Analysis of Movement Pattern among Referee in 2012 Malaysian Cup

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ABSTRACT

Adnan R, Muzayin N, Sulaiman N. Analysis of Movement Pattern among Referee in 2012 Malaysian Cup. *J. Hum. Sport Exerc.* Vol.8, No. Proc3, pp. S642-S650, 2013. This study is to determine the contributing factors of the movement patterns toward the total distance covered by the football referees during the Malaysia Soccer Cup 2012. Seven (7) of referees who officiated the 2012 Malaysian Cup matches were been chosen into this study. All seven matches from the tournament were recorded using Astro beyond decoder and were coding with SportCode Elite Software on the selected performance indicators (P.I) as main movement patterns variables. This movement patterns were categorized as forward walking, forward jogging, forward running, standing, backward walking, backward running and sidestep running. The results analyze the frequency and the total time from the executed movement patterns for correlation and regression analysis by using the Pearson correlation and linear regression test respectively. The Pearson correlation test have shown that there is significant correlation between three movement patterns and the total distance covered by the referees which are sidestep($r= 0.97$, $p=0.000$, $p<0.01$), forward walking ($r= 0.930$, $p=0.002$, $p<0.01$), and forward running ($r= 0.807$, $p=0.028$, $p<0.05$). The linear regression test have shown a positive correlation between contributing factors of the movement patterns towards the total distance covered by the football referees where the total distance covered result is 132.161 + 2.012 (sidestep) – 4.575 (forward walking) + 0.570 (forward jogging) – 2.940 (forward running) + 1.404 (backward walking) + 3.328 (backward running). Hence, this study found that movement patterns that performed by referees are contributed towards the total distance covered by football referees during a match. Thus, this study can give added values to Football Association of Malaysia (FAM), to consider the three significant movement patterns in designing physical fitness criteria for the referees). **Key words**: REFEREES, MOVEMENT PATTERN, DISTANCE COVERED, MALAYSIAN CUP.

INTRODUCTION

Referees and players possess different types of group due to difference in their responsibilities during a match that requires specific physical and psychological attributes (Da Silva et al., 2011). After time has passed, the number of distance that is covered by a referee in a single match of football have steadily increased proving that this population must obtain a considerably different physical conditioning program in order to suit their match fitness. The analysis that involves the comparison of the movement patterns are crucial for the referees to get proper physical conditioning training to perform to the level of intensity that is required during a football match.

Recently, several researches had investigated soccer referees on how they moved and how much they ran during match (Da Silva et al., 2011). These by thorough analysis of using digital technology such as software and hardware make the soccer match analysis are practical and viable for practitioners and researchers respectively (Liebermann et al., 2002). For instance, referees have been studied to make 137 (range 104-162) observable decisions per match at the advance level of a football match, during a playing time of 51 minutes, that in average a referee making 3-4 decisions per minute (Helson & Bultynck, 2004). Moreover, referees have shown high physiological demands when they are officiating an elite level football match according to various researches. For instance, the mean distance covered by referees during a competitive football match is 9348m (7977-10187) based on studies made by Catterall et al. (1993). This obtainment of the statistical data has hugely contributed to the prescription of physical training programs (Oliveira et al., 2008).

The evaluation of referees in terms of the distance covered during an official football match in Brazil was made as the main reference towards the studies that were done (Oliveira, 2008). In recent studies by, Castagna (2004) revealed that referee covered the distance is ranged from 9,000m to 13,000m and 9,000m to 14,000m, respectively in matches, in addition, this distance ran by referee can up to 11,500m (Oliveira, 2007). Moreover, English referees have shown the percentages of movement patterns such as running (47%), walking (42%), running backwards (8%) and peak (3%) (Oliveira, 2008). The distance covered by the referee during the first half (4, 017m) and the second half (3,479m) have shown a significant decrease (p<0.01) thus showing a reduction of physical performance and the increase in difficulty in maintaining the level of mean physical exertion during the football match (Oliveira, 2008).

