



***EFFECT OF SMALL-SIDED GAMES RULE CHANGES ON TIME SPENT
IN DIFFERENT INTENSITY ZONES, FREQUENCY OF TECHNICAL
ACTIONS AND DISTANCE COVERED DURING SOCCER TRAINING***

MUHAMMAD TAUFIQ CHENG BIN ABDULLAH



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By

MUHAMMAD TAUFIQ CHENG BIN ABDULLAH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

April 2016

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Master of Science

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April 2016

Chair: Kok Lian Yee, PhD

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This study aims to examine physiological factors such as the amount of time spent in three intensity zones (low, moderate, high), frequency of technical actions, and distance covered during soccer training utilizing four separate small-sided games (SSGs: 5 vs. 5 plus two goal keepers) with different rule changes (free-touches, SSGFT; one-touch, SSG1T; two-touches, SSG2T; three-touches, SSG3T) in Malaysian Super League (MSL) soccer players. Twelve men's soccer players, the first 11 starting players plus the reserve goal keeper (mean $\pm$ SD: age, 24.3 $\pm$ 4.0 years; height, 171.2 $\pm$ 5.9 cm; weight, 61.9 $\pm$ 7.4 kg) participated in the study. Variables like the amount of time spent in different heart rate (HR) zones and distance covered were recorded using electronic heart-rate monitors and global positioning systems while technical actions were quantified from video recording. This research was conducted using an experimental research design with repeated measures. SSG2T and SSGFT induced longer time spent in the high-intensity heart rate zone ($p = 0.001$) while SSG1T made players spend a longer duration in the moderate-intensity zone ($p = 0.001$) compare to all other SSGs. For technical actions, SSG1T was better for achieving successful passing ($p = 0.001$). SSG1T and SSG3T were better in interceptions ($p = 0.001$). SSGFT created the highest number of shots on goal and crossing ($p = 0.001$). There were no significant differences in goals scored ($p = 0.537$) and the distance covered ($p = 0.574$) during SSGs performance. The essential findings reveals that changes in SSGs playing formats influence training intensity, frequency in technical actions, and distance covered by soccer players during training. Rules with moderate number of touches (SSG2T) are seen to increase the team's chances to score and increase training intensity. These results suggest that SSGs training with different formats are more suitable to specific playing positions such as SSG1T and SSG2T for midfielders, SSGFT and SSG2T for strikers, and SSG1T and SSG3T games for defenders. Finally, the present study suggests that all factors that influence SSGs training should be considered and implemented so that training becomes more complete and reflects actual competitive situations.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains

**KESAN PERUBAHAN PERATURAN PERMAINAN KECIL KE ATAS MASA
DALAM ZON INTENSITI LATIHAN YANG BERBEZA, KEKERAPAN
TEKNIK DAN JARAK LARIAN YANG DILALUI SEMASA
LATIHAN BOLA SEPAK**

