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TIME-MOTION ANALYSIS: DISCRIMINATING BETWEEN WINNING AND LOSING TEAMS IN PROFESSIONAL RUGBY

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ABSTRACT

The current trend in video analysis is the development of performance profiles to describe individual or team patterns created from combinations of key performance indicators. The aim of this study was to quantify distance covered, high-intensity distance covered and percentage work rate at high intensity of various playing positions, as well as to provide a meaningful body of data to determine winning and losing components that jeopardise rugby matches at professional level. The ProZone version 3 time-motion analysis program was used to gather data from 18 matches (Test and Super 14 Rugby). Average distances covered by positional groups ranged from 5816m for front rows to 7166m for inside backs. No significant differences (p<0.05) were found between the winning and losing teams. However, positional group comparisons indicated that the distance covered by the locks showed a significant difference (p=0.03) between the winning and losing teams. Backs performed more high-intensity distance than forwards (backs 1549 to 1715m versus forwards 789 to 1333m). There were no significant differences (p<0.05) between playing positions and winning and losing teams regarding the percentage work rate at high intensity. Time-motion analysis is an effective method of quantifying the demands of rugby and provides a conceptual framework for the specific physical preparation of players.

Key words: Rugby; Time-motion analysis; Distance covered; High-intensity distance covered; Percentage work rate at high intensity.

INTRODUCTION

Now more than ever, rugby players need coaching in weaknesses and strengths to create an even more conditioned individual to perform in the professional arena. The continuing development of professionalism in rugby has included the comprehensive analysis of behavioural aspects of rugby performance known as match or notational analysis. Research of this nature in rugby is often undertaken within the confines of the environment of the team and the organisation or governing body (Vaz *et al*., 2010).

In rugby, research about the game has traditionally been focused on describing the patterns of the game (Williams *et al*., 2005; Deutsch *et al*., 2007), performance indicators (James *et al*., 2005; Ortega *et al*., 2009; Vaz *et al*., 2010) and work ratios (Docherty *et al*., 1988; Deutsch *et al*., 2002; Duthie *et al*., 2005; Deutsch, *et al*., 2007). The current trend in video analysis is the development of performance profiles to describe individual or team patterns created from combinations of key performance indicators. This area is of great interest for research and training purposes (Hughes & Bartlett, 2002).

Another measure of interest is the distance covered during a game (McLean, 1992). Time-motion analysis provides an objective and non-invasive method for quantifying the demands of rugby and provides a conceptual framework for the specific physical preparation of players (Deutsch *et al*., 2002; Duthie *et al*., 2005; Deutsch *et al*., 2007; Cahill *et al*., 2013). Detailed information on the movements in a game provides comprehensive assessment of the demands of competition and assists in developing specific training regimes. However, according to Vaz *et al*. (2010), despite the range of detailed analyses there is no obvious structure or progressive evolution to the development of analysis methods and there are still large gaps in the literature, especially in the area of rugby. Vaz *et al*. (2010) also stated that it must be borne in mind that the game of rugby is complex, with many key performance indicators. Circumstances also change from game to game due to many varying conditions, including the weather, strategies, tactics and players available. Rugby players have a diverse range of physical attributes. The game is intermittent in nature, requiring players to compete in a challenging contest comprising intense bouts of sprinting and tackling separated by short bouts of lower-intensity activity (recovery) (Gabbett, 2005). Sirotic *et al*. (2009) showed that two standards of competition have similar game-specific skills and physical demands during a match; however, there is variation within a match according to standard. Specifically, the higher physical demands placed on elite players could lead to earlier onset of fatigue.

Detailed descriptive analyses of the occurrence of these activities during competition will assist coaches and conditioning staff in the prescription of training for forwards and backs. According to Cahill *et al*. (2013), such knowledge is deemed valuable to coaches and scientific support staff in a training environment, facilitating optimal player conditioning and match preparation. It was for this purpose that Docherty *et al*. (1988) classified movements during amateur club and international fixtures (regional vs. international touring teams). Modifying the movement classification system of Reilly and Thomas (1976), the relative times (expressed as percentages) spent standing still, walking and jogging, running, sprinting, shuffling, and engaged in intense static activity were analysed for props and centres. The activities of scrimmaging, rucking and mauling, line-out's and tackles are critical components in the game of rugby. McLean (1992) quantified times spent in both work and rest during first division and international match-play.