Furthermore, the match work rates of referees have shown significant increase over the past decade. The studies have shown that the mean distance covered during a football match is 10070m (9200-11490m) with standing and walking accounting for 63.2% of total match time, low intensity running 30.2% and high intensity running accounting for the remainder 6.6% (Krustrup & Bangsbo, 2001; D'Ottavio & Castagna, 2001). D'Ottavio & Castagna (2001), reported that the actual mean distance covered during the course of an average 95 minute match is 11376 ± 1604m, with walking constituting 889 ± 94m, 4174 ± 616m of low-intensity running (<13km.h-1), 2585 ± 489m of medium intensity running (13.1 - 18.0km.h-1) and a total of 1556 ± 493m of high-intensity running (18.1 - 24km.h-1). Running at maximal speeds (>24km.h-1) accounted for 608 ± 366m and non-orthodox directional modes, for instance sideways and backwards running, are 181 ± 117m and 1315 ± 569m, respectively.

Aforementioned obtained that there had been a substantial amount of research conducted related to football referees but least amount of research related to analysis in movement patterns is conducted. Analysis of referee's movement was the determining factor of their work rate during matches (Bangsbo, 1994). However despite all the research that have been done, there are no specific study to explain the

type of movement patterns in referees during a match and how it can relate to the type of fitness assessment done towards the referees before they are considered fit to officiate a football match. Therefore, the main objective of this study is to investigate the significant of the movement patterns and the total distance covered that is managed by the referees during the Malaysian Cup 2012 tournament match.

MATERIAL AND METHODS

The data from this study is collected and recorded from the 2012 Malaysian Cup matches. The data consist of (7) matches including the semi-finals and finals match, all analyzed by using the computerized software Sports Code Elite (Sportstec, Australia). From the selected performance indicators (P.I) that have been categorized was used to identify which performance indicators influence the total distance covered during the tournament.

Sampling
The selection of subjects for this study is using the purposive sampling technique, which involves seven referees who were officiated the 2012 Malaysian Cup matches. All of the subjects were male football referees with accredited by the Fédération Internacionale de Football Association (FIFA).

Research design
This research use correlation study and ex-post facto to obtain a relationship between movement patterns and the total distance covered by football referees. The design of the study is as below:
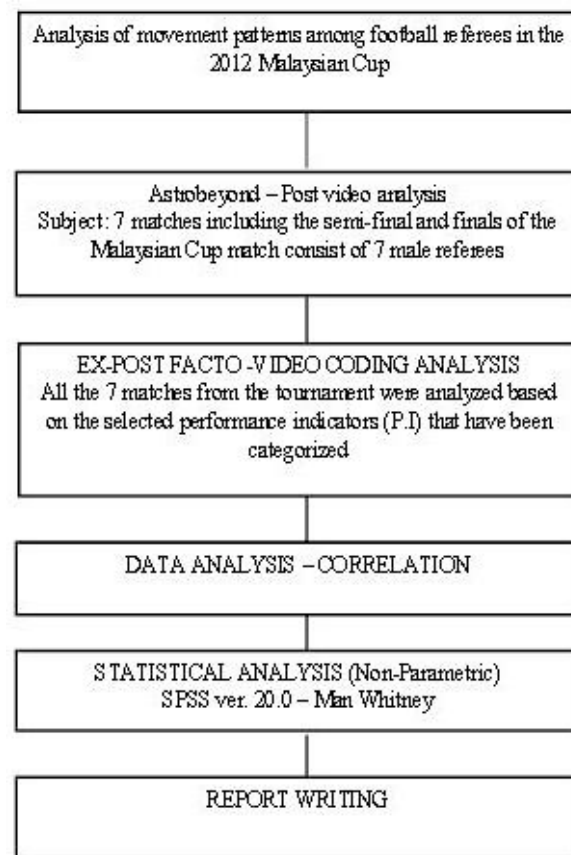
Figure 1. Research design

Instrumentation
The instruments used to complete this study include Astro Beyond and SportsCode Elite software:

a) Astro Beyond
   The main function of using Astro Beyond is as the medium to record the 2012 Malaysian Cup matches.

