

## Endurance capacity and selected technical-tactical skills of soccer players participating in the group stage of the 2014 FIFA World Cup

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The study examines the endurance capacity and selected technical-tactical skills of soccer players participating in the 2014 World Cup in Brazil. The results indicate the significant impact of players' motor preparation level on the execution of technical-tactical actions in top-class soccer tournaments. The covered distance by players during a match is one of the most important indices used for assessment of players' endurance capacity. The analysis revealed that the Spain and Italy national teams which attained very high passing efficiency and total number of passes failed to advance to the knockout stage of the tournament. The analysis of the structure of match performance, especially by elite teams, is necessary for rational programming of endurance training in professional soccer. The knowledge of endurance loads at top-level soccer tournament permits the optimalization of modern soccer training.

**KEYWORDS:** soccer, endurance, covered distance, ball possession, completed passes, World Cup 2014.

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### What is already known on this topic?

The study examines the endurance capacity and selected technical-tactical skills of soccer players participating in the 2014 World Cup in Brazil. The results indicate the significant impact of players' motor preparation level on the execution of technical-tactical actions in top-class soccer tournaments. The covered distance by players during a match is one of the most important indices used for assessment of players' endurance capacity. The analysis revealed that the Spain and Italy national teams which attained very high passing efficiency and total number of passes failed to advance to the knockout stage of the tournament.

### Introduction

The final match result in team games, including association football, is determined by multiple factors. One of them is players' physical preparation which not only affects the level of physical activity of individual players and the whole team, but also the execution of players' technical-tactical skills and performance efficiency during the game. Physical training has also a significant influence on the effectiveness of analytical and decision-making processes in the player's brain, especially on making quick and accurate decisions in conditions of incremental fatigue during match-play. It also determines the dynamics of recovery processes during and after sport competition. Physical training of players is crucial for World Cup and European Championships competitions in which the top teams

can play up to seven matches within a month in different stages of the tournament, and the result of each match can decide about the team's advance.

An important component of players' motor preparation is the genetic profile that contains information about players' predispositions and affects players' match performance. Gronek et al. [1-3] stress the usability of genetic research in team sports games, which can enable more effective individualization of the training process. It should be noted that players' speed, strength and endurance abilities are genetically determined. Also the maximal oxygen uptake ( $VO_{2max}$  in l/min) as a major physical fitness index also depends on the player's genetic profile.

Endurance is one of fundamental components of motor training of soccer players. A practical measure of a player's endurance skills is the distance travelled covered by him during a match. The total match distance is covered by walking, jogging and running with high, medium and low intensity [4]. Motion analysis of matches of the 2010 World Cup in South Africa showed that the longest total distance during a match was covered by players of the Australia national team (121.51 km), and individually by Carl Valeri (12.93 km) [4]. With regard to the playing position on the pitch, the longest mean distance was covered by South Korea midfielders ( $10.91 \pm 0.40$  km) followed by forwards ( $9.69 \pm 0.62$  km) and defenders ( $9.57 \pm 0.80$  km) [5]. Similar distances were recorded by other authors examining top soccer players from different European national leagues [6-12].

The high level of players' performance skills also affects the team's tactical indices such as ball possession and the number of total and successful passes. Regardless of the opponent's class, different teams use high, midfield, or low pressing in their match tactics. This requires an appropriate level of players' endurance to perform actions with the ball. Players who are better physically prepared can perform at a higher intensity level, which in most cases can decide about the match outcome.

Poor endurance preparation of players results in their rapidly increasing fatigue, greater number of committed errors, losing one-on-one plays and lowering the effectiveness of technical-tactical actions, especially in the last quarter of the match. Its main consequence is the loss of goals [13, 14].

The present study examines selected aspects of players' endurance capacity in the context of technical-tactical skills of soccer players participating in the 2014 World Cup in Brazil.