Oleh

MUHAMMAD TAUFIQ CHENG BIN ABDULLAH

April 2016

Pengerusi: Kok Lian Yee, PhD

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Kajian ini bertujuan mengkaji faktor-faktor fisiologi seperti masa yang dihabiskan dalam tiga zon intensiti latihan (rendah, sederhana, tinggi), kekerapan dalam tindakan teknikal dan jarak yang dilalui semasa menjalani latihan *small-sided games* (SSGs: 5 vs. 5 dan dua penjaga gol) dengan menggunakan empat peraturan yang berbeza seperti menggunakan sentuhan bebas (SSGFT), satu sentuhan (SSG1T), dua sentuhan (SSG2T) dan tiga sentuhan (SSG3T) dalam kalangan pemain Liga Super Malaysia (MSL). 12 pemain bola sepak lelaki terdiri daripada kesebelasan utama dan ditambah dengan penjaga gol simpanan (min $\pm$ SP: umur, 24.3 $\pm$ 4.0 years; tinggi, 171.2 $\pm$ 5.9 cm; berat badan, 61.9 $\pm$ 7.4 kg) terlibat dalam kajian ini. Variabel seperti masa yang dihabiskan dalam zon kadar denyutan jantung (HR) yang berbeza dan jarak yang dilalui semasa latihan direkodkan dengan menggunakan *electronic heart-rate monitor* dan *global positioning systems* manakala kekerapan teknikal ditentukan dengan menggunakan perakam video. Kajian ini menggunakan reka bentuk eksperimen dengan pengukuhan ulangan. SSG2T dan SSGFT menghabiskan tempoh masa yang lebih lama dalam zon kadar nadi intensiti tinggi ($p = 0.001$) manakala SSG1T menghabiskan tempoh masa yang lebih lama dalam zon kadar nadi intensiti sederhana ($p = 0.001$) berbanding dengan SSGs yang lain. Keputusan kekerapan teknikal, SSG1T menunjukkan pencapaian yang lebih baik dalam kejayaan membuat hantaran tepat ($p = 0.001$) SSG1T dan SSG3T menunjukkan pencapaian yang baik dalam membuat pintasan ($p = 0.001$). SSGFT menunjukkan kekerapan yang paling tinggi dalam teknik rembatan ke arah gol dan hantaran lintang ($p = 0.001$). Tiada perbezaan yang signifikan ditunjukkan dalam kekerapan jaringan gol ($p = 0.537$) dan jarak yang dilalui ($p = 0.574$) semasa menjalani latihan SSGs. Penemuan utama praktikal menunjukkan bahawa perubahan dalam peraturan SSGs boleh mempengaruhi intensiti latihan, kekerapan teknikal dan jarak yang dilalui oleh pemain bola sepak. Latihan SSG2T yang mempunyai kaitan tentang peluang untuk menjaringkan gol boleh meningkatkan intensiti latihan semasa SSGs. Keputusan kajian mencadangkan bahawa latihan SSGs menggunakan peraturan berbeza adalah yang bersesuaian dengan posisi khusus pemain

iaitu SSG1T dan SSG2T sesuai untuk midfield, SSGFT dan SSG2T untuk penyerang dan SSG1T dan SSG3T untuk pertahanan. Akhir sekali, kajian ini mencadangkan supaya semua faktor yang boleh mempengaruhi latihan SSGs hendaklah diambilkira dan diimplimentasikan supaya latihan menjadi lebih lengkap dan mirip kepada situasi pertandingan sebenarnya.



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Last but not least, praise be to God, Lord of all the worlds, my Creator, for being so generous with His everlasting blessings for me and family.

I certify that an Examination Committee has met on (date of viva voce) to conduct the final examination of Muhammad Taufiq Cheng bin Abdullah on his degree Master of Science thesis entitled “Effect of Small-Sided Games Rules Changes on Time Spent in Different Intensity Zones, Frequency of Technical Actions and Distance Covered during Soccer Training” in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the Master of Science.

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LIST OF ABBREVIATIONS

SSGs	Small-sided games
SSG1T	Small-sided game with one-touch
SSG2T	Small-sided game with two-touches
SSG3T	Small-sided game with three-touches
SSGFT	Small-sided game with free-touches
GPS	Global positioning satellite system
HR	Heart rate
HRmax	Maximal heart rate
VO ₂ max	Maximal oxygen uptake

LIST OF ABBREVIATIONS

SSGs	Small-sided games
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HR	Heart rate
HRmax	Maximal heart rate
VO ₂ max	Maximal oxygen uptake