b) Sportscode Elite
   SportsCode Elite is used to analysis video that being recorded by Astro Beyond. SportsCode Elite features are: It can capture video live, full screen capture, code 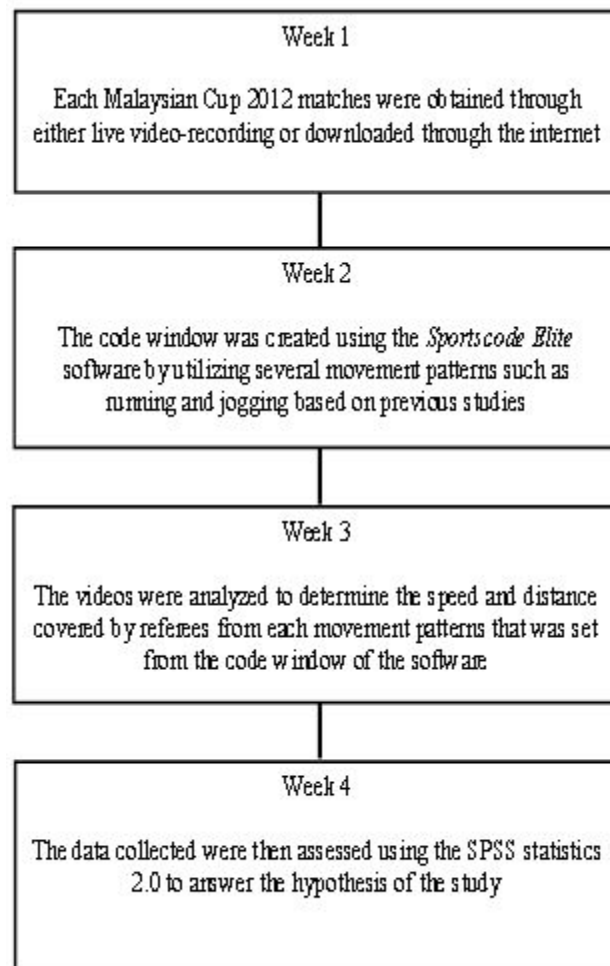& review video during capturing, live code matrix viewing during capture, timeline sharing for easy review during capture, support HDV, DV, DV widescreen, MPEG4, HD, preset capture time, and support 4x3, 16x9, and native movie dimensions (Sportstech.com, 2012).

c) Coding structures
   For coding structures it is no predefined structures of coding templates, define our own code, label and title button, set lead and lag times for codes, define powerful coding relationship through the use of activation and exclusive code behavior, code in full screen, 1000+ customizable keyboards hot keys, statistical commands and set up key performance indicators alerts in code window for instant notification (Sportstech.com, 2012).

d) Analysis
   The ability of this software during analysis is unbelievable where it can review vision directly from the Code and Statistic Window, splice video files to play side by side, overlay any two video files and switch between different feeds using hot keys (Sportstech.com, 2012).

For the validity and reliability of SportsCode Elite software, all of the data gathered must be tested in the same way and to the same technique in which it were be processed in the subsequent analyses (Hughes et al. 2002). Other researcher in their study also uses this software. Computerized analyses has been used in other types of sports for research such as netball for a recorded game and coded six different movement patterns analysis using the system (Davidson et al., 2008).

Data collection procedure
This research has been approved by the Ethics Committee of Research Project from the Faculty Sports Science and Recreation before data is collected. The data collection procedure is as the figure below:

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┌─────────────────────────────────────────────┐
│                    Week 1                     │
│                                               │
│  Each Malaysian Cup 2012 matches were         │
│  obtained through either live video-          │
│  recording or downloaded through the internet │
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│                    Week 2                     │
│                                               │
│  The code window was created using the        │
│  Sportscode Elite software by utilizing       │
│  several movement patterns such as running    │
│  and jogging based on previous studies        │
└─────────────────────────────────────────────┘
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┌─────────────────────────────────────────────┐
│                    Week 3                     │
│                                               │
│  The videos were analyzed to determine the    │
│  speed and distance covered by referees from  │
│  each movement patterns that was set from     │
│  the code window of the software              │
└─────────────────────────────────────────────┘
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│                    Week 4                     │
│                                               │
│  The data collected were then assessed using  │
│  the SPSS statistics 2.0 to answer the        │
│  hypothesis of the study                      │
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Figure 2. *Data collection procedure*