Deutsch *et al*. (1998) also used time-motion analysis to quantify the physiological demands of Under 19 match-play. However, their analysis combined absolute measurements (frequency, time [s] and relative [%] time spent in various activities) with individual work-rest ratio data. Deutsch *et al*. (2007) combined these previous time-motion analysis methods to estimate the physical demands on professional rugby union players in various playing positions and to provide specific information for the preparation of elite rugby players. However, Deutsch *et al*. (2007) also stated that there was a lack of empirical research investigating the physiological demands of professional rugby, and advised that this lack of data on elite players and rule modifications, since the publication of most previous studies, made a comprehensive time-motion analysis of elite rugby timely. Therefore, Vaz *et al*. (2010) aimed to analyse a large sample of rugby matches from northern and southern hemisphere competitions, apply a measure to control for the differences in match scores and to determine if there are any game related statistics that can discriminate between winning and losing teams. Cahill *et al*. (2013) also quantify the movement characteristics of elite rugby union players during competitive play and identify whether position-related differences exist. Ninety-eight elite players from eight English Premiership Clubs were tracked using global positioning systems (GPS) during 44 competitive matches throughout the 2010/2011 season. Jones *et al*. (2004) highlighted a number of team factors which contribute to winning matches. Subsequent combination of these variables (line-out's won, tries scored, turnovers won, etc.) may be used to develop a model to predict future performance within rugby union.

Probably the most important component for rugby players, conditioning coaches and coaches to consider when structuring an exercise programme, is the high-intensity distance covered. This component is represented by the distance covered during running, high-speed running and sprints. Dwyer & Gabbett (2012) suggest that a sprint can be defined as any movement that reaches or exceeds the sprint threshold velocity for at least one second and any movement with an acceleration that occurs within the highest 5% of accelerations found in the corresponding velocity range. The high-intensity distance covered can be regarded as the actual playing intensity, because most activities are performed during this stage. McLean (1992) observed that when the ball was in open play, the average running pace of players central to the action ranged from five to eight metres per second. This together with scrum, line-out, ruck and maul was classified as high-intensity exercise. According to Austin *et al*. (2011), the durations of the most intense repeated high-intensity exercise bouts for each position ranged from 53 sec to 165 sec and the minimum recovery periods between repeated high-intensity exercise bouts ranged from 25 sec for the back row forwards to 64 sec for the front row forwards. The most intense periods of activity are likely to last as long as 120 sec and as little as 25 sec recovery may separate consecutive repeated high-intensity exercise bouts.

During a game, outside backs are engaged in more sprints than front row forwards. As a result, outside backs spend significantly more total time sprinting than front row forwards. An overall difference between forwards and backs is also observed. Mean sprint duration is longer for outside backs than for any other positional group, contributing to significantly longer mean sprint duration for backs than for forwards (Deutsch *et al*., 1998). Deutsch *et al*. (2007) reported an overall difference between forwards and backs (10.2 sec vs. 29.4 sec). In contrast to this believe, Cahill *et al*. (2013) provided new insight into the position-related sprinting demands of the game, for instance, that the forwards sprinted greater total distances than the backs. It will, therefore, be meaningful for conditioning coaches and coaches to be aware of differences and to adapt their programmes to the demands revealed by time-motion analysis.

According to Deutsch *et al*. (2002) and Cahill *et al*. (2013), the distance covered during a game of rugby commonly includes distances covered by walking, jogging, running, high-speed running and sprints. Walking in rugby can be considered as the rest phase and the time passing between set phases, walking back to position after a high-intensity bout or walking to a scrum or line-out. Jogging can also be found between set phases or when moving back to position either after the ball has gone dead or whilst the game is still underway. Running, high-speed running and sprints take place while the game is underway to get to rucks and mauls or when defending, and also include running with the ball and chasing a ball. The sum of all these activities is considered the distance covered (Deutsch *et al*., 2002).

Early estimations of the distance covered during a rugby match indicated that a centre covered 5 800m, of which 2 200m was walking, 1 600m jogging and 2 000m sprinting (Morton, 1978). Deutsch et *al*. (1998) monitored six players during four Under-19 matches between different levels of play. Although backs had a lower overall exertion based on heart rate, they covered the greatest distance, with props and locks covering 4 400±398m, back row 4 080±363m, inside backs 5 530±337m and outside backs 5 750±405m. Within elite Under-19 colts' rugby, forwards spent a larger percentage of time standing still (46%) compared with the backs (39%), and covered a shorter distance in all gait movements except jogging. Data from Cunniffe *et al*. (2009) revealed that players covered on average 6 953m during play. Of this distance, 2 800m was spent standing and walking, 1 900m jogging, 700m cruising, 990m striding, 320m high-intensity running, and 420m sprinting. The distance covered during a game of rugby has been influenced by rule changes over the last few years, but can also be influenced by weather, playing conditions, competition structure, team structure or the magnitude of the game (Vaz *et al*., 2010).