## Material and Methods

All 32 national teams that qualified for the 2014 World Cup finals were analyzed in the study. The Castrol Performance Index motion analysis system was used for recording all players' movements during the tournament matches and processing them into quantitative data. Using the official FIFA match reports, the total mean distance covered by players in a match was analyzed with regard to the playing position, team tactics and selected technical-tactical skills. The analysis covered 48 matches in the group stage.

The conformity of distribution of all examined parameters was checked against normal distribution. The normality of distribution was assessed with the Shapiro-Wilk test ( $p < 0.05$ ). Arithmetic means and standard deviations were calculated for all parameters. Analysis of variance was used to compare mean values of the total distance covered by particular teams and players in different positions on the pitch. The differences between mean total distances between match halves and teams were examined using a repeated measures analysis of variance. In the case of significant differences between the mean values a Tukey's HSD test was applied. A repeated measures analysis of variance was used to determine significant differences, mean total distances between rounds of the group stage and players' performance intensity ranges. ANOVA for multiple factors was used to compare mean values of technical-tactical players' skills between advancing and non-advancing teams in particular matches of the group stage. The level of statistical significance was set at  $p < 0.05$ . All statistical analyses were carried out with the use of the STATISTICA software package.

## Results

### *Total covered distance in particular groups of the group stage*

Table 1 shows that the total distances covered by teams displayed statistically significant differences between the studied groups ( $p \leq 0.01$ ). Teams from Groups B, H, G covered the longest total distance (112 km). A 10-km shorter total distance was covered by teams from Groups A and C (102 km). Significant differences ( $p \leq 0.01$ ) were found between Groups in which the teams covered the longest distances (B, H, G) and the remaining groups. Furthermore, statistically significant differences ( $p \leq 0.01$ ) were also noted between Groups with the shortest mean total covered distance (A, C) and Groups D and F.

**Table 1.** Mean covered distance in groups of the 2014 World Cup group stage

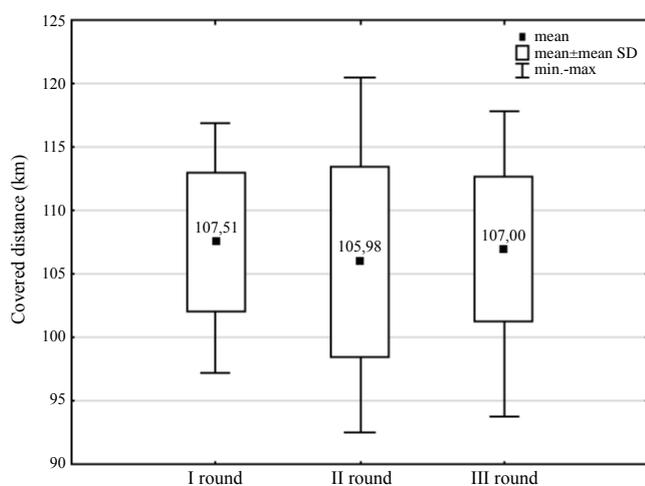
Group	Distance [km] 1 <sup>st</sup> half	Distance [km] 2 <sup>nd</sup> half	Total covered distance [km]
	$\bar{x} \pm SD$		
A	51.34 ± 2.05	50.34 ± 2.64	101.69 ± 4.50
B	56.07 ± 3.27	55.88 ± 3.10	111.95 ± 6.12
C	51.32 ± 2.53	50.64 ± 2.96	101.96 ± 5.02
D	53.69 ± 1.65	52.86 ± 1.09	106.57 ± 9.85
E	52.15 ± 2.78	51.02 ± 4.58	102.92 ± 6.50
F	52.71 ± 3.03	53.53 ± 2.20	106.24 ± 4.83
G	55.90 ± 2.69	55.67 ± 3.17	111.58 ± 4.27
H	56.01 ± 2.30	55.73 ± 1.84	111.73 ± 3.66

Out of all matches of the first round the longest distance was covered by the players from the Australia team (120.56 km) in the match against the Netherlands (2:3) in the second round; and the shortest by Cameroon players (92.57 km), in their match against Croatia (0:4) in the second round (Table 3).

