# RELATIONSHIP BETWEEN SPRINT TIME, CARDIOVASCULAR FITNESS AND sRPE DURING IN-SEASON'S TRAINING AMONG PROFESSIONAL SOCCER PLAYERS

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# ABSTRACT

The purpose of this study was to examine the relationship between sprint time, cardiovascular fitness and session's rate of perceived exertion (sRPE) among the professional soccer players during the seventy sessions of in-season's training. Thirty participants who officially registered as Perbadanan Kemajuan Negeri Perak Football Club professional soccer players participated in this study. The quasi-experimental research design was used and the data were collected during actual in-season training sessions from December 2016 to April 2017. Sprint time performance was determined by using the 20m sprint test and the 20m Yoyo Intermittent Recovery Test Level 1 was used to determine the cardiovascular fitness level of the players. Ten scales rating for the sRPE was asked at the end of each training to determine the self-perception intensity of the players. Pearson Correlation was used to analyze the empirical data. The result showed a moderate but negative significant correlation between sprint time performance and sRPE ($r=-0.36$, $p<0.05$). In terms of the relationship between cardiovascular fitness performance and sRPE, the data showed a significant moderate positive correlation ($r=0.48$, $p<0.05$). In conclusion, the main results indicated a negative correlation between sprint time and sPRE and a positive correlation between cardiovascular fitness and sPRE. The implication of this study is that sprint time and cardiovascular fitness are pertinent for professional soccer players.

# PERKAITAN ANTARA MASA PECUTAN, KECERGASAN KARDIO-VASKULAR DAN KADAR TANGGAPAN INTENSITI SETIAP SESI DALAM KALANGAN PEMAIN BOLA SEPAK PROFESIONAL SEWAKTU LATIHAN DALAM MUSIM

## ABSTRAK

Kajian ini bertujuan untuk menyelidik perkaitan antara masa pecutan, kecergasan kardiovaskular dan kadar tanggapan intensiti setiap sesi (sRPE) dalam kalangan pemain bola sepak professional sewaktu tujuh puluh sesi latihan dalam musim. Tiga puluh peserta yang berdaftar secara rasmi sebagai pemain bola sepak professional Kelab Bolasepak Perbadanan Kemajuan Negeri Perak telah menyertai kajian ini. Kajian ini dijalankan dengan kaedah ambilan data-data berkaitan sewaktu program latihan dalam musim yang sebenar daripada Disember 2016 hingga April 2017. Reka bentuk penyelidikan kuasi-eksperimen digunakan dan prestasi masa pecutan ditentukan oleh ujian masa 20m pecut dan 20m *Yoyo Intermittent Recovery Test Level 1* (YYIR1) digunakan untuk menentukan tahap kecergasan kardiovaskular semua pemain. Penarafan sepuluh skala sRPE ditanyakan pada setiap akhir sesi latihan dan ujian kecergasan bagi mengenalpasti tahap intensiti persepsi kendiri pemain. *Pearson Correlation* digunakan untuk menganalisis data empirikal. Hasil menunjukkan perkaitan signifikan yang sederhana tetapi negatif antara prestasi masa pecutan dan sRPE ($r=-0.36$, $p<0.05$). Dari segi hubungan antara prestasi kecergasan kardiovaskular dan sRPE, data menunjukkan perkaitan signifikan positif yang sederhana ($r=0.48$, $p<0.05$). Kesimpulannya, hasil utama menunjukkan perkaitan negatif antara waktu pecutan dan sPRE dan perkaitan positif antara kecergasan kardiovaskular dan sPRE. Implikasi kajian menunjukkan bahawa masa pecutan dan kecergasan kardiovaskular adalah relevan bagi pemain bola sepak profesional.

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| | |
|---|---|
| sRPE | Session's rating of perceived exertion |
| YYIR1 | Yoyo Intermittent Recovery Level 1 test protocol |
| PKNP FC | Perbadanan Kemajuan Negeri Perak Football Club |

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# CHAPTER 1

# INTRODUCTION



## 1.1 Introduction

Soccer has been known as one of the prestigious and popular sports in the world. Most of the professional soccer players are highly paid based on their ranking and performances (Andreff & Staudohar, 2000; Dobson & Gerrard, 1999; Pedace, 2008). The best performance demanding a high contribution in terms of positive attitude and discipline, individual technical ability, individual skill, individual tactical ability, team tactical adaptation, and on top of the others is the physical conditioning preparation.