CHAPTER 1

INTRODUCTION

Background

Soccer is the world's most famous and popular game with approximately 240 million professional players worldwide in (Reilly & Williams, 2003). Soccer is a game played by 22 players, divided into two teams, moving across an area almost 100m by 60m in size. The game comprises of two 45 minutes game, with 15 minutes gap in between. In a knock-out stage competition, if a game ends with a draw, an extra-time comprising of another two 15-minute half, will be played. Thus, a full game that comprises extra-time can take almost 120 minutes. Playing soccer places intensive requirements on the aerobic pathways while at the same time requiring players to produce sports of high-intensity movements (Little & Williams, 2007a; Reilly & Williams, 2003). Therefore competitive soccer depends on both well-developed aerobic and anaerobic fitness (Reilly, 1997; Reilly & Gilbourne, 2003) in order to develop repeated bouts of short-duration but high-intensity movements combined with low-intensity activities and rest (Teplan, Maly, Zahalka, Hrasky, Kaplan, Hanus & Grye, 2012; Little & Williams, 2007b; Svensson & Drust, 2005; Reilly & Williams, 2003).

Soccer players need to acquire high level of technical, tactical, and physical skills in order to be able to play at the professional level. The physiological demands of the game requires all players to have excellent level levels of fitness that include aerobic and anaerobic power, muscular strength, speed and power, flexibility, coordination, and agility to improve performance and to prevent injury (Reilly, 2003). Soccer players require high levels of aerobic and anaerobic energy, and speed, with moderate to high requirements of power and endurance, while moderate levels of flexibility and strength are needed (Martens, 2012).

During a normal 90-minute soccer game, elite-level players run approximately 9 –13 km (FIFA, 2013; Njororaj, 2012; Bradley, Mascio, Peart, Olsen & Sheldon, 2010; Odetoyinbo, Wooster & Lane, 2009; Zubillaga, Gorospe, Hernandez-Mendo & Blanco-Villasenor, 2009; Krustup, Mohr, Ellingsgaard & Bangsbo, 2005; Stolen, Chamari, Castagna & Wisloff, 2005; Mohr, Krustup & Bangsbo, 2003; Bangsbo & Michalsik, 2002; Shephard, 1999; Bangsbo, 1994a) with high-intensity sports accounting for almost 22% of the entire match distance (Mohr et al., 2003). The distance covered with the ball makes up less than 2% of the overall distance (Reilly & Thomas, 1976), and players make contact with the ball almost 50 times throughout a match with mean heart rate averages of 160-170 b.min⁻¹ throughout a match (Bangsbo, 1994b). Almost 98% of total energy is produced via aerobic metabolism while the remaining 2% is induced from anaerobic metabolism at 80 – 90 % of maximal heart rate (Bangsbo, 1994a; Ekblom, 1986; Ali & Farrally, 1991; Helgrud, Engen, Wisloff & Hoff, 2001; Krustup et al., 2005). Endurance performance for soccer players is expressed by the extent of work performed throughout a match through as running. Other game-related and energy-demanding activities such as dribbling, tackling and heading add on to the overall requirements on the player (Bangsbo, 1994a; Reilly, 1997). The development of soccer players' aerobic capability has been shown to improve field performances such as elevated distance coverage, increase in involvement with the ball, improved and retain

of technical performance with significantly higher exercise intensity and raised number of sprints (Helgerud et al., 2001). The capability of soccer players to maintain exercise at high intensities is an essential component of fitness for soccer (Reilly & White, 2005).

Most soccer teams participate in league seasons that stretch over 8 – 10 months. The S-League and Malaysian Super League (MSL) seasons normally spans 9 – 10 months, usually from January to October. Concurrently, the English Premier League lasts for 10 months, usually from August to May. Due to the long in-season or competition periods, teams have short physical pre-season training phase which lasts between 6 – 8 weeks during which players should reach peak physical condition in terms of explosiveness, endurance, speed, strength and proprioception. A team mostly trains 7 – 10 times a week for 90 – 120 minutes per session until the league competition or competitive phase begins. Throughout the competitive stage, teams mostly train 5 – 7 times a week and play 1 – 2 matches a week (FIFA, 2013; Papaevangelou, Metaxas, Riganas, Mandroukas & Vamvakoudis, 2012; Kalapotharakos, Ziogas & Tokmakidis, 2011; Lago-Penas, Rey, Lago-Ballesteros, Casais & Dominguez, 2011; Rey, Lago-Penas, Lago-Ballesteros, Casais & Dellal, 2010; Aziz, Newton, Tan & Teh, 2006).

