



# Physical Analysis

of the FIFA Women's World Cup Canada 2015™





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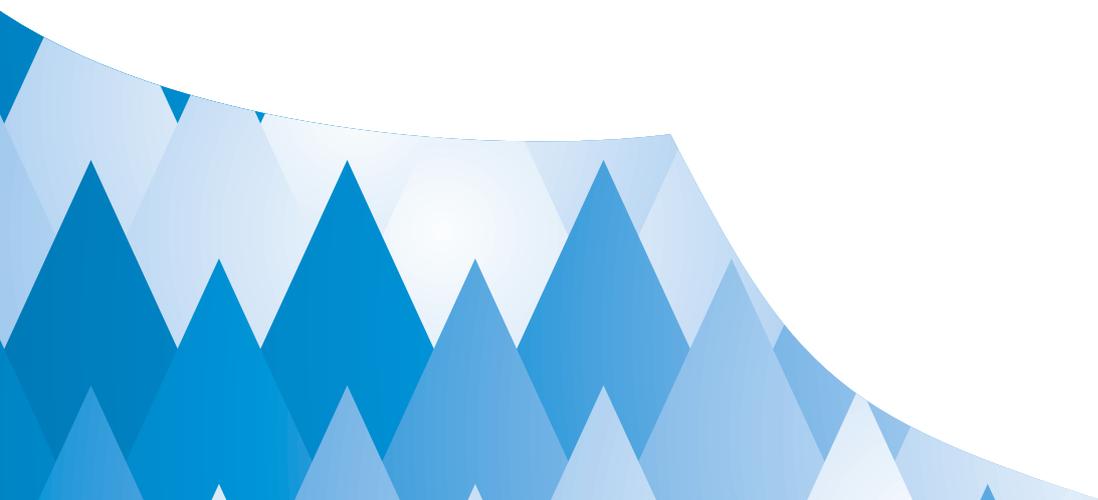
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## FOREWORD



The FIFA Women's World Cup™ in Canada was a landmark event for women's football and for FIFA. With huge crowds, all-time TV viewing records and the introduction of world-class artificial turf, the seventh edition of the tournament saw 24 teams line up for the first time in the competition's history and the USA become the first nation to lift the trophy three times.

The success of the tournament in Canada confirmed that women's football has established itself as a powerhouse in the sporting landscape, with standards reaching a new high.

Besides technical, tactical and mental training, the physical aspect of the game has also grown in recent years. Today's game is so fast that the physical demands on a player are tremendous. No matter what level it is played at, football requires thorough, supervised physical preparation. Developing the women's game, however, also remains paramount to FIFA's core mission.

FIFA is very pleased to share with you the results of the second edition of this specific study, analysing the physical performance of teams, as well as practical recommendations for physical training and sample training sessions.

A handwritten signature in black ink, consisting of stylized letters that appear to be 'FSA', enclosed within a simple rectangular frame.

Fatma Samoura  
Secretary General

## INTRODUCTION

The World Cup is the pinnacle for anyone involved in football. The FIFA Women's World Cup Canada 2015™ was the seventh for women since the inaugural tournament in China PR in 1991. The 2015 tournament was contested by 24 teams, an increase of eight teams from the 2011 finals, and double the number that competed in the very first tournament in 1991. Seven teams (Brazil, Germany, Japan, Nigeria, Norway, Sweden, USA) have competed in all seven tournaments, whilst eight teams (Cameroon, Costa Rica, Côte d'Ivoire, Ecuador, Netherlands, Spain, Switzerland, Thailand) made their debut in 2015. A total of 146 goals were scored, the highest yet, at an average of 2.81 goals per game, which was higher than the rate in 2011, but a lower scoring rate compared to previous tournaments. Attendances at the games were consistent across the two most recent tournaments, with many sold-out games, which shows the continued support for and interest in women's football. Furthermore, FIFA and individual teams reported many media and digital records during this tournament, again reflecting the ever-increasing popularity of the women's game. Additionally, there are currently 30 million female players worldwide, and FIFA has made a commitment to increase that to 45 million by 2019, showing that women's football is continuing to grow and develop across the world.

The physical preparation of players is one facet of football performance, and along with the technical, tactical and psychological preparation of players, this can make a difference for success at the elite level. Competing in multiple games over a short period of time further increases the physical demands on players to maintain their level of performance and be successful. Physical planning and preparation can be key to ensuring that players are optimally prepared to deal with successive games with limited recovery time. The more information we have in relation to the physical match demands, especially during tournaments, the more specific we can be with the physical preparation of players to cope with such

loads, thereby optimising performance and reducing the risk of injury.

In 2011, the first-ever physical analysis of the FIFA Women's World Cup™ was conducted and this report aims to build on those findings. The report (FIFA, 2012) used speed thresholds and definitions which had not previously been used, hence making comparison to the available research difficult. The main findings from the 2011 analysis reported that outfield players covered an average total distance of 10.2km during games, with 2.3km of moderate running (12.1-18km/h), 395m of high-speed running (18.2-21km/h), 235m of optimum sprinting (21.1-25km/h) and 55m of maximum sprinting (25km/h). The analysis also showed that, on average, players from the top six ranked teams in the tournament covered 10.6km per game, compared to 9.9km per game for players from the bottom six ranked teams. Additionally, teams that progressed to the knockout stages covered, on average, 3.6% more total distance during the latter rounds compared to the group stage, with an average increase of 21.7% of sprinting activity. This suggests that the intensity of match-play and physical demands increased as the tournament progressed, which has implications for the training and preparation of players.

Despite the growing participation and involvement of girls and women in football, this increase in popularity has not yet been matched by an increase in the available scientific research. The majority of the literature and research on the physiological demands of football describe the work rate of elite male players (Castellano et al., 2014). Consequently, detailed information on the physical game demands, training and preparation of female players is lacking. Two recent reviews (Datson et al., 2014; Martinez-Lagunas et al., 2014) have given an overview of the research conducted in women's football to date. However, much of the research has focused on the physical characteristics of female players, encompassing demographic variables



(age, body height and weight), as well as the physical fitness profiles of players. Far less research has focused on the physical match demands for female football players. Furthermore, the research that has been conducted to date has used a variety of assessment methods, a limited number of players and/or games, and a range of speed thresholds and locomotor definitions, making comparisons and interpretation challenging. More recent research (Dwyer and Gabbett, 2012; Vescovi, 2012; Bradley and Vescovi, 2015) has attempted to define and standardise suitable speed thresholds for female football players through the analysis of sprint profiles collected with GPS (Global Positioning System) units. However, much of the data has been collected from college and lower-level football players, and the thresholds suggested are lower than those that many practitioners use with some of the world's top-ranked women's national football teams. This report will attempt to bridge some of those gaps in the literature at present, using a combination of speed thresholds suggested from the scientific literature, as well as thresholds currently being used by practitioners supporting some of the top-ranked women's national teams, enabling a comparison of methods. Ultimately, this report will give a comprehensive overview of the demands of elite female football match-play, using a unique cohort of players competing at the highest level, which can only serve to provide a platform to further develop the women's game.

In comparison to 2011, the 2015 tournament presented many additional

physical challenges to the competing teams, such as:

1. **Number of teams.** The increase to 24 teams in this tournament meant that the teams that progressed out of the group stage faced an extra round of competition. This resulted in the four teams reaching the semi-finals competing in seven rather than six games over a 29-day period, compared to six games over 21 days in the 2011 tournament.
2. **Surface.** Canada 2015 was the first-ever FIFA competition to only use football turf in accordance with the Laws of the Game and the competition regulations. All six venues had FIFA-recommended 2 star football turf – the highest standard of football turf in the world, which FIFA developed specifically for professional football. In 2011, all games were played on natural grass.
3. **Environmental conditions.** The average temperature (mean $\pm$ SD) for games was 22.1 $\pm$ 2.7°C (range: 16-27°C), the relative humidity was 50.3 $\pm$ 12.6% (30-79%), and the wind velocity was 12.8 $\pm$ 6.6km/h (1-25)km/h, so the conditions varied between games and locations. Additionally, nine games were played indoors at the Olympic Stadium in Montreal. In 2011, all games were played outdoors and the average temperature, relative humidity, and wind velocity were 21.8 $\pm$ 4.5°C (13-32°C), 54.5 $\pm$ 13.8% (34-97%), and 11.3 $\pm$ 4km/h (4.7-20.2) km/h, respectively.