The mean distance covered by all teams in the tournament groups in the 1<sup>st</sup> and 2<sup>nd</sup> halves of matches was similar and statistically non-significant ( $p \geq 0.05$ ). In the 2<sup>nd</sup> halves the teams covered shorter distances, with the exception of Group F teams. The greatest difference between the first and the second match halves (1.13 km) was in Group E. In all 48 matches of the group stage, the players covered a mean distance of  $106.83 \pm 6.23$  km.

*Total covered distance in particular rounds of matches of the group stage*

In the group stage of the 2014 World Cup the longest distance was covered by players in the first round of matches:  $107.51 \pm 5.42$  km (Figure 1). In the second round the distance was  $105.98 \pm 7.46$  km, and in the third –  $107.00 \pm 5.74$  km, i.e. shorter than the distance in the first round. The differences between the mean distances in the three rounds of matches of the group stage were statistically non-significant ( $p \geq 0.05$ ).



**Figure 1.** Mean covered distance in three rounds of matches of the group stage

*The mean distance covered by teams in three matches of the group stage*

The longest mean distance in three consecutive matches of the group stage was also covered by the Australia team ( $118.10 \pm 2.34$  km), followed by the Russia team ( $115.81 \pm 1.95$  km) and the US team ( $113.94 \pm 3.39$  km) (Tables 2, 3). The distance covered by the Germany team – the World Cup winner – was  $113.77 \pm 2.75$  km. It should be noted that four teams covered a distance below 100 km: Ecuador ( $98.75 \pm 3.63$  km), Cameroon ( $97.31 \pm 4.13$  km), Honduras ( $96.11 \pm 2.52$  km) and Ivory Coast ( $95.78 \pm 1.30$  km) (Table 3). The mean longest and shortest covered distances revealed statistically significant differences at  $p \leq 0.01$ .

*The distance covered by advancing and non-advancing teams to the Round of 16 of the knockout stage*

Table 2 shows that that the mean distances covered by teams advancing to the knockout stage ranged from  $113.94 \pm 3.39$  km (USA) to  $100.34 \pm 2.60$  km (Brazil). Among the non-advancing team the mean distance was from  $118.10 \pm 2.34$  km (Australia) to  $95.78 \pm 1.30$  km (Ivory Coast) (Table 3). The mean distance travelled in three matches was longer in the advancing teams ( $107.14 \pm 4.46$  km) than in the non-advancing teams ( $106.53 \pm 6.72$  km); however, the differences were statistically non-significant ( $p \geq 0.05$ ).

*The covered distance with regard to the intensity of match performance*

In 48 matches of the group stage the longest distance was covered with low intensity  $63.08 \pm 2.46$  km, followed by medium intensity –  $16.58 \pm 1.89$  km and high intensity –  $27.16 \pm 3.02$  km. Although the teams advancing to the Round of 16 covered a 0.55 km longer distance with high intensity than the non-advancing teams, the difference was statistically non-significant ( $p \geq 0.05$ ).

**Table 2.** Distance covered in particular matches and the mean number of covered kilometers in teams advancing to the knockout stage

Team	Mean covered distance [km]			
	1 <sup>st</sup> match	2 <sup>nd</sup> match	3 <sup>rd</sup> match	$\bar{x} \pm SD$
1 USA	116.98	110.29	114.55	113.94 $\pm$ 3.39
2 Germany	111.65	116.88	112.79	113.77 $\pm$ 2.75
3 Algeria	113.47	113.82	110.18	112.49 $\pm$ 2.01
4 Chile	113.55	117.87	104.23	111.88 $\pm$ 6.97
5 Netherlands	109.38	115.08	103.80	109.42 $\pm$ 5.64
6 Switzerland	113.63	106.17	105.91	108.57 $\pm$ 4.38
7 France	108.18	105.64	110.97	108.26 $\pm$ 2.67
8 Costa Rica	108.61	107.10	108.97	108.23 $\pm$ 0.99
9 Belgium	109.96	108.15	104.70	107.60 $\pm$ 2.68
10 Columbia	107.62	102.06	104.81	104.83 $\pm$ 2.78
11 Uruguay	104.26	105.35	104.31	104.64 $\pm$ 0.62
12 Mexico	104.44	100.23	108.23	104.30 $\pm$ 4.00
13 Argentina	105.43	100.30	102.20	102.64 $\pm$ 2.60
14 Nigeria	100.10	103.27	102.35	101.91 $\pm$ 1.63
15 Greece	104.85	95.56	103.75	101.39 $\pm$ 5.08
16 Brazil	102.09	97.35	101.58	100.34 $\pm$ 2.60