The normally long competitive phase in soccer makes it difficult for soccer players to train and retain fitness during competition, as technical or skill training requirements have to be given priority. Training methods that are normally utilized by soccer players during training activities requiring players to sprint with the ball, weight training, plyometric training, circuit training, interval training, skill training and small-sided games (SSGs). These training help to develop both technical skills and physical fitness components such as cardiorespiratory endurance, strength, speed, power and agility. Whichever training method utilized, training volume and intensity should be specific to the demands of soccer competitions (Teplan et al., 2012; Reilly, 2005a).

One approach for making training volume and intensity similar to that required for competition is by combining physical fitness and technical skill training through SSGs. SSG training is defined as a soccer specific training which consist of fewer number of players as well as smaller field dimensions (Rampinini, Impellizzeri, Castagna, Abt, Chamari, Sassi & Marcora, 2007b). Game-based conditioning using SSGs has become a popular approach for improving specific energy in soccer because of the short preparation but long competitive phase. The use of SSGs for training and developing physical fitness, technical and tactical skills in soccer players has been commonly used and is well accepted (Rampinini et al., 2007b; Little & Williams, 2006; Sassi, Reilly & Impellizzeri, 2004; Reilly & White, 2005; Eniseler, 2005; Sainz & Cabello, 2005; Gamble, 2004). SSGs are usually used by players as part of their regular training programs in different forms, depending on the purpose and the philosophy of the coach (Rampinini et al., 2007b). SSG training in soccer has been recommended as a training method that can concurrently develop physical fitness, technical and tactical aspects of soccer (FIFA, 2013; Owen, Wong, Paul & Dellal, 2012; Gabbett & Mulvey, 2008). They are increasingly used as an alternative to interval training for energy system training in soccer (Brandes, Heitmann & Muller, 2012; Hill-Haas, Coutts, Rowsell & Dawson, 2008; Rampinini, Coutts, Castagna, Sassi & Impellizzeri, 2007a; Rampinini et al., 2007b; Sassi et al., 2005).

Statement of Problem

The normally long competitive phase in soccer makes it difficult for soccer players to train and retain fitness during competition, as technical or skill training also need to be given priority. During the competition phase, most teams train daily and play 1 – 2 matches a week (FIFA, 2013; Kalapotharakos et al., 2011; Lago-Penas et al., 2011; Rey et al., 2010; Aziz et al., 2006). Other data indicate that many teams also play two to three matches in five days with one to three days of recovery before playing the next match (Lago-Penas et al., 2011; Odetoynho et al., 2009). The short recovery between matches may induce fatigue and influence players' coordination, reduce their performance, and increase their risk of injury (Ekstrand, Walden & Hagglund, 2004; Ekblom, 1986). The short recovery period between matches also impose high physiological demands on players they need to be efficient in many fitness variables including aerobic and anaerobic power, muscular strength, speed and power, flexibility, coordination, and agility (Reilly, 2003). Consequently, one of the biggest problems for coaches and players is to effectively develop both the fitness and skill elements within the fixed conditioning and training time normally available for the soccer calendar. Additionally, coaches need to help their players maintain their fitness throughout the competition phase.

Among the many training methods that can be utilized, SSGs can be used to train both skill and fitness because the smaller pitch and the fewer number of players allows more contact time with the ball and deals with game situations more often (Katis & Kellis, 2009; Jones & Drust, 2007; Capranica, Tessitore, Guidetti & Figura, 2001). These situations depend on the efficiency of technical skills for example passing, dribbling and kicking, as well as tactical skills like running without the ball, marking and cooperating with other players (Capranica et al., 2001). Additionally, when SSGs were utilized as a physical conditioning tool, it can produce heart rate responses up to almost 80-90% of maximum heart rate (Koklu, Ersoz, Alemdaroglu, Asci & Ozkan, 2012a; Brandes et al., 2012).