4. **Jet lag and travel fatigue.** The six match venues in Canada were spread across five time zones, which meant that long distances were sometimes travelled between games. In total, 20 games were played in the Western venues (Vancouver (UTC -7h), Edmonton (UTC -6h)), seven games in mid-Canada (Winnipeg (UTC -5h)) and 25 games in the Eastern venues (Ottawa (UTC -4h), Montreal (UTC -4h) and Moncton (UTC -3h)). All games in the 2011 tournament were played in the same time zone. For the 2015 final alone, USA travelled from Montreal to Vancouver, a journey of more than 3,000 miles and a three-hour time-zone shift.

Whilst the current analysis of physical match performances does not aim to be scientific in nature, it will take into account the challenges outlined above in the interpretation and application of the data, and make reference to some of the scientific data now available on women's football. The analysis will be descriptive in nature but will aim to increase the understanding of the physical demands of elite football match-play, and with that information aim to continue developing our game across the world. Therefore, the key aims of this analysis are as follows:

1. Increase the knowledge base and information available on the physical demands of elite female football players, and the associated physical match demands during tournament match-play.

2. Provide a comprehensive analysis of the physical workloads completed by individual teams, with consideration of the effects of successive games, stage in the game, tournament phase, confederation membership and final tournament ranking.
3. Give an overview of the positional demands of elite female match-play, including an in-depth analysis of the outstanding players of the tournament, encompassing the FIFA All-Star team and FIFA Official Award winners.
4. Provide guidelines on the physical preparation and training of female players based on the findings of this report.
5. Provide recommendations for further research to continue to assist in the development of women's football worldwide, including an attempt to standardise the speed thresholds used in the analysis of elite female football players.

As FIFA continues to commit to the further development of the women's game, the more information we can gather about the physical demands during match-play and help with the physical preparation of players will enable the development of more effective training programmes. Improving the physical status of players worldwide can only serve to further increase the level and intensity of match-play in the women's game, and keep the best players on the pitch to improve the standard and entertainment as a spectator sport. In addition, this publication will give less developed countries in women's football and their leaders, such as coaches, technical directors, physical trainers and support staff, a good overview of where the top women's teams in the world stand in terms of their physical fitness and the demands of the game.

## METHODOLOGY

### Player characteristics

A total of 552 players from 24 different countries (23 players per nation) were officially registered to participate in the FIFA Women's World Cup Canada 2015™ from 6 June to 5 July. Their average age, body height and weight (mean±SD) at the start of the tournament were 25.6±4.2yrs (range: 15.8-40yrs), 167.3±6.6cm (140-187cm), and 60.6±6.5kg (42-82kg), respectively. However, only 438 of these players actually recorded official playing time in at least one match. Therefore, this number (n=438) represents the specific player sample size that was considered for the present analysis. The average age, body height and weight of this player sample size corresponded to 25.9±4yrs (16.6-40yrs), 167±6.7cm (140-187cm), and 60.3±6.3kg (45-82kg), respectively.

Important note: players' age, body height and weight information was submitted by each participating team to the FIFA general secretariat according to article 25 of the Regulations for the FIFA Women's World Cup Canada 2015™. Thus, these values were not measured directly for the purpose of this report.

### Data collection

#### Match and venue information

Data was recorded at all 52 matches of the FIFA Women's World Cup Canada 2015™ as part of this analysis. Nevertheless, due to technical difficulties with the data recording of three matches (match #1 Canada v. China PR, match #13 Canada v. New Zealand, and match #31 Nigeria v. USA), only 49 of them were actually included in the data analysis. These matches were played in six different cities across Canada (from West to East): Vancouver, Edmonton, Winnipeg, Ottawa, Montreal and Moncton covering five different time zones. **Table 1** outlines the host cities and venues used during the tournament. The average environmental conditions for the 52 matches were 22.1±2.7°C (16-27°C), humidity 50.3±12.6% (30-79%), and wind speed 12.8±6.6km/h (1-25km/h).

Host city	Venue	Pitch size	Capacity	Time zone	No. of matches
Vancouver	BC Place Stadium	105 x 68m	54,267	Pacific Daylight Time (UTC -7h)	9
Edmonton	Commonwealth Stadium	105 x 68m	56,335	Mountain Daylight Time (UTC -6h)	11
Winnipeg	Winnipeg Stadium	105 x 68m	33,318	Central Daylight Time (UTC -5h)	7
Ottawa	Lansdowne Stadium	105 x 68m	24,341	Eastern Daylight Time (UTC -4h)	9
Montreal	Olympic Stadium	105 x 68m	51,335	Eastern Daylight Time (UTC -4h)	9
Moncton	Moncton Stadium	105 x 68m	19,772	Atlantic Daylight Time (UTC -3h)	7

Table 1: Host cities and venues of the FIFA Women's World Cup Canada 2015™

### Measurement system and procedures

All of the games were filmed using a mobile video-based tracking system that uses three high-definition cameras with a sampling frequency of 20Hz (Prozone® System, Prozone Sports Ltd., Leeds, United Kingdom). This system allows simultaneous capturing of the movement patterns of all 22 players participating in a football match. Scientific research supports the accuracy and consistency of this system for this purpose (Di Salvo et al., 2006). Before each match, the mobile video-based tracking

system was installed by a trained operator in the stadium near the halfway line on the main camera platform situated at a minimum height of 10m above pitch level (Figure 1). After system calibration, the match data collection took place followed by post-match data analysis in the Prozone Production Centre, which includes a strict quality control process before the complete match data set is available for further analysis with customisable speed thresholds. Figure 2 illustrates this process.



Figure 1: Prozone® mobile tracking system installed at BC Place Stadium before a match

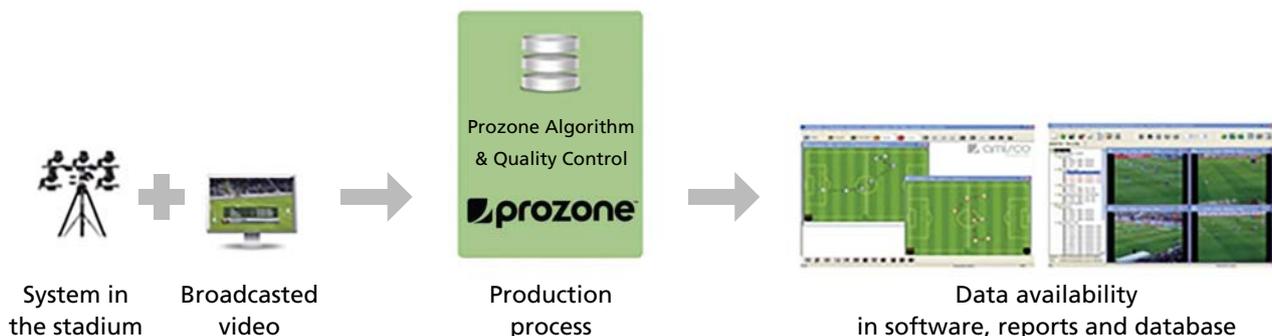


Figure 2: Prozone® match data production process

## Measured parameters and speed thresholds

Physical performance parameters are not the only determinant of success in football and these parameters are highly influenced by technical and tactical aspects as well as other psychological and miscellaneous factors (Castellano et al., 2014). Therefore, physical, technical-tactical performance parameters, among other variables, were evaluated as part of this report in a holistic attempt to better understand their effect on each other and overall football success. **Table 2** shows the parameters that were measured and analysed as part of this report.

The specific speed thresholds (ST) selected for use in this report are summarised in

**Table 3.** These speed thresholds were developed after a meticulous review of current scientific research relevant to the physical match performance analysis of female football players (Datson et al., 2014; Martinez-Lagunas et al., 2014) and thresholds currently being used by practitioners supporting some of the world's top-ranked women's national teams.

Further arguments that strengthen the selection of these speed thresholds include:

- 1) There is scientific support for using 16km/h and 20km/h as the generic thresholds to define the high-speed running and sprinting thresholds for the analysis of physical performance during women's football matches (Bradley and Vescovi, 2015). Additionally, the use

Match duration	Physical performance	Technical-tactical performance
Match duration	Total distance (TD)	% team ball possession
Effective playing time	Distance covered with and without the ball	Total team passes
	Distance covered in defensive, middle and attacking third of the pitch	% team passing success
	Distance covered, number of runs, average distance of runs, and recovery time between runs at the various speed thresholds	Team shots on goal
	Average speed	Team corner kicks
	Maximum speed	Team goals scored per match
		Team goals conceded per match
		Team final tournament ranking

Table 2: Parameters measured and evaluated for this report

Speed threshold #	Speed range (km/h)	Movement category
ST1	0-6	Walking
ST2	6-12	Low-speed running
ST3	12-16	Moderate-speed running
ST4	16-18	High-speed running zone 1
ST5	18-20	High-speed running zone 2
ST6	20-23	Sprinting zone 1
ST7	>23	Sprinting zone 2

Table 3: Speed thresholds selected for this analysis (ST = speed threshold)

of 2-3km/h increments in the high-speed and sprinting thresholds allows a more precise identification of physical performance differences at these speeds between the participating nations of various levels (e.g. highly developed v. developing countries). This threshold selection also prevents "overestimation" for the highly developed countries and "underestimation" for the less developed countries of high-speed running and sprinting distances by including two different zones in these movement categories that will match their actual physical capabilities more accurately.