**Table 3.** Distance covered in particular matches and the mean number of covered kilometers in teams non-advancing to the knockout stage

Team	Mean covered distance [km]			
	1 <sup>st</sup> match	2 <sup>nd</sup> match	3 <sup>rd</sup> match	$\bar{x} \pm SD$
1 Australia	115.89	120.55	117.87	118.10 $\pm$ 2.34
2 Russia	113.81	117.71	115.92	115.81 $\pm$ 1.95
3 Bosnia and Herzegovina	115.49	110.32	111.97	112.59 $\pm$ 2.64
4 South Korea	108.13	112.90	111.97	111.00 $\pm$ 2.53
5 Ghana	110.57	110.74	111.50	110.94 $\pm$ 0.49
6 Spain	102.04	109.26	114.16	108.49 $\pm$ 6.10
7 Iran	108.29	108.03	107.16	107.83 $\pm$ 0.59
8 Portugal	101.87	106.52	114.66	107.68 $\pm$ 6.48
9 Italy	110.46	104.47	106.39	107.11 $\pm$ 3.06
10 England	107.25	104.22	107.48	106.32 $\pm$ 1.82
11 Japan	108.25	102.03	107.21	105.83 $\pm$ 3.34
12 Croatia	109.16	101.45	103.74	104.78 $\pm$ 3.96
13 Ecuador	98.92	95.04	102.29	98.75 $\pm$ 3.63
14 Cameroon	100.07	92.57	99.31	97.31 $\pm$ 4.13
15 Honduras	98.77	95.80	93.76	96.11 $\pm$ 2.52
16 Ivory Coast	97.23	94.69	95.44	95.78 $\pm$ 1.30

*The mean covered distance with regard to playing position*

Considering all players who played full-time in the studied matches, the longest distance was covered by midfielders – 10.73  $\pm$  0.85 km, followed by forwards – 10.11  $\pm$  0.97 km, and defenders – 9.77  $\pm$  0.78 km. The differences between the playing positions were statistically significant ( $p \leq 0.01$ ).

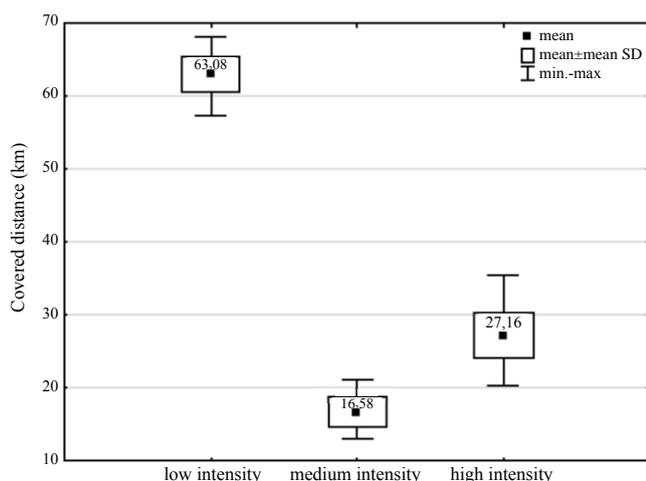
As for individual players, the longest distance was covered by an Australia midfielder Matt McKay who ran 13.25 km in the match against Spain (0:3). The runner-up was Michael Bradley (USA) – 13.08 km in the match against Germany (0:1), and the third was Saphir Taider (Algeria) – 12.73 km in the match against Belgium (1:2). In comparison, Thomas Mueller from the victorious Germany team ran 12.22 km in the drawn match against Ghana (2:2), while Wayne Rooney from the England team ran 11.28 km. Among the defenders the longest distance was covered by Stephan Lichtsteiner of Switzerland – 11.45 km, and Marcos Rojo from the runner-up Argentina team covered 11.18 km.