In spite of support for SSGs as an efficient training method, its effectiveness relies on a few variables such as the number of players, pitch dimensions, duration of play, rules (number of touches/plays), presence or absence of goalkeeper and good-scoring moves, training continuously or intermittently and coach encouragement. These factors are thought to effect the level of physiological stress throughout physical training sessions (Casamichana, Castellano & Dellal, 2013; Aguiar, Botelho, Lago, Macas & Sampaio, 2012; Bekris, Gissis, Sambanis, Milonya, Sarakinos & Anagnostakos, 2012; Dellal, Owen, Wong, Krustrup, Exsel & Mallo, 2012a; Ngo, Tsui, Smith, Carling, Chan & Wong, 2012; Clemente, Couceiro, Martins & Mendes, 2012; Dellal, Lago-Penas, Wong & Chamari, 2011b; Casamichana & Castellano, 2010; Hill-Haas, Coutts, Dawson & Rowsell, 2010; Duarte, Batalha, Folgado & Sampaio, 2009; Hill-Haas et al., 2008; Hill-Haas, Rowsell, Dawson & Coutts, 2009a; Hill-Haas, Dawson, Coutts & Rowsell, 2009b; Hill-Haas, Coutts, Rowsell & Dawson, 2009c; Barbero-Alvarez, Soto, Barbero-Alvarez, Granda-Vera, 2008; Gabbett & Mulvey, 2008; Impellizzeri, Marcora, Castagna, Reilly, Sassi, Iaia & Rampini, 2006; Tessitore, Meeusen, Piacentini, Demarie, & Capranica, 2006; Bangsbo, 1998). The control of each of these variables separately or in combination would influence the training load (volume and intensity), and hence influence the training effect felt by the players. Unfortunately, the efficacy of SSGs has been difficult to assess as different researchers have used different number of players, pitch dimensions, and game rules. Currently, the most commonly utilized playing format utilised during research is the 5 vs. 5 format (Casamichana et al., 2013; Fradua,

Zubillaga, Caro, Fernandez-Garcia, Ruiz-Ruiz, & Tenga, 2013; Aguiar et al., 2012; Bekris et al., 2012; Dellal et al., 2012a; Owen et al., 2012; Da Silva, Impellizzeri, Natali, de Lima, Bara-Filho, Silami-Garcia & Marins, 2011; Casamichana & Castellano, 2010; Barbero-Alvarez, D'ottavio, Vera & Castagna, 2009; Coutts, Rampinini, Marcora, Castagna & Impellizzeri, 2009; Hill-Haas et al., 2009a; Kelly & Drust, 2009; Dellal, Chamari, Pintus, Girard, Cotte & Keller, 2008; Little & Williams, 2007a; Rampinini et al., 2007b; Reilly & White, 2005).

Additionally, more of these studies have compared the time spent in various heart-rate (HR) intensities zones with different SSG rules such as free-touches, one-touch, two-touches and three-touches. Linking HR with SSG rules is important as the number of touches would affect intensity (Abrantes, Nunes, MaCas, Leite & Sampaio, 2012; Dellal et al., 2012a; Hill-Haas et al., 2010; Little & Williams, 2006, 2007a; Bangsbo, 1998). As intensity is a factor that affects the pace/speed that players can produce and maintain throughout a match, a number of previous research have already examined the amount of time spent in different intensity zones (Abrantes et al., 2012; Castagna, Belardinelli, Impellizzeri, Abt, Coutts, & D'Ottavio, 2007; Hill-Haas et al., 2009a). Studies have compared low-intensity (< 50 % maximal heart rate, HRmax) and high-intensity (> 90 % HRmax) performance during training and competition (Wrigley, Drust, Stratton, Scott & Gregson, 2012).