- 2) The lower threshold range (zone 1) of the high-speed running and sprinting movement categories will not only reflect more accurately the physical capabilities of the less developed countries but also those of the goalkeepers and the younger players (U-20 and U-17 levels) who also participated in the tournament. Goalkeepers have lower physical demands than outfield players during match-play. Similarly, younger players (U-20 and U-17 levels) commonly have lower physical capabilities than older players (>U-20 level). Thus, setting the speed thresholds too high for them may also lead to underestimation of the amount of high-speed running and sprinting that they actually perform during a game. Lastly, the higher threshold range (zone 2) of the high-speed running and sprinting movement categories will more accurately meet the needs of the most developed countries

and the more experienced/talented outfield players who participated in the tournament.

- 3) Currently, a variety of speed thresholds are being used by scientists and practitioners around the world for the quantification of physical match performance of female footballers, making the comparison of results very challenging due to the lack of a global consensus on standardised speed thresholds for this purpose. Therefore, we hope that this report can also serve as a starting point to standardise these speed thresholds so that most countries can use the same ones in order to compare data more accurately and use them to design more specific physical training programmes for each playing position. This will aid with the further development of the women's game worldwide.

#### Combined speed thresholds

For some variables, results were also reported in combined speed thresholds such as <12km/h (low-intensity movement categories: ST1+ST2), <16km/h (low- to medium-intensity movement categories: ST1+ST2+ST3), >16km/h (high-intensity and sprinting movement categories zone 1: ST4+ST5+ST6+ST7), >18km/h (high-intensity and sprinting movement categories zone 2: ST5+ST6+ST7), and >20km/h (sprinting movement categories: ST6+ST7).

Throughout the text, reference to the different speed thresholds is mainly made using their quantitative speed ranges in km/h rather than their corresponding descriptive movement category.



## Data analysis

The analysis of the match data included the following main categories:

- Level of analysis (match, team, and individual level)
- Match time period (full match, first and second half, 15-minute intervals, extra time)
- Tournament phase (group and knockout stages, final)
- Confederation membership (CONCACAF (4 teams: Canada (CAN), Costa Rica (CRC), Mexico (MEX), United States of America (USA)), UEFA (8 teams: England (ENG), France (FRA), Germany (GER), Netherlands (NED), Norway (NOR), Spain (ESP), Sweden (SWE), Switzerland (SUI)), CONMEBOL (3 teams: Brazil (BRA), Colombia (COL), Ecuador (ECU)), CAF (3 teams: Cameroon (CMR), Côte d'Ivoire (CIV), Nigeria (NGA)), AFC (5 teams: Australia (AUS), China PR (CHN), Japan (JPN), Korea Republic (KOR), Thailand (THA)), OFC (1 team: New Zealand (NZL))
- Final tournament ranking
- Playing position (goalkeepers and outfield players including central defenders, full-backs, central midfielders, wide midfielders/wingers, and forwards)
- Outstanding players (FIFA All-Star team and FIFA Official Award winners)
- FIFA Women's World Cup Canada 2015™ vs. Germany 2011™ main results comparison

Important note: the match data from the FIFA Women's World Cup Germany 2011™ had to be re-analysed using the new speed thresholds and data analysis procedures used in the current report in order to compare results more accurately with the 2015 tournament. Data was missing from one of the 2011 matches (match #18 Canada v. Nigeria), which could not be recovered. Thus, the data of only 31 matches instead of 32 matches was re-analysed for this tournament. Differences in methodological and data analysis procedures between the current report (2015 tournament) and the

previously published report of the 2011 tournament (FIFA 2012) may account for the discrepancy in final results.

For most parameters, average values were reported unless otherwise indicated (e.g. some standard deviations (SD) and ranges were also stated). For selected parameters, statistical tests such as t-tests, ANOVA tests, and product-moment correlations were computed. Statistical significance was set at  $p < 0.05$ . Physical performance values registered by each team were calculated from all the outfield players who took part in each match including substitutes, but without taking into account the goalkeeper data (sum of all individual outfield player values divided by 10). The goalkeeper-specific results were calculated separately. All of the analyses were conducted over the duration of a normal match or regular time (e.g. 90-94min including any additional time but no extra time), except for the analysis of the 2011 final where some extra-time results were included. For the positional analyses of physical performance variables, only the data sets of the players who completed the entire match were evaluated. The playing position recorded for each player corresponded to the main positional role that each of them had during each match.

## RESULTS AND ANALYSES

### Team analysis

#### 1. Match duration

The average duration of all matches during the FIFA Women's World Cup Canada 2015™ was 95:02 (range: 91-100 mins) including additional time, but without taking extra time into account, whereas the effective playing time on average was 53:21. For the FIFA Women's World Cup Germany 2011™, the average duration of matches was 95:07, whereas the effective playing time was 56:21, three minutes more than in the 2015 tournament, which compared to 53:40 during the FIFA Women's World Cup China 2007™. During the 2011 tournament, the effective playing time increased from 56:56 during the group stage to more than 60:00 during the knockout rounds. During the 2015 tournament, however, the effective playing time decreased slightly from 53:28 during the group stage to 53:07 during the knockout rounds. The average duration of the first half of matches was 46:18, with the ball in play for 26:56, whilst for the second half, the duration was over two minutes longer on average, with an average second-half duration of 48:45, however the effective playing time for the second half was slightly less at 26:23.

#### Summary

- The match duration was very similar during the FIFA Women's World Cup Canada 2015™ (95:02) and the FIFA Women's World Cup Germany 2011™ (95:07).
- The effective playing time was lower in the 2015 tournament compared to 2011, with 53:21 and 56:21 respectively.
- Some of the factors which could make a difference in effective playing time between and within tournaments include the playing surface, the timing and logistics of the return of the ball when knocked out of play, as well as technical factors, most notably the playing strategies of individual teams.

#### 2. Analysis of total distances covered during matches

An analysis of the distances covered by all of the teams shows an average total distance ("TD") of 10,860m per outfield player per match during the FIFA Women's World Cup Canada 2015™ (Figure 3b) and 10,965m during the FIFA Women's World Cup Germany 2011™ (Figure 3a). The average TD for the 2011 tournament was actually higher than stated in the 2011 report (10,200m), since the current report

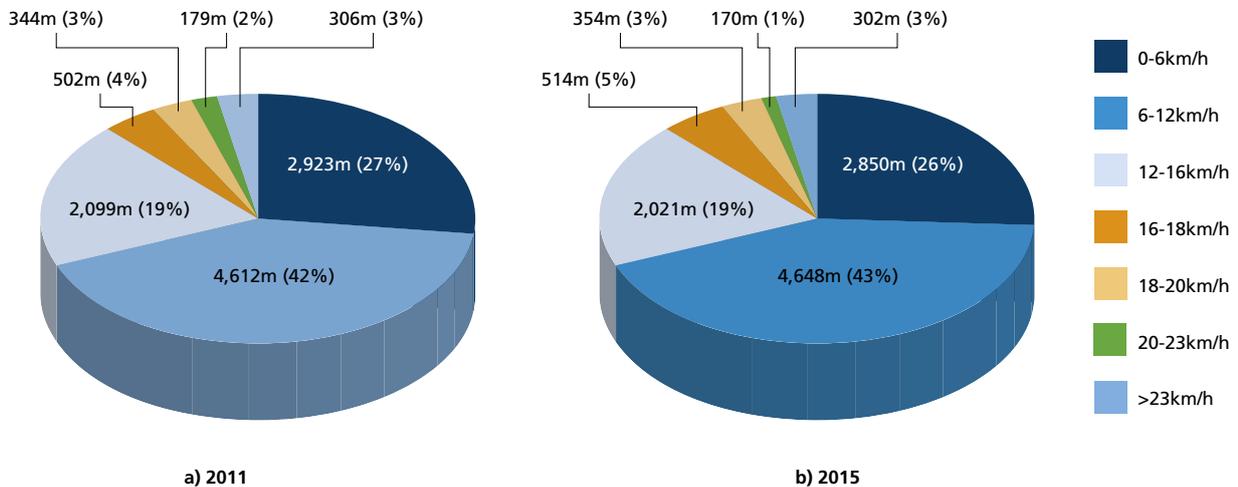


Figure 3: Analysis of the average distances covered per outfield player per match for the FIFA Women's World Cup Canada 2015™ and the FIFA Women's World Cup Germany 2011™

re-analysed the 2011 data and included stoppage time at the end of each half of matches. The TDs of both tournaments were very similar, as was the breakdown of distance covered in the various speed thresholds, with players completing on average 1% more running at 20-23km/h during the 2011 tournament.