*Covered distance in ball possession*

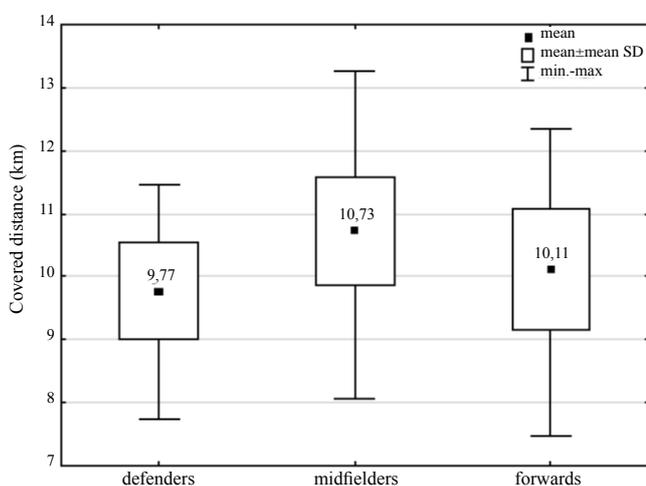
The mean covered distance in ball possession was 38.83  $\pm$  7.49 km, i.e. 35.47  $\pm$  3.46% of the mean total distance covered by 32 teams in the group stage. The longest mean distances in ball possession were run by the Spain team – 42.78%, the Argentina team – 42.50% and the Germany team – 42.10%; the shortest distance in ball possession was covered by the players from Uruguay – 28.57%.

*Selected technical-tactical skills*

The ball possession time in the first round of matches of the advancing



**Figure 2.** Mean distance covered by all teams in the group stage with low, medium and high intensity



**Figure 3.** Mean distance covered by players in the group stage matches with regard to their playing position: defenders, midfielders, forwards

teams to the knockout stage was significantly longer i.e. 53.38% ( $p < 0.05$ ) than of the non-advancing teams, i.e. 46.63%. The total number of passes and the number of accurate and inaccurate passes in the first round were higher in the advancing teams than in the non-advancing teams (Table 4). The differences between these variables were statistically non-significant. In the second and third rounds of matches these values were higher in the non-advancing teams (Table 4). The mean values of these variables were statistically non-significant ( $p \geq 0.05$ ). The greatest number of passes in the group stage was executed by the players from Germany – 2,120, Spain – 2,071, Argentina – 1,882 and Italy – 1,854. The Brazil players executed only 1,528 passes, taking the 16<sup>th</sup> place among the 32 teams. In terms of passing accuracy, the best was the Italy team (85.22%), followed by Germany (84.53%), Spain (82.23%), France (81.50%) and Argentina (81.03%). The Brazil team came only 15<sup>th</sup> (75.79%). The Australia team, i.e. the team with the best endurance preparation level, executed 1,459 passes with 75.60% accuracy.

**Discussion**

The above data show that the teams playing in the group stage of the 2014 World Cup in Brazil represented different levels of endurance preparation and technical skills. These differences are best illustrated by the distances covered in particular Groups in the three rounds of matches of the group stage by the teams advancing and non-advancing to the Round of 16. Also the differences are manifested by the distances covered with regard to performance intensity, playing

**Table 4.** Selected technical-tactical skills in teams advancing and non-advancing to the knockout stage of the 2014 World Cup in Brazil