These studies however did not have categorise heart-rate intensity zones consistently. Some studies utilised only two intensity zones (Wrigley et al., 2012) while others utilised three (Castagna, Impellizzeri, Chaouachi, Bordon & Manzi, 2011), four (Abrantes et al., 2012) or even five zones (Owen, Wong, McKenna & Dellal, 2011; Impellizzeri et al., 2006). Compounding this situation is that the heart-rate percentages utilized for each intensity zone different for different studies making comparisons pointless.

A number of references (Kenney, Wilmore, & Costill, 2012; Chandler & Brown, 2013) have categorised low intensity training as when HRmax is less than 60%, moderate intensity training between 60-79% HRmax, and high intensity training as more than 80% HRmax. This clasification was also utilised in a previous SSG study (Castagna et al., 2007) and seems to adhere to current physiological categorization of training intensity.

Besides the gaps that have not been previously examined above, previous investigations on SSGs have utilized players from various positions (defenders, midfielders and strikers) but it was not known if the players were from the starting players, or were reserve team players. No previous research have utilized the starting players, playing five versus five in two teams with equal playing position roles such as two defenders, two midfielders and one striker for each team. Therefore the objectives described in the following section would focus on these unexamined gaps.

Objectives of the study

Based on the issues raised in the statement of problem, the main objective of this study was to examine the influence of rule changes through different SSGs on the time spent in different HR zones, the frequency of technical actions, and the distance covered during the training session using the starting players of the team. The rules changes involved

four different SSGs, they are SSGFT (free-touches), SSG1T (one-touch), SSG2T (two-touches), and SSG3T (three-touches).

These objectives can be stated more specifically:

1. To determine the time spent in the low ($\leq 60\%$ HR_{max}), moderate (60 – 79% HR_{max}), and high ($\geq 80\%$ HR_{max}) intensity heart-rate zones (Castagna et al., 2007) during soccer training using the four different game rules of SSGs.
2. To compare the differences in the frequency of technical actions such as passing, shots on goal, crossing, interceptions, and goals scored during different game rules of SSGs.
3. Finally, to compare the distance covered during the different SSGs.

Research Questions and Hypotheses

Three research questions were formulated based on the specific objectives from the previous section. The three questions are:-

1. Does rule changes in SSGs influence the amount of time spent in different intensity zones?
 2. Does rule changes in SSGs influence the frequency of technical actions (successful passing, shots on goals, crossing, interception, goal scored)?
 3. Does rule changes in SSGs influence the distance covered?
- The research questions above were used to formulate a number of hypotheses. The hypotheses were grouped according to the dependent variables.

Hypotheses to examine amount of time spent in different intensity zones.

H₀₁: There is no significant difference in the amount of time spent in the low intensity zone among the SSGs utilized.

$$: \mu_{\text{low SSGFT}} = \mu_{\text{low SSG1T}} = \mu_{\text{low SSG2T}} = \mu_{\text{low SSG3T}}$$

H₀₂: There is no significant difference in the amount of time spent in the moderate intensity zone among the SSGs utilized.

$$: \mu_{\text{mod SSGFT}} = \mu_{\text{mod SSG1T}} = \mu_{\text{mod SSG2T}} = \mu_{\text{mod SSG3T}}$$

H₀₃: There is no significant difference in the amount of time spent in the high intensity zone among the SSGs utilized.

$$: \mu_{\text{high SSGFT}} = \mu_{\text{high SSG1T}} = \mu_{\text{high SSG2T}} = \mu_{\text{high SSG3T}}$$

Hypotheses to examine the frequency of technical actions among the different SSGs utilized.