Data analysis
The result gathered from the frequency and the total time from the executed movement patterns in the Malaysian Cup 2012 matches were analyzed using SportsCode Elite. The results are reported as correlation and linear regression. Differences between the matches were determined using the Pearson correlation and linear regression test, utilizing the SPSS statistics. Values for $p < 0.05$ were considered statistically significant.

RESULTS

The researcher used the Descriptive Statistics to determine the mean and standard deviation of the movement patterns and the total distance covered by the football referee in the Malaysian Cup 2012 match. The result is as the table below:

Table 1. *Shown side step movement, forward walking, and forward running have shown significant correlations with the total distance covered during the whole duration of matches. The others movements were found insignificant with referees during 7 matches of 2012 Malaysian Cup*

		N	Min	Max	Mean	Std. Deviation
Sidestep	Frequency	7	1	16	9.57	5.884
	Total distance	7	1	8	4.86	2.410
	Valid N (list wise)	7				
Forward walking	Frequency	7	38	45	42.00	2.160
	Total distance	7	30	38	34.57	2.573
	Valid N (list wise)	7				
Forward jogging	Frequency	7	27	38	33.71	3.638
	Total distance	7	27	37	30.71	3.302
	Valid N (list wise)	7				
Forward running	Frequency	7	6	17	10.86	3.579
	Total distance	7	17	21	22.86	3.338
	Valid N (list wise)	7				
Backward walking	Frequency	7	11	31	22.00	6.831
	Total distance	7	14	25	18.14	3.716
	Valid N (list wise)	7				
Backward running	Frequency	7	2	11	6.71	3.251
	Total distance	7	2	16	10.43	4.353
	Valid N (list wise)	7				

Mean and standard deviation for the movement patterns and total distance covered by football referees in the 2012 Malaysian Cup matches

Table 2. Shown side step movement, forward walking, and forward running have shown significant correlations with the total distance covered during the whole duration of matches. The others movements were found insignificant with referees during 7 matches of 2012 Malaysian Cup

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.052	.487		2.160	.083
Sidestep**	.398	.044	.970	8.985	.000
(Constant)	-11.929	8.253		-1.445	.208
Forward walking*	1.107	.196	.930	5.641	.002
(Constant)	16.101	12.083		1.333	.240
Forward jogging	.433	.357	.478	1.215	.278
(Constant)	14.684	2.795		5.253	.003
Forward running*	.433	.357	.478	3.057	.028
(Constant)	13.193	5.070		2.602	.048
Backward walking	.225	.221	.414	1.016	.356
(Constant)	3.881	3.019		1.285	.255
Backward running	.225	.221	.728	2.377	.063

Correlation between contributing factors towards the total distance covered for each movement pattern by football referees in the 2012 Malaysian Cup matches

DISCUSSION

From the results and findings, side step movement, forward walking, and forward running have shown significant correlations with the total distance covered during the whole duration of matches which proves that if there is an increase in the number of movement patterns of the referees, the total distance covered by the football referees during the match will increase as well. During a football match, the referees in the

Malaysian Cup tournament spend most of the time of the field executing forward movements either running or walking. This is because it is easier for the referees to be able to see and follow the game to make important decisions when they are moving forward. Furthermore, walking movement and running movement often happen in a continuous motion based on the pace of the match. This means that a referee might be changing his/her pace of movement from walking to running when there is a sudden counter attack being executed by a football team thus forcing a change of pace in order to be as close to the incident that might happen. On the other hand, backwards referees do movement during a dead ball situation in a football match such as a free kick. This is where the referees apply the movement to set the defensive wall or to move backwards to a certain distance where they do not intervene with the match results during a match.