The relationship between the final ranking of the teams at the 2011 and 2015 tournaments and the distances in the various speed thresholds (**Table 4**) shows that the correlations tended to be stronger during the 2015 tournament. This could be due to the increase in the number of competing teams and a greater range in the level and physical attributes of the teams. The strongest correlations were in the 2015 tournament for the ranking position and distance covered at 0-6km/h ( $r=0.41$ ), suggesting lower-ranked teams covered more distance in the lowest speed threshold, and the ranking position and distance covered at 12-16km/h ( $r=-0.42$ ), which implies that higher-ranked teams covered more distance in this threshold

due to the inverse relationship. There were also moderate inverse relationships between ranking and TD ( $r=-0.34$ ), and distance covered at 18-20km/h ( $r=-0.34$ ) and distance >23km/h ( $r=-0.37$ ). Again, these relationships suggest that higher-ranked teams tended to cover greater distances in the highest speed thresholds during the 2015 tournament. During the 2011 tournament, there were small correlations for the final ranking and TD ( $r=-0.20$ ), as well as distance covered at 20-23km/h ( $r=-0.18$ ), 12-16km/h ( $r=-0.17$ ) and 6-12km/h ( $r=-0.23$ ).

**Table 5** shows a summary of the average distances, and percentage breakdown, for the group and knockout stages for the FIFA Women's World Cup Canada 2015™ and the FIFA Women's World Cup Germany 2011™. As can be seen, the average TD covered throughout a match does not differ that much either across the two tournaments, or between the group stage and knockout rounds within each tournament. These values are slightly higher than some of the previous

Tournament	0-6km/h	6-12km/h	12-16km/h	16-18km/h	18-20km/h	20-23km/h	>23km/h	TD
2011	0.01	-0.23	-0.17	0.04	0.04	-0.18	-0.07	-0.20
2015	0.41	-0.29	-0.42	-0.28	-0.34	-0.25	-0.37	-0.34

**Table 4: Correlation (r) between the average distances covered in each speed threshold ("ST") and final ranking during the FIFA Women's World Cup Canada 2015™ and the FIFA Women's World Cup Germany 2011™**

	Total distance (m)	0-6km/h		6-12km/h		12-16km/h		16-18km/h		18-20km/h		20-23km/h		>23km/h	
		m	%	m	%	m	%	m	%	m	%	m	%	m	%
2011 group stage (n=46)	10,830	2,909	26.9	4,563	42.1	2,031	18.8	502	4.6	346	3.2	174	1.6	305	2.8
2011 knockout (n=16)	11,099	2,937	26.5	4,660	42.0	2,167	19.5	502	4.5	342	3.0	184	1.7	307	2.8
2015 group stage (n=68)	10,816	2,885	26.7	4,618	42.7	1,992	18.4	510	4.7	350	3.2	164	1.5	297	2.7
2015 knockout (n=30)	10,904	2,815	25.8	4,678	42.9	2,050	18.8	519	4.8	359	3.3	176	1.6	307	2.8

**Table 5: Analysis of the average distances covered in a match by the teams during the group and knockout stages at the FIFA Women's World Cup Canada 2015™ and the FIFA Women's World Cup Germany 2011™**

total distances reported in literature for female football players, namely 9,900m (Andersson et al., 2010), 9,970m (Gabbett and Mulvey, 2008) 10,300m (Krustrup et al., 2005), which might be expected as the FIFA Women's World Cup™ is the highest level of competition for women's football. The distances (m and % of TD) in 0-6km/h and 6-12km/h were very similar across both the group stage and the knockout rounds, and for both tournaments. For both 2011 and 2015, there was a trivial increase (136m, 0.7%; 58m, 0.4%, for 2011 and 2015 respectively) for the distance covered in 12-16km/h. For the 2015 tournament especially, there was a small increase in distance covered in 18-20km/h, 20-23km/h and >23km/h from the group stage to the knockout rounds, which amounted to 31m in total per player. Making direct comparisons of the more intense speed thresholds with previous literature is difficult, and should be done with caution, since the methods of analysis and thresholds used in the literature, especially for studies focusing on women's football, have not been consistent.

In this section, the physical analysis for each team refers to the amount of distance, as stated, per outfield player per match, and is calculated by dividing the complete distances completed by each team by 10, as outlined in the methods section. The results relate to the matches during the FIFA Women's World Cup Canada 2015™ only, unless stated otherwise.

**Figure 4** shows the average total distances, per team, covered in 0-16km/h and >16km/h, plotted against the average team ball possession and shots on goal for each team for all of their matches throughout the tournament. The graph is ranked by the amount of distance spent >16km/h, with the lowest values from left to right. It should be noted that data is missing for the CAN v. CHN, CAN v. NZL and USA v. NGA group matches, hence the results for NZL are based on the average for two matches only, CAN from three matches, CHN from four matches and USA from six matches. Overall, NZL (17%) covered the

greatest amount of distance in the highest speed thresholds (>16km/h), followed by GER (15%) and USA (15%). The other two semi-finalists (ENG, JPN) both completed 14% of running >16km/h. Five of the eight teams who were knocked out in the group stage were in the bottom six for the least amount of distance covered >16km/h, with CIV, ECU, ESP and COL (11%) completing the least amount of distance in those thresholds. In the current analysis, the correlations between the distance covered at 0-16km/h and team ball possession ( $r=0.05$ ), 0-16km/h and shots on goal ( $r=0.06$ ), >16km/h and team ball possession ( $r=0.07$ ) were all trivial, whilst there was a small correlation between distance covered >16km/h and team shots on goal ( $r=0.21$ ).

Therefore, for the current analysis, it appears that team ball possession was not related to the intensity of the running that teams completed, however teams who covered more distance >16km/h had a slightly higher number of shots on goal. FRA (60%) had by far the highest average for team ball possession across their five matches, whilst they were ranked 13<sup>th</sup> for the amount of distance covered >16km/h, whereas ECU and THA (39%) had the lowest average team ball possession and both of those teams were in the bottom five for the amount of distance covered >16km/h. Rampinini et al. (2007) reported that high-speed activity accounts for approximately 8% of the total distance covered during match-play (12% for the current results >16km/h) in men's football. Research in women's football has found that high-speed running activities account for 12.5% for domestic Scandinavian league players (Mohr et al., 2008) to as much as 24.7% for Australian international players (Gabbett and Mulvey, 2008).

Caution should be taken when comparing figures in the research since a range of methods (video tape, GPS, hand notation, computerised systems) have been used, and a wide range of speed thresholds have been applied to the data. Furthermore, Gregson et al (2010) found that high-speed activity completed by players during match-