Action	Advancing teams			Non-advancing teams			p-value (matches v. teams)
	1 <sup>st</sup> match	2 <sup>nd</sup> match	3 <sup>rd</sup> match	1 <sup>st</sup> match	2 <sup>nd</sup> match	3 <sup>rd</sup> match	
	$\bar{x} \pm SD$						
Ball possession [%]	53.37±8.79	48.50±8.98	48.69±8.66	46.62±7.26	51.50±8.50	51.31±6.67	0.0091
Total passes	547.63±113.76	469.50±113.80	484.19±127.50	491.13±110.17	507.19±112.07	523.88±90.83	0.0266
Completed passes	429.00±120.77	351.75±111.81	362.88±129.05	380.13±114.34	387.25±117.30	395.88±91.27	0.0706
Incomplete passes	118.63±15.07	117.75±13.75	121.31±18.12	111.00±19.59	119.94±23.63	128.00±15.68	0.2363
Passing efficiency [%]	77.06±6.83	73.56±7.06	73.63±6.53	76.50±7.13	75.38±7.55	74.94±5.43	0.6433

$p < 0.05$  – statistically significant;  $p \geq 0.05$  – statistically non-significant

position and the percentage of covered distance in ball possession. A considerable disproportion in the levels of technical-tactical skills was revealed by different ball possession times, the total number of passes and passing accuracy.

The analyzed results show that the mean distances covered in particular rounds of matches by all participating players and teams advancing and non-advancing to the knockout stage were relatively stable, which leads to the conclusion that the performance levels of the teams were similar. A much greater difference was noted between particular teams.

In the group stage of the tournament the longest distance was covered by players from Australia ( $118.10 \pm 2.34$  km), which can be indicative of their high level of endurance preparation before the World Cup. In spite of this the Australia team failed to advance to the knockout stage. As for the mean total covered distance among the advancing teams the best prepared in terms of their endurance capacity were the teams from the USA ( $113.94 \pm 3.39$  km) and Germany ( $113.77 \pm 2.75$  km). The covered distance noted in the present study was slightly longer than in other studies [4, 5]. Although the Australia and Russia teams covered longer distances than the US and Germany teams, i.e., 16 km and 2.04 km longer, respectively, they failed to advance to the knockout stage.

Among the 16 teams advancing to the knockout stage, the difference in the mean covered distance between the first and the last team, i.e. USA and Brazil, respectively, amounted to 13.60 km. Out of all 32 teams in the tournament, the Brazil team attained one of the lowest values of this parameter ( $100.34 \pm 2.60$  km), placing themselves only ahead of Ecuador, Cameroon, Honduras and Ivory Coast. It can be related to such factors as Brazilian players' exhaustion after an intensive league season, inadequate recovery period, improper choice of pre-competitive training loads, and psychological factors, e.g. great expectations of victory.

In modern association football an important determinant of the final match result is the intensity of match performance. This variable can be assessed by a set of ranges of players' movement speed on the pitch. Researchers have so far used 5 – 6 ranges of intensity in their studies [8, 15-18]. The present analysis used the Castrol Performance Index based on three intensity ranges: low, medium and high. The results showed that in all 48 matches of the group stage of the World Cup in Brazil, the players covered 59% of their total

distance with low intensity, 16% with high intensity and 25% with medium intensity. In accordance with results obtained by other authors [15, 19] soccer players usually cover the longest distances with low intensity. Mohr et al. [15] claim that the combined walking and jogging time during a match amounts to 57.5% of total playing time. The observations from the last World Cup indicate a steady tendency to increase the intensity of match performance [4, 5].

The present study revealed significant differences in the mean covered distance by players in different positions who played their matches full-time. The longest distance was covered by the midfielders as compared with the forwards and the defenders ( $p \leq 0.01$ ). This is confirmed by the results of studies of players from the UEFA Europa League [17, 18] and top-class national leagues [8, 10, 20]. The most intensive match performance by the midfielders can be justified by the fact the midfield is the pitch zone in which players stay for more than a half of match time, and that the midfielders are usually heavily involved in initiation of plays, flanking actions and ball interceptions.