The physiological ability of the player to cope with high-intensity exercise with very little rest in between bouts are expressed as a percentage of the work rate at high intensity and can be related to the overall performance of the team or an individual. McLean (1992) found that the mean duration of work in a rugby union game was 19s; he further indicated that 60% of the duration of work periods were between 11 sec and 25 sec and 5% were between 50 sec and 60 sec. Work-rest ratios were on average 80:106 per game; 20% were 2:1, 18% were 1:4 and higher and 5% was higher than 3:1 (McLean, 1992). In a study done by Sykes *et al*. (2009) on rugby league, outside backs had a higher work to rest ratio for ball in play and defending than all other positional groups ($p<0.05$).

Deutsch *et al*. (2007) reported mean work-rest ratios of 7.3 for front rows, 7.5 for back rows, 20.9 for inside backs and 22.8 for outside backs. In his study on Super 12 players, front row and back row forwards performed significantly more high-intensity work than inside and outside backs ($p<0.01$) as a result of performing work more frequently. The mean rest period was significantly longer for inside and outside backs than for front row and back row forwards ($p<0.01$). As a result of a shorter mean rest period, the inside and outside backs had significantly lower mean work-rest ratios than front and back row forwards ($p<0.01$). Heart rate data collected by Deutsch *et al*. (1998) indicated that props and locks (58.4%) and back row forwards (56.2%) spent significantly more time in high exertion (85-95% HRmax) than inside backs (40.5%) and outside backs (33.9%). Inside backs (36.5%) and outside backs (38.5%) spent significantly more time in moderate exertion (75-84% HRmax) than props and locks (22.6%) and back row forwards (19.8%). These results add to our understanding of the variety in the positional demands of rugby union and can be utilised in our methods for the preparation of elite rugby players.

PURPOSE OF THE STUDY

This research attempted to identify time-motion statistics in the game of rugby that discriminate between winning and losing teams, and to provide, by means of time-motion analysis, a meaningful body of data to determine winning and losing components that jeopardise matches at senior international level through specific movements. The question must therefore be asked if there is a significant difference ($p<0.05$) between the total distances covered, high-intensity distances covered and percentage work rate at high intensity of various playing positions in the winning and losing teams during professional rugby union match-play. The question also arises if total distance covered, high-intensity distances covered and percentage work ratio (%) significantly discriminate between winning and losing in international rugby games.

METHODOLOGY

Subjects

A total of 270 rugby players that participated in 18 games played during the 2005-2007 Super 14 competitions (n=12), Tri-nations (n=2) and International tours (n=4) were included in the study. The participants varied from Super 14 level to international test playing nations, including South Africa, New Zealand and Australia. Super 14 teams are all regarded as international teams due the international players from all 3 participating nations that compete for these teams. Team positions were classified according to subgroups reflecting positional commonality (front row, locks, loose forwards, inside backs and outside backs) (Meir *et al*., 2001). Players from each of the positional groups were studied: front rows (players 1 & 3); locks (players 4 & 5); loose forwards (players 2, 6, 7, 8); inside backs (players 9, 10, 12, 13); and outside backs (players 11, 14, 15). A total of 36 front rows, 36 locks, 72 loose forwards, 72 inside backs and 54 outside backs were evaluated.

Research method and techniques

Time-motion analysis was conducted on all 18 games played. Data was supplied by the ProZone Company to the South African Rugby Union and Springbok management team. The study did not involve any verbal or physical contact with the players, as data were collected with informed consent via the Springbok teams' video analyst and the ProZone analysis system. The Research Ethics Committee of the Faculty of Humanities, University of the Free State approved the study.

To obtain data about the game, ProZone uses 8 cameras placed around the stadium in combination with manual operators. Computer vision technology is used to capture the movements of the players and the ball, but a lot of manual work is required, not only to register all the events that happen during the game, such as free kicks, penalties and passes, but also to aid the automatic tracking (Mylvaganam *et al*., 2002). The validity of ProZone has been established by Di Salvo *et al*. (2006).