### 1.1.1 Importance of Physical Conditioning in Soccer

Player's physical conditioning is one of the important factors that influence the outcome of the match. The readiness of the players to perform at high-level performance has a bigger influence in an individual capacity and collectively in a team capacity. There was a significant relationship between an average jump height performed by a player with team success and this shows that there is a needs to maximize the individual physical conditioning ability to influence the team's success (Arnason, 2004). A physical conditioning preparation relies a lot on the current physical performance status of the players, and the next status aimed by the players and coaches. To produce a greater positive impact on performance, a sequence of training module needs to be followed. The well-planned training program can produce performance enhancement and decreasing the risk of injury (Gabbett, 2016).

### 1.1.2 Importance of Player's Performance Monitoring

On top of that, nowadays, most of the elite soccer team practically used performance monitoring tools to make sure their training program is on the positive track (Buchheit et al., 2013; Thorpe et al., 2015; Wehbe, Gabbett, Dwyer, McLellan, & Coad, 2015). The importance of the player's performance monitoring has been widely discussed and accepted in soccer to ensure players are ready to perform at their maximum performance ability (Akubat & Van Winckel, 2014). The club or team performance is usually reflected in the player's performance throughout the season. Hence, the progressive and a series of player's performance assessment or fitness testing need to

be conducted. The outcome from a block of the training program is normally measured by fitness testing protocols conducted after a certain period, whereas daily basis immediate responses typically assess by daily or session's rate of perceived exertion scale (sRPE).

Besides that, massive marketing and publicity on the technology related to training load monitoring tools for sports programming of training (Wehbe, Hartwig, & Duncan, 2014), has to lead to awareness on the importance of training load measurement among coaches, making it as a part of the coach's main consideration when evaluating their training program (Brink, Nederhof, Visscher, Schmikli, & Lemmink, 2010). The training load monitoring system also can assist the coaches in terms of revealing the indicator or factors that might influence the rate of injuries, as the increasing the training and gameplay intensity leading up the injuries (Ehrmann, Duncan, Sindhusake, Franzsen, & Greene, 2016). Proper measurement and monitoring systems, therefore, ensure the possibility of updating training programs based on current accurate feedback for better performance enhancement or adjustment.

### 1.1.3 Importance of Fitness Testing in Soccer

There were a few different approaches to identify the player's and team's fitness performance. Two different natures of fitness testing which is a field test or laboratory test can be conducted to determine the player's fitness performance. Monitoring fitness performance regularly can be done mainly via two ways that are either by

laboratory-based tests or more practical by field-based tests such as yoyo endurance test and yoyo intermittent recovery test for determination of aerobic capacity and aerobic-anaerobic power of the players (Castagna, Impellizzeri, Chamari, Carlomagno, & Rampinini, 2006). Studies have found that such field-based tests are significantly correlated with laboratory-based tests, giving assurance that $VO_2$max result on laboratory treadmill running is not significantly differed with soccer-specific field test such as maximum speed endurance running test, yoyo intermittent endurance test, yoyo intermittent recovery test, and 20m multistage bleep test (Bulder, Moen, Weir, Bakker, & Tol, 2011; Chamari, 2005; Daros et al., 2012). Even though in some study show the indirect calculation to estimated $VO_2$max is at high correlations with a direct test to determine $VO_2$max, there was a limitation of laboratory facilities need to be taken into consideration, as not all soccer team has easy access to an accredited sports laboratory lab, hence simple and practical test need to be used and decided for the team which resulted in more usage of alternative field-based tests (Da Silva, Guglielmo, & Bishop, 2010).

No matter what, as experienced by the researcher himself, decisions on types of tests to be utilized relies heavily on strength and conditioning coaches and their discussions with the head coach.