H₀₄: There is no significant difference in the frequency of successful passes among the SSG utilized.

$$: \mu_{\text{P SSGFT}} = \mu_{\text{P SSG1T}} = \mu_{\text{P SSG2T}} = \mu_{\text{P SSG3T}}$$

H₀₅: There is no significant difference in the frequency of shots on goal among the SSG utilized.

$$: \mu_{\text{S SSGFT}} = \mu_{\text{S SSG1T}} = \mu_{\text{S SSG2T}} = \mu_{\text{S SSG3T}}$$

H₀₆: There is no significant difference in the frequency of crosses among the SSG utilized.

$$: \mu_{C \text{ SSGFT}} = \mu_{C \text{ SSG1T}} = \mu_{C \text{ SSG2T}} = \mu_{C \text{ SSG3T}}$$

H₀₇: There is no significant difference in the frequency of interceptions among the SSG utilized.

$$: \mu_{I \text{ SSGFT}} = \mu_{I \text{ SSG1T}} = \mu_{I \text{ SSG2T}} = \mu_{I \text{ SSG3T}}$$

H₀₈: There is no significant difference in the frequency of goals scored among the SSG utilized.

$$: \mu_{G \text{ SSGFT}} = \mu_{G \text{ SSG1T}} = \mu_{G \text{ SSG2T}} = \mu_{G \text{ SSG3T}}$$

Hypothesis to examine the total distance covered when utilizing the different SSGs.

H₀₉: There is no significant difference in the total distance covered among the SSG utilized.

$$: \mu_{D \text{ SSGFT}} = \mu_{D \text{ SSG1T}} = \mu_{D \text{ SSG2T}} = \mu_{D \text{ SSG3T}}$$

Significance of the Study

Training methods used to prepare soccer players for competition need to simulate the demands of match-play, and the training volume and intensity should be specific to the requirements of soccer competitions (Reilly, 2005b). The long competition phase for soccer requires coaches to utilize training methods that can concurrently train physical, technical and tactical factors in order to be time-efficient. From the many training methods available, results of this study could support the efficacy of SSGs for developing physical fitness, technical and tactical skills simultaneously, and efficiently within the short preparation phase.

As the number of touches can influence the physiological stress felt by players, and this in turn would affect heart rates, the ability to perform technical actions, and also distance covered, it could be significant for coaches to obtain information regarding which SSG rule would be more suitable for different technical and tactical requirements. For example, the results from this study may be able to supply coaches and players regarding which SSG format is more suitable for training at specific heart-rate intensities, for creating more accurate technical actions for creating more goal-scoring opportunity, and for covering longer distances more efficiently. The findings from this study may be beneficial in ways that will help coaches to understand and choose SSGs with particular amount of touches or rule changes to be used for daily training as a game-based conditioning training mode for improving players' physical fitness, technical and tactical skills.

Limitations of the Study

Limitations are possible shortcomings or influences that either cannot be controlled or are the results of the restrictions imposed by the investigator (Thomas, Nelson & Silverman, 2005). Therefore the results from this study cannot be compared with different combinations of players. Limitations in this study would include the players'

attitude during the training sessions, the quantity and quality of rest or sleep they had and also nutrition and fluid intake throughout the experimental period as these factors may affect their performance. To control these factors, all players were advised to maintain their normal diet, and were asked to record their dietary intake throughout the entire period. Players were also asked to maintain the usual rest and recovery protocols. Additionally, the coaches motivated the players to produce their best effort during each training session.

Delimitations refer to the focus of the study, which is usually set by the researcher (Thomas et al., 2005). In this study, the delimitation was using a single squad of professional players with the selection of the starting players and the two goalkeepers from the Kedah Malaysian Super League team. Therefore, differences in physiological and technical response may exist between different levels of players or players with different training histories, as a result, the potential applications may not be directly transferable to other groups with homogenous characteristics.

The researcher also delimited the number of players involved (5 v 5 plus 2 goal keepers for all the SSGs formats), the pitch size used (50m x 40m), and the duration for each SSG session (24 minutes). This study was also delimited to the specific SSG rules used such as free-touch, one-touch, two-touches and three-touches. Another delimitation included the order effect of performing the SSGs. In this study, the SSGs were played in specific order that was randomly arranged that is, SSG2T, SSG3T, SSGFT and SSG1T. If other studies utilized a different arrangement, the results may be different from this study.