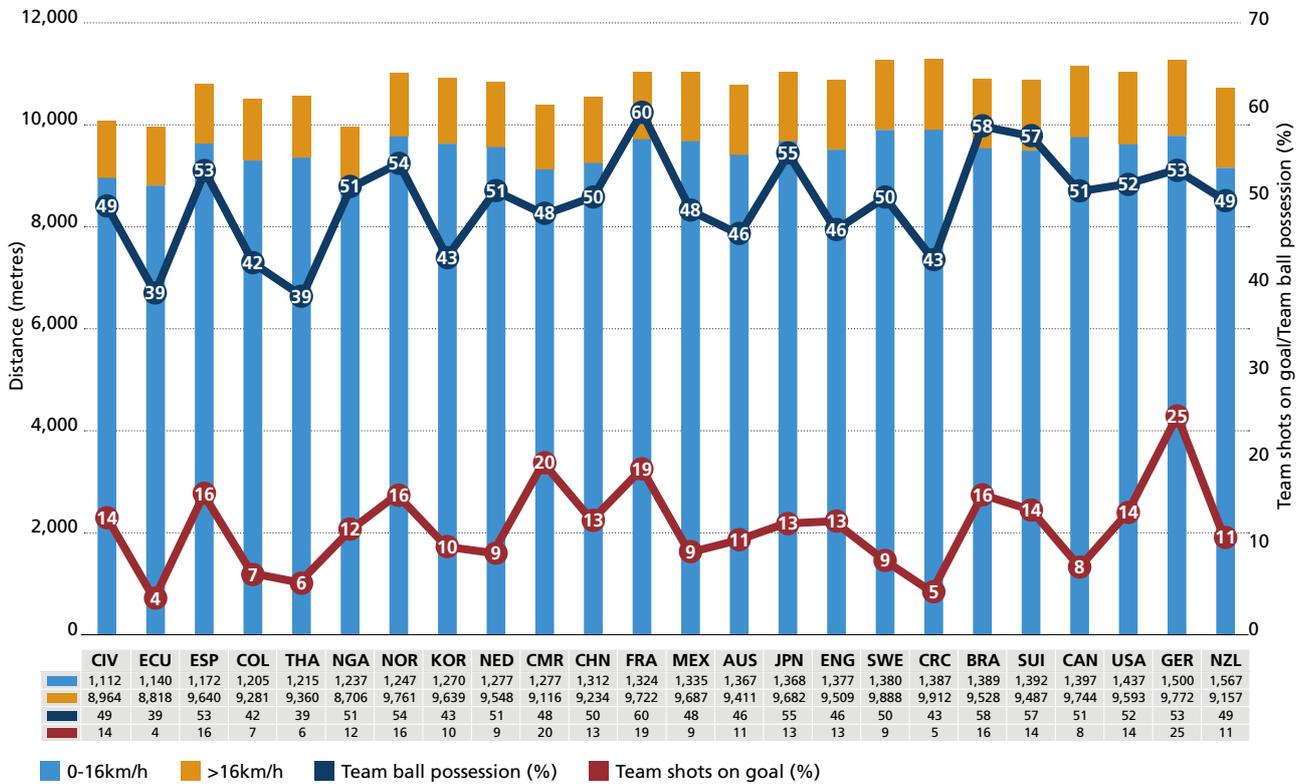


Figure 4: Analysis of the total distance covered (0-16km/h and >16km/h), shots on goal and team ball possession

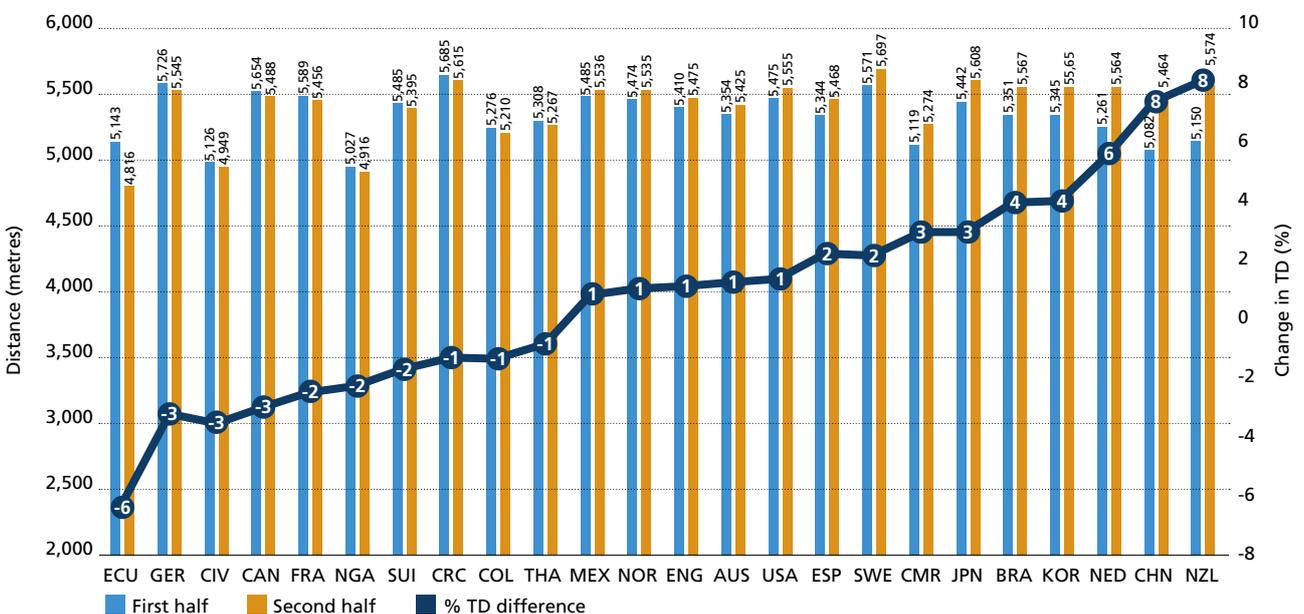


Figure 5: Analysis of the total distances covered during the first and second half of matches

play is highly variable between matches, and is affected by factors such as playing position and having possession of the ball, which are in turn affected by the changes in the tactical and technical requirements of the match. This observation could be more pronounced during tournament play when the match outcome becomes more crucial as the tournament progresses, causing teams to change formation and personnel depending on the result needed in each match.

**Figure 5** shows a comparison of the average TD covered by all teams in the first and second half of the match (both periods include any additional time played due to stoppages in play). Other than the differences for THA and MEX, all other differences suggest a moderate change in distance covered from the first to the second half. Ten of the teams covered less overall distance in the second half of the match. ECU (382m; 6% decrease) had the biggest drop in distance covered from the first to the second half, followed by GER, CIV and CAN (3%), although GER (5,726m) did cover the highest TD in the first half. NZL (425m; 8%), CHN (382m; 8%) and NED (302m; 6%) had the highest increase in TD from the first half to the second half. As highlighted previously, during the second half of matches, the ball was in play for approximately 33 seconds less compared to the first half, which means that players effectively have less time to do their running.

By taking into account the duration of each half of the match, the average meterage for each player per team can be calculated by dividing the distance covered by the exact duration of the first and second half (**Figure 6**). As can be seen, some teams had a substantial decrease in work rate from the first half to the second half, notably ECU dropping from 111m/min to 99m/min in the second half (11% decrease). CIV, GER, CAN (8%) also had large decreases in work rate from the first to the second half. Many teams had a similar work rate, and a trivial difference from the first to the second half. NZL (3%) and CHN (2%)

showed the largest increases from the first to the second half. Many factors can determine this, including the nature of the match, the need to defend/score a goal, a team's formation and that of the opposing team, fatigue, individual player fitness levels, substitution patterns and impact, as well as technical factors, amongst others.

#### Summary

- There was a small difference between the 2011 and 2015 tournaments for the TD or distance in the various speed thresholds.
- For the 2015 tournament, there was a small increase in distance covered >18km/h from the group stage to the knockout rounds.
- Correlations showed that higher-ranked teams tended to cover greater distances in the higher-speed thresholds during the 2015 tournament, however those relationships were less obvious during the 2011 tournament.
- NZL (17%), GER (15%) and USA (15%) covered the most distance >16km/h, and CIV, ECU, ESP and COL (11%) the least.
- There was no correlation between the distance covered at <16km/h and team ball possession or team shots on goal. There was a small correlation between distance covered >16km/h and shots on goal, suggesting that teams who covered more distance >16km/h tended to have more shots on goal.
- The majority of teams had a trivial difference in TD covered from the first to the second half. However, NZL and CHN (8%) had the biggest increase and ECU (6%) the biggest decrease.
- By expressing the TD per minute, the work rate (meterage) of players can be determined. From this, ECU had the largest decrease in work rate, dropping from 111m/min to 99m/min from the first to the second half (11% decrease). CIV, GER, CAN (8%) also had large decreases in work rate from the first to the second half. NZL (3%) and CHN (2%) showed the largest increases from the first to the second half.
- Some of the factors which could contribute to these observations include

the playing surface, the nature of the match, the ranking/level of opposition, the need to defend/score a goal, a team's formation and that of the opposing team, fatigue, individual player fitness levels, substitution patterns and impact, as well as technical factors, amongst others.

- Caution should be expressed when making direct comparisons of the more intense speed thresholds with previous literature, since the methods of analysis and thresholds used in the literature, especially for studies focusing on women's football, have not been consistent.

### 3. Analysis of high-speed runs (16-20km/h) and sprint (>20km/h) activity

Figure 7 displays the average first- and second-half distances spent in the higher-speed thresholds, >16km/h only, which is deemed to be the speeds when players are more involved in the match and can have more impact on the match outcome.