## 1.2 Background of the Study

Football injuries have been estimated to occur in approximately every ten to thirty-five from 1000 playing hours and the majority of the injuries are on lower extremities which are knees and ankles (Dvorak & Junge, 2000). Most of the injuries were on the knee and ankle but there were also reported head and shoulder injuries. Muscle strain from the sprinting, sprain from the tackling and false landing, contusion caused by physical contact is a common injury in soccer and it showed the team who had a proper and more time in pre-season can suffer less injury (Arnason, Gudmundsson, Dahl, & Jóhannsson, 2007; Junge & Dvorak, 2004; Longo et al., 2012). Therefore, to prevent injuries that can be detrimental to the performance, a systematic training program inclusive with proper progress tracking or monitoring system is required.

### 1.2.1 Physical Conditioning Specific to Match Demand

Soccer's pattern of play and team tactical formation has evolved exponentially over the years. Most of the elite soccer team starts to adapt to a faster tempo and high pressing game. The game passing rate increase in 35% with a playing structure changed towards a higher player density meanwhile the game speed also increases by 15%, with players start to regain the ball in the shortest time once losing it (Wallace & Norton, 2014). This no doubt leads to the need for a higher level of fitness level from all players. Without an outstanding physical conditioning preparation, the high tempo pressing game with a minimal time of recovery cannot be performed. Soccer nowadays considered as high intensity and high duration intermittent sports, which

required speed and strength, for example, a great movement of jumping and sprinting need to be performed and all of this movement or activity result in muscular microtrauma which can delay player's recovery and training performance (Coelho et al., 2013). With more competitive gameplay, the physical training programs itself evolve dramatically. Whatever is presented in a match is a reflection of the preparation done in training. Coaches need to plan their training program based on the progressive overload principle, where loading was prescribed progressively following the athlete's level and capacity at that time (Brown & Greenwood, 2005; Kraemer & Ratamess, 2004; Stand, 2009).

### 1.2.2 Importance of Speed in Soccer



Sprinting becomes more important in modern soccer. Most of the professional players perform a straight or linear sprinting before scoring a goal and it becomes a most frequent movement or action. The performance level of the players is distinguished through sprint velocity either in acceleration and maximal sprinting speed embedded with certain agility skills and repeated sprint ability (Haugen, Tønnessen, Hisdal, & Seiler, 2014). In an intermittent team sports event including soccer, the importance of sprinting ability is hardly express as one of the keys or the main factor contributing to fitness performance (Dardouri et al., 2014).

### 1.2.3 Importance of Speed Endurance in Soccer

Speed endurance production and speed endurance maintenance is a soccer-specific physical performance training drill. Both drills respectively improved the distance covered in the Yo-Yo Intermittent Recovery Test level 2 after 3 weeks of training. Speed endurance production improved the repeated sprint ability and high-intensity intermittent performance whereas speed endurance maintenance training drill improved fatigue tolerance in speed ability during performing repeated sprinting and maximum continuous short-duration sprinting (laia et al., 2015). Speed endurance training improved the ability of professional soccer players to perform a repeated high-intensity drill or exercise (Nyberg et al., 2016). 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.

### 1.2.4 Fitness Testing and Performance Monitoring Program

There is a different perception of how hard the training is (termed dose-response) between coaches and players (Brink, Frencken, Jordet, & Lemmink, 2014). While the coaches may think that the training is easy for the players, the players themselves may think and feel otherwise. Most of the current tests prescribed for performance monitoring can be classified as external in nature, meanings they are external to the athletes, which is the intensity performed by the players is evaluated from the heart rate monitoring, GPS monitoring, or fitness testing, not from the player's perception

or self-evaluation (Lovell, Sirotic, Impellizzeri, & Coutts, 2013). However, with many studies on prescribed training load and effect on performance, a method called session's rate of perceived exertion or sRPE has been created and validated, in which it is internal in nature or more towards self-perception or evaluation on the individuals own performance (Comyns & Hannon, 2018; McGuigan & Foster, 2004; Turner, Bishop, Marshall, & Read, 2015). The external evaluation of training intensity and internal self-perception or evaluation of training intensity needs to be closely monitored and complement each other to ensure the training program is progressive towards the upward and positive track.



## 1.3 Problem Statement

The soccer head coach or physical conditioning coach needs to practice a training program that specific to the matching demand and verify the effectiveness of the training program either in an acute or chronic stage. Currently, limited study and published data in the area of performance monitoring in the Malaysian soccer league.