Statistical analysis and interpretation of data

All data were captured in Microsoft Excel 2007. The SAS Version 9.1.3 statistical software was used for the further analysis. Means and standard deviations were used for numerical data. Mean values between winning and losing sides were compared using the t-test procedure. A significance level of $p<0.05$ was used throughout. To determine if the distance covered, high-intensity distance covered and percentage work rate at high-intensity could discriminate between winning and losing teams in international games, a discriminant analysis (SPSS, 2013, version 21) was done. The measure of agreement with help from the *Kappa (k)*-coefficient were used to explore the aim. The practical significance of the results was also investigated in order to provide findings on the practical importance of the statistical significant results which were found with the research. As standard of practical significance, the effect size was also be calculated (Hopkins, 2002). A total of 270 rugby players that participated in 18 games played during the 2005 to 2007 Super 14 competitions were included in the analysis. Data collected were statistically analysed to show the differences between winning and losing sides.

RESULTS AND DISCUSSION

The influence of each component (total distance covered, high-intensity distance covered, and the percentage work rate at high intensity) was compared between the winning and losing teams. All 3 variables were added simultaneously to the comparison and a Wilk's Lambda value of 0.996 was recorded. The corresponding χ^2-value was 2.185 for the 3 degrees of freedom. This value does not show a statistically significant result (p=0.535), and therefore, it was concluded that total distance covered, high-intensity distance covered, and the percentage work rate at high intensity was not able to discriminate significantly between winning and losing teams. The statistical analysis indicates that:

- 51.3% of the winning results were again classified as winning, whilst 48.7% of the winning results have been wrongly classified as a loss.
- 52.5% of the losing results were correctly classified, while 47.5% of the losing results have been wrongly classified as a win.

It is, therefore, clear that all 3 variables (distance covered, high-intensity distance covered and percentage work rate at high-intensity) could not successfully discriminate between winning and losing in a rugby game.

***TABLE 1*: DESCRIPTIVE STATISTICS AND EFFECT SIZE FOR ALL VARIABLES FOR WINNING AND LOSING TEAMS**

Position	Vari-able	Winning team M±SD	Losing team M±SD	Mean Diff.	Ave-rage	Effect size	Size effect	p-value
Front rows	Dist (m)	5829±547	5802±698	27	622.5	0.04		0.85
	HI dist (m)	789±318	812±287	-23	302.5	-0.08		0.75
	% WR HI	11±4	12±4	-1	4	**-0.25**	**Small**	0.33
Inside backs	Dist (m)	7260±586	7072±677	188	631.5	**0.30**	**Small**	0.07
	HI dist (m)	1690±325	1715±396	-25	360.5	-0.07		0.67
	% WR HI	22±3	23±4	-1	3.5	**-0.29**	**Small**	0.20

TABLE 1. **DESCRIPTIVE STATISTICS AND EFFECT SIZE FOR ALL VARIABLES FOR WINNING AND LOSING TEAMS (*cont.)***

Position	**Vari-able**	**Winning team M±SD**	**Losing team M±SD**	**Mean Diff.**	**Ave-rage**	**Effect size**	**Size effect**	**p-value**
Locks	Dist (m)	5958±679	6263±498	-305	588.5	**-0.52**	**Small**	0.03*
	HI dist (m)	1016±242	1109±305	-93	273.5	**-0.34**	**Small**	0.15
	% WR HI	16±3	16±4	0	3.5	0.00		0.93
Loose forwards	Dist (m)	6404±421	6329±485	75	453	0.17		0.32
	HI dist (m)	1331±276	1333±317	-2	296.5	-0.01		0.96
	% WR HI	19±3	20±4	-1	3.5	**-0.29**	**Small**	0.25
Outside backs	Dist (m)	7194±523	6976±715	218	619	**0.35**	**Small**	0.07
	HI dist (m)	1549±254	1562±347	-13	300.5	-0.04		0.82
	% WR HI	21±2	22±3	-1	2.5	**-0.40**	**Small**	0.11
Team Average	Dist (m)	6529±700	6489±700	40	700	0.06		-
	HI dist (m)	1275±500	1307±500	-32	500	-0.06		*
	% WR HI	18±5	19±5	-1	5	-0.20		-

The actual p-values of all variables were only provided for positional groups of winning and losing teams and not with team averages. *p<0.05 M= Mean SD= Standard deviation
Dist= Distance HI= High Intensity WR= Work Rate