As highlighted previously, this is variable between matches, largely due to individual physical factors, as well as the tactical and technical requirements of the match (Gregson et al., 2010). Investigating this

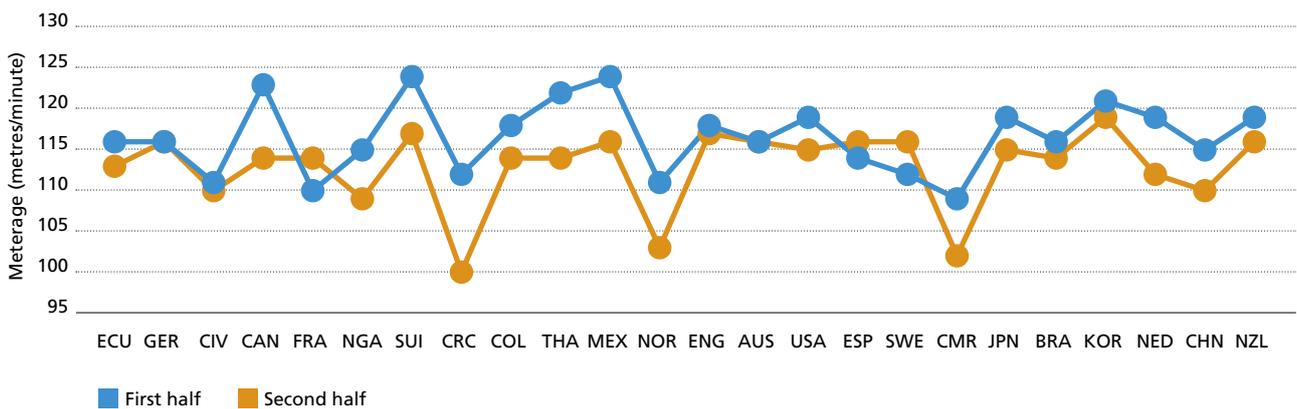


Figure 6: Analysis of the average meterage for TD during the first and second half of matches

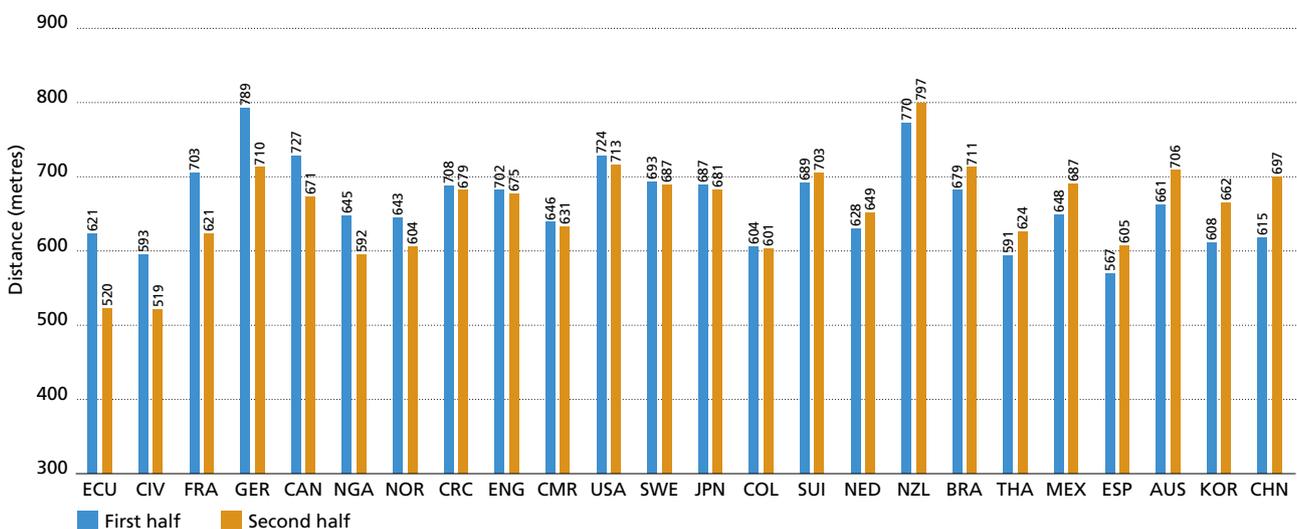


Figure 7: Analysis of the distances covered >16km/h during the first and second half of matches

data in more depth, **Figure 8** shows the percentage change for all teams from the first to the second half, with the differences for USA, SWE, JPN and COL being trivial. CHN (13%) and KOR (9%) showed the largest increase in distance >16km/h from the first to the second half. Conversely, ECU (-16%), CIV (-12%), FRA (-10%), and GER (-10%) had the largest decrease in distances covered at the higher speed thresholds from the first to the second half. Taking into account the duration of each half of the match, **Figure 9** shows the change in meterage for distance >16km/h from the first to the second half for teams. Whilst NED, NZL, BRA and THA had an increase in the actual distance >16km/h in the second half, their meterage was the same as the second half of matches was longer (48:45 compared to 46:18 for the first half). Whilst GER (17m/min) had the highest meterage in the first half, they dropped to 15m/min

during the second half of matches. Again, this could be due to a number of different factors including the fitness and fatigued state of players, environmental conditions, the ranking/level of opponent, and the state of the match as well as any change of personnel and/or formation during the second half of a match.

**Figure 10** shows the distances covered >16km/h (including the breakdown for the four higher-speed thresholds), plotted against the average number of team passes per match. There was a small correlation between the average number of teams passes and distance covered at 16-18km/h ( $r=0.23$ ), 18-20km/h ( $r=0.22$ ) and 20-23km/h ( $r=0.06$ ), and a moderate correlation with distances >23km/h ( $r=0.31$ ). When a team is in possession of the ball, players not on the ball tend to be making intense movements to make space, lose their marker and be able to receive the ball, which would involve higher-intensity running, which could in part explain this stronger correlation of number of team passes to speeds higher than 23km/h.



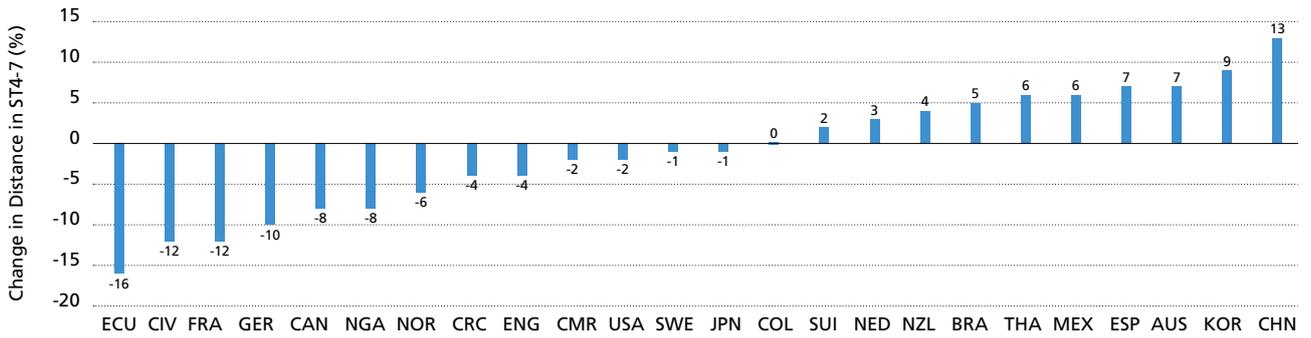


Figure 8: Analysis of change in distance covered >16km/h between the first and second half of matches

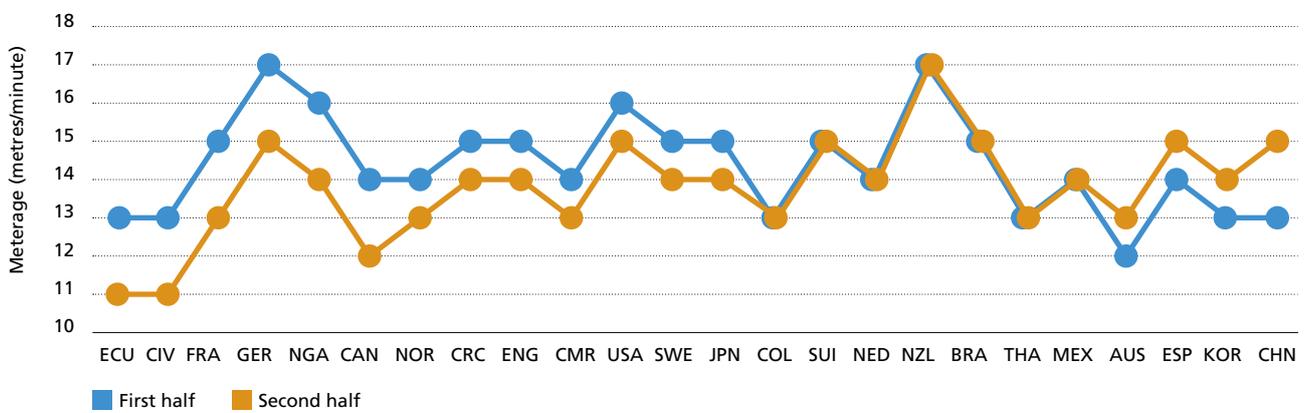


Figure 9: Analysis of the average meterage >16km/h during the first and second half of matches