Based on the results of the study, backward movements does not show significant correlation because the difficulty in executing the particular movement. When executing a movement that an individual cannot see is increasingly difficult and impose high-energy expenditure because it involves a higher use of the physical and psychological aspects of the human body. Referees will have to be aware of the incidents happening either in front of him or behind him thus referees chose to limit the particular movement towards a situation where there is not much movements that requires a sudden change of intensity such as a free kick situation.

This study is supported by previous studies from Oliveira (2008), where locomotors activities have shown significant correlation in determining the total distance covered by soccer referees during a football match. Oliveira also added from his study that the most type of movement patterns performed by football referees are walking and jogging. According to Mallo et al. (2006), the total distance covered by the referees is related to the high intensity movements performed during the entire matches that were analyzed. The finding of this study therefore supports the hypothesis of the study.

Referees do not perform any movements such as standing when they are there are incidents such as injuries during a match thus do not contribute towards any distance covered during a match. Forward movements such as walking, running and jogging are used constantly during the match because they are done based on the intensity of the match. For example, a referee only needs to walk if the football incident is close to them but if the ball is suddenly kicked at a long distance the referees have to run following the ball because there is where the incidents might happen. In a football match, referees might also use unorthodox movements such as side step but occasionally. Therefore, the movement patterns performed by the referees during the match are accounted for as a contribution towards the total distance covered during the whole duration of the match.

CONCLUSIONS

The study also concluded that there was a significant correlation between the contributing factors of movement patterns toward the total distance covered by football referees. Thus this shows that movement patterns from the referees can contribute towards the total distance covered by football referees during a match.

RECOMMENDATION

This data give fundamental knowledge to the Malaysia Referee Association and Malaysia Football Association to delve or improve their assessment fitness criteria towards the major movement pattern that possess by the referees during the match. This can be includes:

1. Specific VO2max field testing that specific design based on this movement pattern.
2. Specific training program that can suit to this movement pattern instead of general fitness program.

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REFERENCES

1. BANGSBO, J. The physiology of soccer with special reference to intense intermittent exercise. *Acta Physiol Scand*. 1994; 151 (suppl.619): 1-156.
2. CASTAGNA C, ABT G, D'OTTAVIO S. Activity profile of international-level soccer referees during competitive matches. *J Strength Cond Res*. 2004; 18(3): 486.
3. CATTERALL C, REILLY T, ATKINSON G, COLDWELLS A. Analysis of the work rates and heart rates of association football referees. *Brit J Sport Med*. 1993; 27(3): 193-6.
4. DA SILVA A, FERNANDES L, FERNANDEZ R. Time motion analysis of football (soccer) referees during official matches in relation to the type of fluid consumed. *Braz J Med Biol Res*. 2011; 44(8): 801-809. Clerk Maxwell J. A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892: 68-73.
5. DAVIDSON A, TREWARTHA G. Understanding the Physiological Demands of Netball: a time-motion investigation. *International Journal of Performance Analysis in Sport*. 2008; 8(3):1-17.
6. DE OLIVEIRA MC, SANTANA CHG, DE BARROS TL. Analysis of in-field displacement patterns and functional indexes of referees during the soccer match. 2008
7. HELSEN W, BULTYNCK JB. Physical and perceptual-cognitive demands of top-class refereeing in association football. *J Sport Sci*. 2004; 22(2): 179-89.
8. HUGHES M. Notational analysis-a mathematical perspective. *International Journal of Performance Analysis in Sport*. 2004; 4(2): 97-139.
9. KRUSTRUP P, BANGSBO J. Physiological demands of top-class soccer refereeing in relation to physical capacity: effect of intense intermittent exercise training. *J Sport Sci*. 2001; 19(11): 881-91.
10. MALLO J, NAVARRO E, GARCIA JM, HELSEN WF. Physical demands of top-class soccer assistant refereeing during high-standard matches. *Int J Sports Med*. 2009; 30(5): 331-336.