High-intensity distance covered

Table 1 presents the distance covered, high-intensity distance covered and percentage work rate at high intensity of various playing positions during professional rugby union in winning and losing teams, as well as the significance of these differences and the effect size. It is interesting to note that the losing teams covered a greater distance in high intensity in all positions and in team averages (1 307m vs. 1 275m). However, there was no significant difference in the high-intensity distance covered and it provides a small effect size between winning and losing teams. It must be noted that the difference is only 32m in an 80 minute game of rugby. This can be due to the pressure of losing and having to play harder to be successful. When the winning and losing teams are compared, there are some differences between playing positions. The results of this study also supports the findings of Deutsch *et* *al*. (1998), showing that the backs were engaged in more sprints than front row forwards (outside backs 1 549m; inside backs 1 690m vs. front rows 789m). Front row forwards were more engaged in set pieces like rucking and mauling and did not often have the freedom or space to sprint. As expected the loose forwards were also engaged in more sprints (1 331m) than the other forwards. Sirotic *et al*. (2011) showed that positional roles play an important part in determining the amount of physical and game-specific skill involvement during match play. The hooker spent more time jogging than the backs and forwards and touched the ball on more occasions than any other positional group.

Distances covered

The distances that were covered by the winning and losing teams are compared in Table 1. Interestingly, of the 18 games that were played, 12 were won by the home team, which confirms the belief that it is more difficult to win matches away from home. Only 7 of the 12 winning teams were able to cover greater distances than the losing teams. This study showed average distances ranging from 5 816m (front rows) to 7 166m (inside backs). The distances covered by positional groups showed only one significant difference ($p<0.05$) between the winning and losing teams. The total distance covered by the locks showed a significant difference ($p=0.03$) but the value provides a small effect size of 0.52 between the winning and losing teams (see Table 1). Locks had an increase in distance from winning a game to losing (winning= 5 958m; losing= 6 263m). It can then be stated that the role of locks might change as the possibility of winning or losing becomes more apparent. Locks are also frequently used as primary defenders in close quarters or around the fringes of the rucks because of their weight, but mobile locks also play a significant role in defence and attack. Reasons for the only 1 significant difference and small effect sizes would be that positional groups, whether in losing or winning teams, have the same work or game description no matter the team.

Early estimations on the distance covered during a rugby match indicate that a centre covered 5 800m, of which 2 200m was walking, 1 600m jogging and 2 000m sprinting (Morton, 1978). Data from Cunniffe *et al*. (2009) revealed that players covered on average 6 953m during play. Of this distance, 2 800m was spent standing and walking, 1 900m jogging, 700m cruising, 990m striding, 320m high-intensity running, and 420m sprinting. In the study of Cahill *et al*. (2013) the backs covered greater absolute distances (6 545m) than the forwards (5 850m) during competitive matches. However, these distances were substantially lower than for the backs (7 002m) and forwards (6 427m) reported by Coughlan *et al*. (2011) and the backs (7 227m) and forwards (6 680m) in the article by Cunniffe *et al*. (2009). The average distance covered during this study was 6 509m, which is greater than what Morton (1978) and Cahill *et al*. (2013) estimated, but less than reported by Cunniffe *et al*. (2009) and Coughlan *et al*. (2011). This increase in distances covered by players could explain the change in opinion over the last 20 years regarding the game being quicker, more demanding and a lot more entertaining (Deutsch *et al*., 2002). The team averages in the current study indicated that the winning team covered a slightly greater distance (40m) than losing team averages (6 529±700m vs. 6 489±700m).

Deutsch *et al*. (1998) monitored 6 players during 4 Under-19 matches between different teams. Although backs had a lower overall exertion based on heart rate, they covered the greatest distance, with props and locks covering 4 400±398m, back row 4 080±363m, inside backs 5 530±337m and outside backs 5 750±405m. It is important to note that distances covered at senior level rugby is much higher (Table 1). In comparing the distance covered by inside backs, it was found that the winning team had covered more distance than their losing opponents (7 260 vs. 7 072m) in this positional group because of possible sustained pressure on the attack and having more ball possession, but no significant difference was found ($p=0.07$). The same can be said about the distance covered by front rows, which varied from 5 802m when the game was lost to 5 829m when the game was won; still no significant difference was found ($p=0.85$). Another possible reason could be due to the fact that forwards spent a larger percentage of time standing still (46%) compared with the backs (39%), and covered a shorter distance in all gait movements except jogging (Deutsch *et al*., 1998).