The variation of the training program resulted in a different perspective of the outcome. As mention earlier, the specific soccer match demands need to be incorporated in every training program since the speed endurance, and high aerobic capacity are needed in a modern soccer match, and most of the professional soccer players performed (Iaia et al., 2015). Highly trained or professional soccer players improved in repeated high-intensity work rates with extra training on speed endurance and this indirectly assists them to perform a better soccer play in a real match (Nyberg

et al., 2016). The training that lasts from 30 seconds to 4 minutes in high intensity improved in speed endurance and when embedded with high-intensity aerobic training can enhance the performance and respectively delay fatigue development, reduced energy expenditure in high-intensity exercise and this intensified training action benefits a team sports as soccer team (Bangsbo, 2015).

That is the reason to support the current soccer training need to implement and incorporate the speed endurance training in their training program to ensure the demands of the modern soccer match is fulfilled. However, most of the previous study was result in a specific treatment or training program given to produce specific finding needs. It is crucial to examine or look into the actual case study that is implemented on professional soccer players without given a specific or separated training program or treatment. Hence, the actual training program implemented in the professional soccer team needs to be examined based on the actual case study.

To produce a great result, it is not only focusing on how or what the training is implemented, but it also needs to consider how to monitor the training load given and how to evaluate the outcome of the training provided. A practical and relevant training monitoring method needs to be considered. The quick and direct measurement of intensity 20 minutes after every training session needs to be considered as it reflected the training session achievement. As discussed earlier, the external or internal evaluation can be used to determine the training intensity, but the most important factor to consider is the practicality and cost-effectiveness. The simple and practical method with fewer cost expenses benefited the professional soccer team.

Performance monitoring can be conducted throughout the season or just focusing on the pre and post of the season. It depends on the demands and needs of the team head coach (Los Arcos & Martins, 2018). As mention earlier, most of the study conducted 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 needs to be conducted in an actual study case 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.

## 1.4 Purpose of the Study



The main purpose of this study is to examine 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.

## 1.5 Research Objectives

The objectives of the study are as below:

a) To examine the relationship between sprint time, cardiovascular fitness, and sRPE.

b) To examine the relationship between sprint time and cardiovascular fitness.

c) To examine the relationship between sprint time and sRPE.

d) To examine the relationship between cardiovascular fitness and sRPE.

e) To examine the player's sprint time performance throughout in-season training.

f) To examine the player's cardiovascular fitness performance throughout in-season training.

## 1.6 Research Questions

The research questions that need to be answered by this study are as below:

a) Will there be a significant relationship between external-based performance assessment (sprint time and intermittent cardiovascular fitness level) with internal based assessment (self-perception of intensity based on sRPE) among PKNP's professional soccer players during in-season's training session?



b) Will there be a significant relationship between external-based performance assessment (sprint time and intermittent cardiovascular fitness level) among PKNP's professional soccer players during in-season's training sessions?

c) Will there be a significant relationship between external-based performance assessment (sprint time) with internal based assessment (self-perception of intensity based on sRPE) among PKNP's professional soccer players during in-season's training session?

d) Will there be a significant relationship between external-based performance assessment (intermittent cardiovascular fitness level) with internal based assessment

(self-perception of intensity based on sRPE) among PKNP's professional soccer players during in-season's training session?

e) Will there be a significant improvement on external-based performance assessment (sprint time) among PKNP's professional soccer players during in-season's training session?

f) Will there be a significant improvement on external-based performance assessment (intermittent cardiovascular fitness level) among PKNP's professional soccer players during in-season's training session?