Definition of Terms

The variables of this study will be defined in this section. The independent variable of this study is rule changes. Rule changes in this study are indicated by how the small-sided games (SSG) are conducted. The dependent variables that are defined are training intensity, technical actions, and distance covered.

1. Small-sided games (SSGs)

SSGs are specific methods of conditioning for soccer players to utilize movement patterns in team sports while maintaining a competitive environment in which players must perform under pressure and exhaustion (Gabbett, 2006; Gabbett, 2002). In this study, four different SSGs were by 10 out-field players (two defenders, two midfielders and one striker for each team) and two goalkeepers. The game was played continuously for 24 minutes in an area 50m x 40m with two goal posts. Each SSG were allowed a different number of touches.

a. Small-Sided Game Free-Touches (SSGFT)

The game was played continuously for 24 minutes with players playing with any number of touches throughout the training game.

b. Small-Sided Game One-Touch (SSG1T)

The game was played continuously for 24 minutes with players playing one touch before uploading the ball to another player throughout the training game.

c. Small-Sided Game Two -Touches (SSG2T)

The game was played continuously for 24 minutes with players playing two touches before uploading the ball to another player throughout the training game.

d. Small-Sided Game Three -Touches (SSG3T)

The game was played continuously for 24 minutes with players playing three touches before uploading the ball to another player throughout the training game.

2. Training intensity

Monitoring the heart rate is the easiest method of determining the intensity of exercise (Miller, 2012). The intensity of training is how hard the players train and is sometimes referred to as training quality, and can be quantified as a percent of maximal heart rate (Reilly, 2007). In this study, training intensity was monitored via heart rate monitors and was categorized into low ($\leq 60\%$ maximal heart rate, HRmax), moderate (60 – 79% HRmax), and high ($\geq 80\%$ HRmax) intensities (Castagna et al., 2007) and the amount of time spent by the players in each intensity was compared as they performed each SSG.

3. Technical actions

Soccer players perform technical actions that include passing, dribbling, tackling, heading, kicking, and getting up from the ground (Bangsbo, 1994a; Reilly, 1997). In this study, the technical actions that were observed were successful passing, shots on goal, crossing, interceptions and goal scored during SSGFT, SSG1T, SSG2T and SSG3T by a hand notational system (Dellal et al., 2012a). Each technical action is operationally defined below (Liu, Hopkins, Gomez & Molinuevo, 2013; Evangelosi, Eleftherios, Aris, Ioannis, Konstantinos & Natalia, K. (2012):

a. Successful passing

Player in possession successfully sends the ball to a team mate (eg using the foot, thigh or chest; using various techniques such as ground, lofted, chip, flick or volley; over short or long distances).

b. Shots on goal

An attempt or shot to goal which required intervention to stop it going in or resulted in a goal/shot which would go in without being diverted.

c. Crossing

Any ball sent by a player into the opposition team's area from a wide position.

d. Interceptions

Player contacts the ball enabling him to retain possession, preventing an opponent's pass from reaching its intended destination.

e. Goal scored

Any ball scored by a player into the opposition team's goal post or the action of putting a ball into a goal from any position in the field.

4. Distance covered

One of the physical aspects that points to the physical preparation of a team is the distance covered in a match by individual players and a team as a whole (Njororaj, 2012). The distance covered during a SSG is a good indicator for endurance performance (Hoff, 2005). Soccer players cover a distance which is intermittent in nature when in possession of the ball or without possession and comprises bouts of walking, jogging, cruising and sprinting (Reilly & Thomas, 1976; Bangsbo, 1994b). In this study, the distance covered was measured using six global positioning system (GPS) units as the players performed the SSGFT, SSG1T, SSG2T and SSG3T. The players wore the GPS units on their wrist as they performed the SSGs.



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