Percentage work rate at high intensity

The percentage work rate at high intensity also showed no significant differences ($p<0.05$) and only small effect sizes between playing positions in winning and losing teams (Table 1). Team averages showed that the losing teams had a higher percentage work rate at high intensity than the winning teams (19%±5% vs. 18%±5%), which could be attributed to either having to defend more or to playing harder to achieve success. Van Rooyen *et al*. (2008) concluded that 80% of the impact contacts were recorded at a higher frequency when the team lost as opposed to when they won. Within the winning and losing teams, the forwards had a lower work rate than the backs, which could be due to higher distances performed in high intensity by the backs as opposed to the forwards' predominant involvement in high-activity actions like scrumming or rucking (front row 11.8%, locks 16.7%, loose forwards 19.7%, inside backs 22.8%, outside backs 21.1%).

In contrast to this finding, Holmyard *et al*. (1988) found that front row and back row forwards performed more high-intensity work than inside and outside backs, as the result of performing work more frequently. Possible reasons for this contrast in results are the different actions taken into consideration when performing time-motion analysis. Some authors may regard high-intensity actions as only the contact phases on the field and not necessarily high-speed running or sprinting. Docherty *et al*. (1988) declared in this regard that centres spent more time in intense running and that the time spent in static exertion by the forwards contributed to a greater time spent in high-intensity activity (forwards, 11 minutes) compared with the backs (4 minutes) (Docherty *et al*., 1988). The mean duration of recovery periods was reported to be 33 seconds during international matches, with the majority of rest periods less than 40 seconds (Menchinelli *et al*., 1992).

Rugby players have a diverse range of physical attributes, and it must be borne in mind that the game of rugby is complex, with many key performance indicators. Circumstances also change from game to game due to many varying conditions, including the weather, strategies, tactics, and players available and so forth (Vaz *et al*., 2010).

CONCLUSIONS AND RECOMMENDATIONS

The questions subsequently answered were firstly, if time-motion analysis could be implemented as a variable in identifying rugby success. Rugby consists of many different components, like skills (passing, kicking and catching), fitness (aerobic, anaerobic, endurance, speed, agility, strength and power) and game phases (scrums, line-out's, rucks and mauls). It is impossible to recognise one or two specific components that influence the result, especially in professional rugby where coaches spend equal amounts of time to improve each component. Coaches have to provide players with enough assistance to improve on these components and realise that all components need attention. Time-motion analysis is, therefore, an effective method of quantifying the demands of rugby and provides a conceptual framework for the specific physical preparation of players.

Secondly, it was attempted to determine which variable (total distance covered, high-intensity distance covered and percentage work rate at high intensity), in time-motion analysis differed significantly ($p<0.05$) between winning and losing teams. It was clear that all three variables (distance covered, high-intensity distance covered and percentage work rate at high-intensity), could not successfully discriminate between winning and losing in a rugby game. The game plan, weather conditions and competition structure (as teams will continue play even if the time have been exceeded in order to secure the bonus point), may be some reasons for different high-intensity distances covered, distances covered and percentage work rate at high intensity. The level of experience of players improve their ability to 'read' the game better, and therefore, can reduce the distance covered by choosing shorter routes to rucks, mauls and tackle ball situations.

Thirdly, the current study attempted to determine if there were significant differences ($p<0.05$) between positions in the different components in time-motion analysis. Some positions (locks and inside centres) showed differences, but game situations and conditions change too often to confirm the significance of these differences. Positional activities will also be influenced by the game plan incorporated by the team. Certain teams will play an expansive game, and therefore, distances will increase in all positions, whereas other teams will play more physical by keeping the ball between the forwards and as a result the percentage work rate at high intensity will increase, but not the distance. Even these game plans are prone to change on account of weather conditions, home ground advantage, player experience and team experience, and the magnitude of the game. This means that no assumption could be made that one specific positional group or variable would influence success.

In summary, this study showed that international competitions including teams from different nations were unlikely to show statistically significant differences in time-motion analyses between winning and losing teams and a comprehensive profile that include patterns of the game, performance indicators and work ratios would be needed. Quarrie and Hopkins (2007) believe that law changes and developments in match analysis, equipment technology, and player training have contributed to the changes associated with the introduction of professionalism.

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