One of the most important indices in modern soccer is the percentage of the distance covered by a team while in ball possession. The value of this index is determined by players' skills and match tactics. On the one hand, some teams participating in the 2014 World Cup were very well-prepared in terms of their players' endurance capacity, but they represented rather low levels of soccer skills. A good example is the Australia players among whom the percentage of the distance covered in ball possession was merely 31.59%. This means that the Australian players ran longer distances without the ball, which may have had an influence on their greater fatigue and reduced accuracy of ball passes.

On the other hand, the Spain team, traditionally preferring positional attacks with a large number of short passes and maintaining possession (*tiki-taka*) ran the longest distance in ball possession (42.78%), but failed to advance to the Round of 16. This can be indicative of the low variability of match tempo, high predictability of ball plays and fatigue after the league season (most Spanish players had played more than 60 matches before the World Cup). The very different tactics used by the Uruguay, USA and Costa Rica teams resulted in their low percentages of covered distance in ball possession (below 30%). In comparison to the positional attacks, the tactics of these teams based on counter attacks proved more effective and secured their

advance to the knockout stage, despite their lower levels of soccer skills than the Spain players.

In comparison with the 2010 World Cup in South Africa the Brazil tournament revealed an increase in the mean total distance covered by players in each match for about 2.39 km [4, 5], which, in turn, greatly improved the dynamics of play in the group stage. It should be emphasized that at the 2010 World Cup in South Africa the Australia team had also covered the longest mean total distance ( $112.56 \pm 9.54$  km) in the group stage but did not advance to the knockout stage [4]. This can be explained by the lower levels of soccer skills of the Australians, improper choice of match tactics or confrontation with highly ranked national teams in the group stage.

The final match result depends also on players' levels of technical skills such as percentage of ball possession time or the number of accurate and inaccurate passes. In most cases the teams which achieved the highest values of these variables in the first round won their matches and advanced to the knockout stage. In the second and third rounds of matches the levels of these parameters were higher in teams which failed to advance. This could be explained by the strong determination of these teams to exit their elimination groups after losing the first round of matches.

Another determinant of the match result is ball possession. The present analysis showed that the teams advancing to the Round of 16 possessed the ball for longer (53.38%) than the non-advancing teams (46.63%). This means in practice that a longer ball possession time does significantly affect the match outcome. According to Lago [21] there are four factors behind the differences in ball possession time between teams: evolving match status (i.e. whether the team is winning, losing or drawing), venue (i.e. playing at home or away), and the identities of the team and the opponent in each match. Jones et al. [22] showed that teams of the English Premier League that possessed the ball for longer during in matches won their match more often. This probably results from differences in the skills levels of individual players or from preferred team tactics. The analysis of ball possession time in the 2014 World Cup matches seems to confirm these observations.

The most successful passes were executed by teams whose players had played in the world's top national soccer leagues (Italy, Germany, Spain, France). Only the England players were far worse in their passing effectiveness. Although the Spanish and Italian teams had very high percentage of completed passes (85.22%

and 82.23%, respectively) and high numbers of total passes (1,854 and 2,071), they failed to advance to the knockout stage. This can be explained by their preferred team tactics of positional attacks and reliance on many short passes that allowed them to maintain ball possession for a long time in match situations without the opponent's interference. It should be noted, however, the two teams that reached the final featured the highest number of passes in the group stage (Germany – 2,120, Argentina – 1,882). It can be assumed that the Italy, Spain and England national teams, regarded as favorites before the tournament, failed to advance to the knockout stage due to their poorer motor preparation, including endurance preparation.

The motion analysis of the 2014 World Cup matches proves that the development of endurance skills still dominates the process of motor preparation of players before top-class soccer tournaments. A higher level of endurance allows an improvement of overall match performance intensity, better fatigue tolerance and faster recovery during and after a match. This all also contributes to players' more effective execution of technical-tactical actions and to the better realization of players' potential.

#### **What this paper adds?**

The analysis of the structure of match performance, especially by elite teams, is necessary for rational programming of endurance training in professional soccer. The knowledge of endurance loads at top-level soccer tournament permits the optimization of modern soccer training.

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