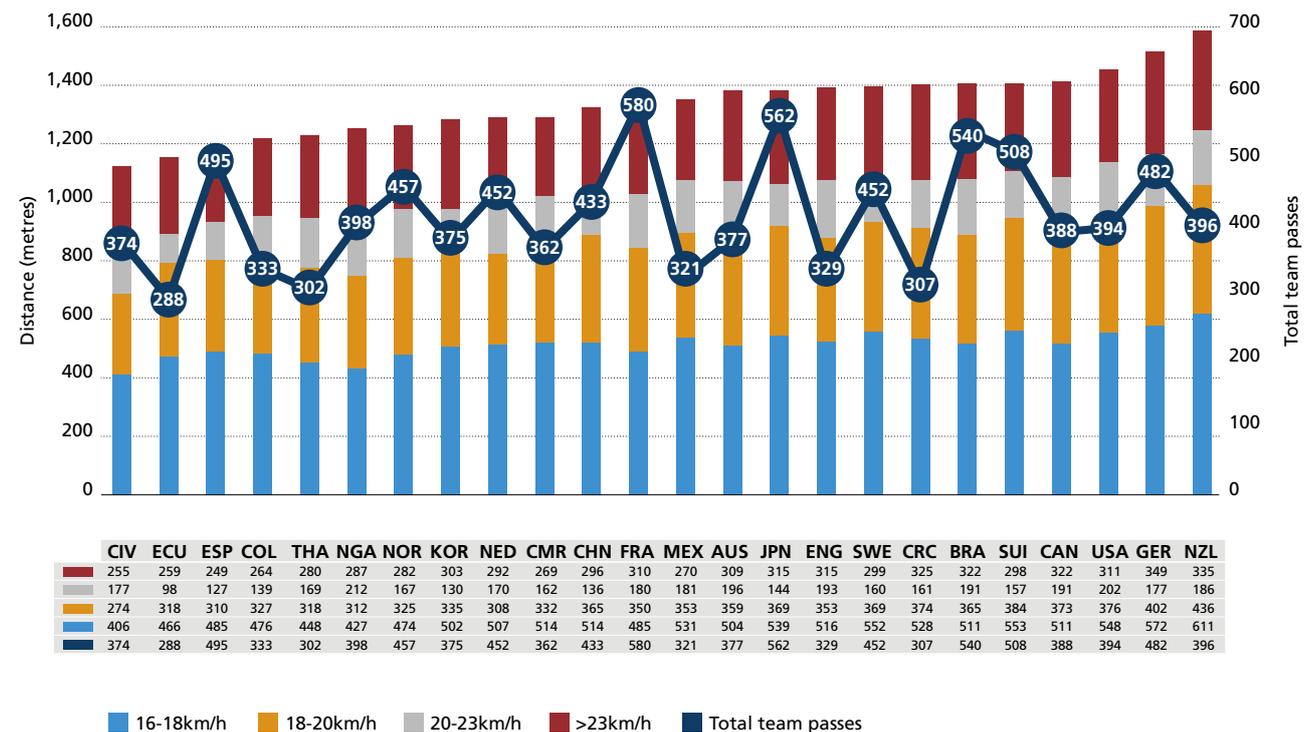


Figure 10: Analysis of distance covered >16km/h correlated to the average number of team passes per match

During the FIFA Women's World Cup 2015™, on average players covered a total of 1,320m per match at speeds >16km/h, compared to 1,266m during the FIFA Women's World Cup 2011™. **Figure 11** shows a comparison of the average distance covered during each 15-minute period of matches, with the final period of each half of the match including additional stoppage time. In both tournaments, the amount of distance covered >16km/h decreased from the first 15-minute period, during 15-30min, by 25% and 14% for 2011 and 2015 respectively. Again, in both tournaments the amount of distance covered during 15-30min and 30-45min+ was similar and less than the amount covered during the first 15-minute period of matches. This suggests that players could be optimally prepared to start matches, but then become fatigued during the latter stages of the first half of the match due to accumulated fatigue, as well as a combination of a lack of fitness and/or inadequate nutrition/hydration. This could also be due to tactical reasons and not wanting to concede a goal during the final period before half-time. Between 45-60min, the distance covered was lower than the first 15-minute period of the match, 20% and 12% less for 2011 and 2015 respectively. This seems to suggest that players are not physically prepared for

the start of the second half and/or they still have some residual fatigue from the first half and may not have refuelled optimally. This is consistent with a growing body of evidence which has demonstrated reduced high-speed activities immediately after the half-time interval, when compared to the opening 15-minute period of the first half (Bradley et al., 2009, Mohr et al., 2003). Lovell et al. (2007) found that active re-warm-up strategies prior to the second period of matches helped to maintain football-specific endurance performance in a controlled study, and coaches/trainers should evaluate what their players do during the half-time period, and more specifically prior to the start of the second half of matches. During the second half, in 2011 the amount of high-speed running completed in the final 75-90min+ period of the match increased, but was still 8% less than during the opening 15-minute period of the match. In 2015, however, players completed 3% more distance >16km/h during the final period of the match compared to the first 15-minute period of the match. This could be linked to the state of the match, and the result needed by individual teams, as well as a potential change in formation to achieve the result. This also shows that in 2015, players were able to increase the amount of running they completed during the latter stages

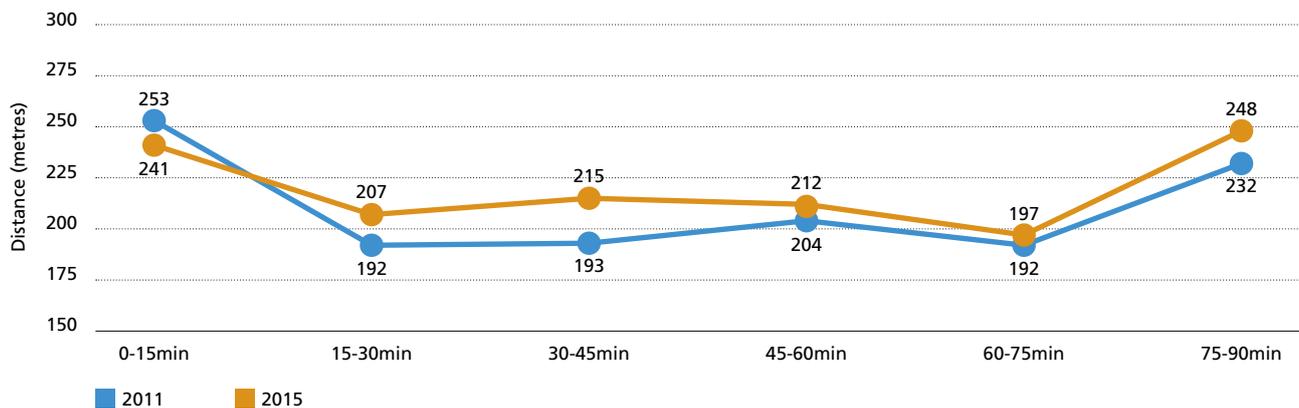


Figure 11: Comparison of distance covered every 15-minute period of the match >16km/h for the 2011 and 2015 tournaments

of matches, suggesting they were better physically prepared, and potentially at higher fitness levels, than in 2011.

### 3.1 Analysis of high-speed runs (16-20km/h)

From **Figure 12a**, it can be seen that on average the distance players covered at 16-18km/h generally only decreased from the first to the second 15-minute period, by 11% and 14% during the 2011 and 2015 tournaments respectively. For the 2015 tournament, the amount then increased slightly in the final period before half time, whilst in 2011 it continued to drop. In the 15-minute period following half-time for both tournaments, players covered 12% and 13%, for 2015 and 2011 respectively, less than during the distance completed in the first 15-minute period of the match. This could again be due to the fatigue of players, and/or a lack of preparation and warm-up ahead of the second half of the match. For both the 2011 and 2015 tournaments, players increased their

running at 16-18km/h in the final period of the match. This could be due to teams needing to score goals to ensure a result. The average distances covered at 18-20km/h (**Figure 12b**) followed a similar pattern to distances at 16-18km/h, with a decrease from the first 15-minute period of 18% and 14%, for 2011 and 2015 respectively, during the 15-30min period. During both tournaments, there was then an increase up to half-time. As for distances at 16-18km/h, during the 15-minute period after half-time, 12% and 10% for 2011 and 2015 respectively, less running was completed at 18-20km/h compared to the first 15-minute period of the match. Distances covered at 18-20km/h again decreased in the next 15-minute period of the match before increasing in the final period, 75-90min+, of the match.

