6 | 3.20±0.14 | 75.40±5.45 |

3.3. Sprint Time Performance based on Repeated Measures
Table 3 showed sprinting performance throughout the four months of training periods, there was a significant improvement for sprinting performance during pre-test (test1) 3.59 ± 0.36 sec post-test
3.20 ± 0.14 sec. All of the other tests also showed a significant improvement in sprinting performance time. The time taken to complete the 20m sprint was reduced and reflect the sprinting ability of the players was improve from Test 1 to Test 6.

| Variable | Sprint Time Performance | Std. Error |
|----------|-------------------------|------------|
| S1-S2    | 0.28                    | 0.04       |
| S1-S3    | 0.41                    | 0.04       |
| S1-S4    | 0.40                    | 0.05       |
| S1-S5    | 0.36                    | 0.05       |
| S1-S6    | 0.39                    | 0.05       |
| S2-S3    | 0.13                    | 0.02       |
| S2-S4    | 0.11                    | 0.02       |
| S2-S5    | 0.08                    | 0.03       |
| S2-S6    | 0.11                    | 0.02       |
| S3-S4    | -0.01                   | 0.01       |
| S3-S5    | -0.04                   | 0.01       |
| S3-S6    | -0.01                   | 0.01       |
| S4-S5    | -0.03                   | 0.00       |
| S4-S6    | -0.00                   | 0.00       |
| S5-S6    | 0.02                    | 0.00       |

Significant is set at 0.05 level.

3.4. Cardiovascular Fitness Performance based on Repeated Measures

Table 4 showed cardiovascular fitness performance throughout the four months of training periods, results showed there was significant improvement in cardiovascular performance from pre-test (test 1) 68.65 ± 3.88 ml•kg⁻¹•min⁻¹ to post-test (test 6) 75.40 ± 5.45 ml•kg⁻¹•min⁻¹, increment in post-test(test6) means the players able to run and covered more distance and level in 20m distance according to the sound recorded.

| Variables | Mean Difference | Std. Error |
|-----------|----------------|------------|
| Y1-Y2     | -3.91          | 0.01       |
| Y1-Y3     | -5.96          | 0.02       |
| Y1-Y4     | -6.74          | 0.02       |
| Y1-Y5     | -6.74          | 0.02       |
| Y1-Y6     | -6.74          | 0.02       |
| Y2-Y3     | -2.05          | 0.01       |
| Y2-Y4     | -2.83          | 0.01       |
| Y2-Y5     | -2.83          | 0.01       |
| Y2-Y6     | -2.83          | 0.01       |
| Y3-Y4     | -0.78          | 0.00       |
| Y3-Y5     | -0.78          | 0.00       |
| Y3-Y6     | -0.78          | 0.00       |
| Y4-Y5     | 0.00           | 0.00       |
| Y4-Y6     | 0.00           | 0.00       |
| Y5-Y6     | 0.00           | 0.00       |
Significant is set at 0.05 level.

\[ Y = YYIR1 \ (ml \cdot kg^{-1} \cdot min^{-1}) \]

3.5. Correlations between Sprint Time Performance and Cardiovascular Fitness Performance

Table 5 showed a correlation analysis between 20m sprint performance and cardiovascular fitness performance. The result showed there was a significant relationship between 20m sprint performance and cardiovascular fitness performance which was tested by YYIR1. It was suggested that a positive improvement in cardiovascular fitness performance also will lead to reducing in 20m sprint time and vice versa. On the other hand, as stated in table 3, it was also can be concluded as one variable was in relation to another variable and if one of the variables was not well trained and maintain, it will affect on another variable.

Table 5. Correlations between Sprint Time Performance and Cardiovascular Fitness Performance

| Variables | Pearson Correlation | Sig. (2-tailed) |
|-----------|---------------------|----------------|
| S1-Y1     | -0.72               | 0.00           |
| S2-Y2     | -0.75               | 0.00           |
| S3-Y3     | -0.60               | 0.00           |
| S4-Y4     | -0.50               | 0.00           |
| S5-Y5     | -0.55               | 0.00           |
| S6-Y6     | -0.61               | 0.00           |

4. Discussion

This study aims to determine sprint time and cardiovascular fitness performance among professional soccer players, the result showed a significant relationship between 20m sprint performance and cardiovascular fitness performance. A positive relationship between both of these variables indicates that players who score better time in 20m sprint have a better score in YYIR1. On the other hand, players with high time in 20m sprint scored less value in YYIR1.

Other than that, this study also showed a significant relationship between 20m sprint performance and cardiovascular fitness performance. The relationship between both of these variables indicates that players who score better time in 20m sprint have a better score in YYIR1. On the other hand, players with high time in 20m sprint scored less value in YYIR1. This finding was in line with a study conducted by [10], they found a correlation between 20m sprint time and repeated sprint ability performance.

Besides that, the lower limb strength and power also tend to influence the sprinting time. A performance shown in 20m sprint time was correlated with the muscle strength and power of the lower limbs [10]. In another study conducted, it shows the high-intensity action and acceleration and deceleration markers of the players start to reduce in the last fifteen minutes of match play [11]. It was suggested, the muscle strength and power of the players start to reduce in the last minute throughout the match play and it is due to muscle fatigue. Therefore, a sport-specific training drill needs to be well planned and implemented on the field in preparing players to perform at maximum ability on a match day.

In this study, PKNP FC professional soccer players underwent an actual training program as per plan by the head coach of the team. It was showed the speed-endurance training implemented on players provides a great improvement in the sprint ability and aerobic capacity of the players. Besides that, speed training conducted also provides an influence on the improvement of sprinting time. It was proved PKNP FC players undergone a relevant training program to develop fitness components such as strength and power.
5. Conclusion
This study was proved a very practical way to identify the physical conditioning status of the players was through conducting a specific and sports-related fitness testing on the player. A 20m sprint shows the sprinting ability and at the same time determined the lower limb strength and power to exert a maximal force in the shortest time. YYIR1 was a well-developed protocol specific to intermittent sports nature such as soccer and rugby. It was used to determine the maximum aerobic capacity of the players. Both of these tests are interrelated with each other and it is proven through a significant relationship in this study. It can be concluded that the monitoring program was important for coaches to have a better view of the current condition of the player to determined players' undergone relevant training programs and easier for them to layout a next suitable training program.

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