## 1.7 Conceptual Framework of Research

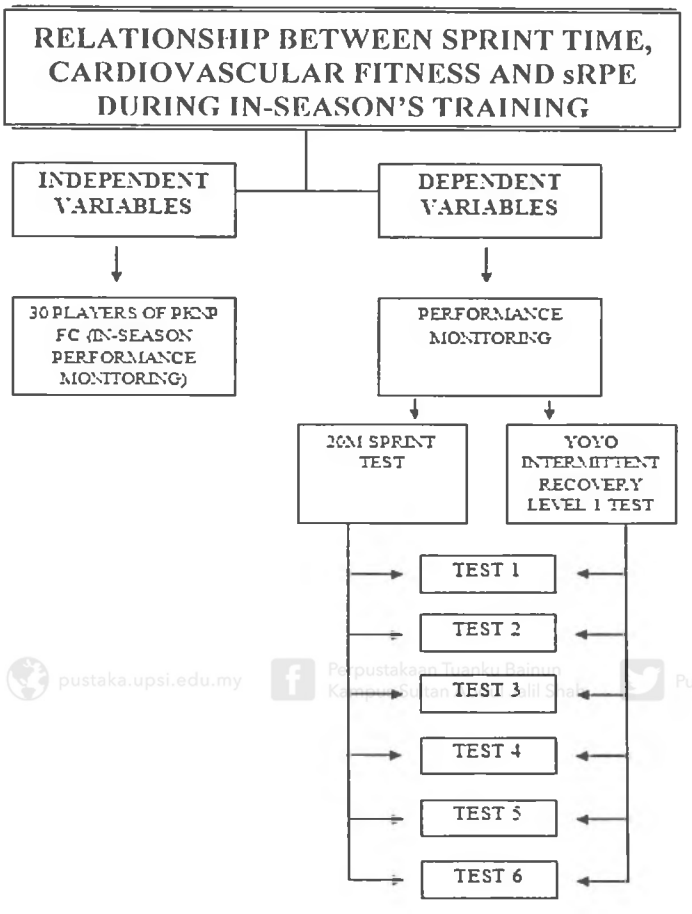


*Figure 1.1* Conceptual Framework of Research Diagram

## 1.8 Significance of the Study

This study is significant as it shows a real-life application of performance monitoring during actual professional soccer league seasons. The overall process of this research was also an actual process on the ground applied by the researcher as the strength and conditioning coach of the team. The write-up of the process in an academic manner provided a more in-depth scientific report of the process and assisted in answering

question arise during actual training sessions. The results of this study had also provided the team with a better understanding of related knowledge and practices, for the betterment of future season's preparation. Even though this study had focused on professional soccer players, the outcome is still valid to be used as a guideline in performance monitoring for school and other semi-professional or development teams.

For strength and conditioning practitioners, results of this study are also significant in a way that it provides evidence on how sRPE as player's perception on intensity interact with other external based assessment traditionally used.

Academically and also for policymakers at sports organizations such as the National Sports Council and Football Association of Malaysia, this study can be said as significantly important due to recorded hands-on knowledge provided, especially on the method of solving problems (research questions) via research method by practitioners on the ground. Finally, this study is significant as it can be said as the first study investigating sRPE in the performance monitoring program in an actual on-going professional soccer league in Malaysia.

## 1.9 Limitations and Delimitations of the Study

The study was conducted during the actual training session of the team. Factors that cannot be controlled in this study include but may not be limited to attendance of the player during a training session, current injury condition of the players, rescheduled

training session by the head coach, and daily weather in each training session. On the other hand, the fitness testing was conducted as planned by the head coach and physical conditioning coach based on the season's schedule. Hence, the time frame or a series of performance monitoring throughout the season cannot be controlled or changed similarly to other research conducted in a pure laboratory environment. However, all of these factors had been counted for and needed to ensure the results of the study depicted actual performance monitoring by the actual team in a soccer league.

## 1.10 Operational Definition



### 1.10.1 Speed

Speed is defined as the average distance over time. In the context of this study, the speed is defined as the average of sprint time performance of players for a 20m distance (Haugen, Tønnessen, Hisdal, & Seiler, 2014)

### 1.10.2 Cardiovascular fitness

Cardiovascular fitness defines the efficiency of the heart, lungs, and vascular system in delivering oxygen to the working muscles. In the context of this study, cardiovascular fitness is defined as the level of fitness being scored by professional soccer players during the 20m sprint and Yoyo Intermittent Recovery Level 1 test protocol (YYIR1) (Bangsbo, Iaia, & Krustrup, 2008).

### 1.10.3 sRPE

Session's Rate of Perceived Exertion is the rating scale from one to ten which is from easy to hard to determine the intensity expressed by the players as reflected the intensity of a training program given (Foster, 2001).

### 1.10.4 Performance monitoring

In the context of this study, performance monitoring refers to the fitness testing conducted and the monitoring tools used to identify the intensity of the training program which is sRPE (Foster, 2001).