**Figure 13** shows the distance covered at 16-18km/h plotted against team ball possession (%) and team passing

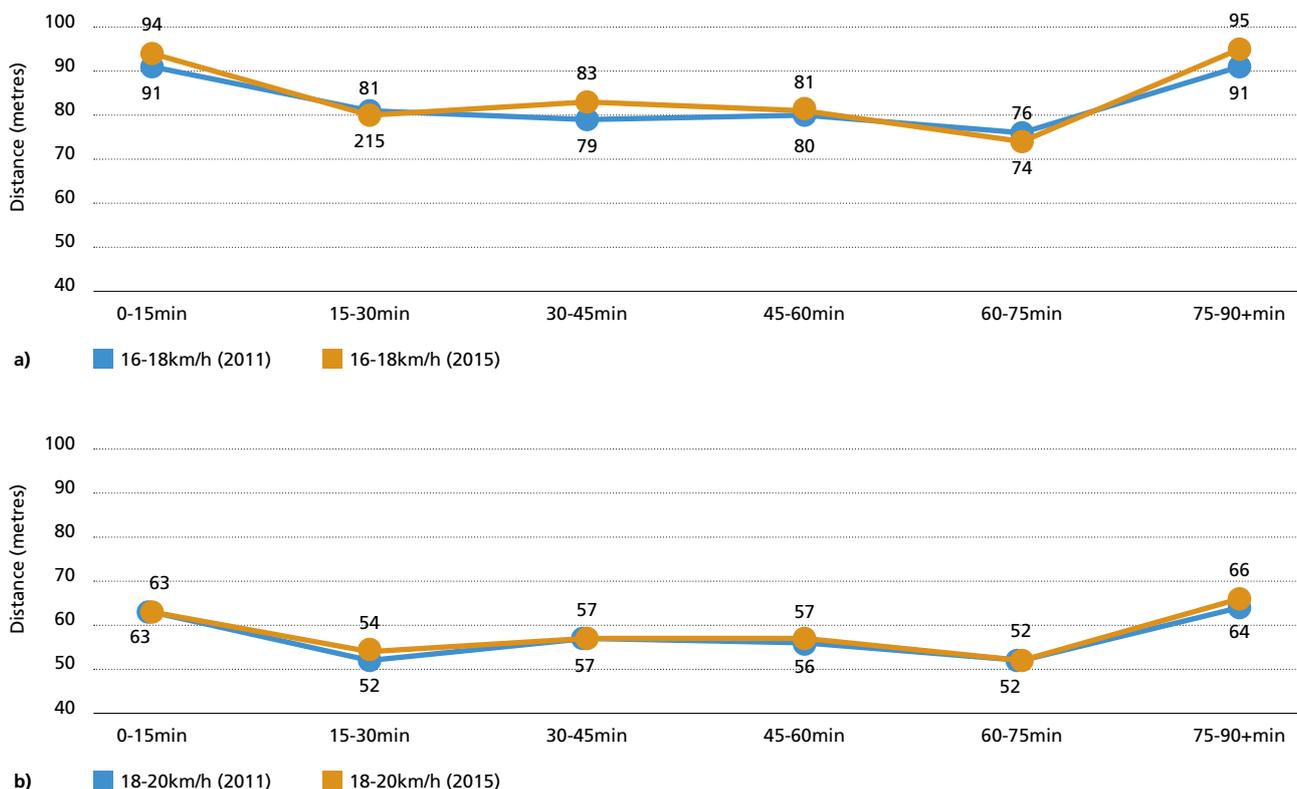


Figure 12: Comparison of distance covered in every 15-minute period of the match for the 2011 and 2015 tournaments

success (%), with the Figure ranked by distance covered at 16-18km/h the lowest from left to right. JPN, BRA and FRA were the three standout teams who completed less running at 16-18km/h, yet had a high passing success rate, and high team ball possession. There was a small correlation ( $r=0.26$ ) between distance covered at 16-18km/h and team ball possession ( $r=0.26$ ), whilst a more moderate correlation between distance covered in this zone and team passing success rate (0.40).

**Figure 14** shows the correlation between distance covered at 16-18km/h and team shots on goal and corner kicks. GER (25) had the highest number of shots on goal per match, with ECU (4) the lowest. There was a small correlation between distance covered at 16-18km/h and shots on goal ( $r=0.18$ ). NZL (9) had the highest number of corner kicks per match and also completed the most running at 16-18km/h. There was a strong correlation between distance covered at 16-18km/h and average corner kicks per match ( $r=0.51$ ).

**Figure 15** shows the distance covered at 18-20km/h plotted against team ball possession (%) and team passing success (%), with the Figure ranked by distance covered at 18-20km/h lowest from left to right. Again JPN, BRA and FRA were the

standout teams who completed less running at 18-20km/h, yet had a high passing success rate and high team ball possession. Conversely, CRC had a low passing success (62%) and low ball possession (43%) yet covered the fifth highest amount of distance at 18-20km/h. There was a small correlation between distance covered at 18-20km/h and team ball possession ( $r=0.27$ ) and team passing success rate ( $r=0.34$ ).

**Figure 16** shows the relationship between distance covered at 18-20km/h and team shots on goal and corner kicks. NZL (9) had the most corner kicks on average per match and the highest distance at 18-20km/h. GER and SUI (8) had the same number of corner kicks per match, and were the second and third highest for distance in this speed zone. There was a strong correlation between distance covered at 18-20km/h and corner kicks ( $r=0.51$ ). There was a small correlation between distance covered at 18-20km/h and team shots on goal ( $r=0.15$ ). GER (25), CMR (20) and FRA (19) had the highest number of shots on goal per match, but CMR and FRA were in the bottom ten of the 24 teams for the amount of distance at 18-20km/h. Therefore, it appears that teams who completed more running in this ST were pressing to score a goal and had a higher chance of then winning a corner, as shown by this correlation.

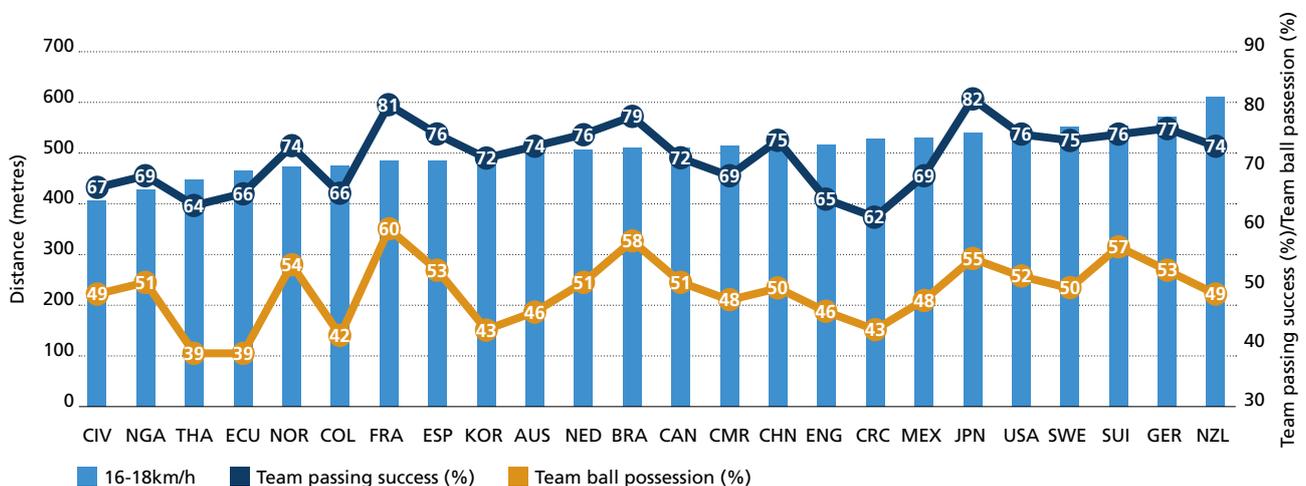


Figure 13: Analysis of distance covered at 16-18km/h correlated to the team ball possession and team passing success

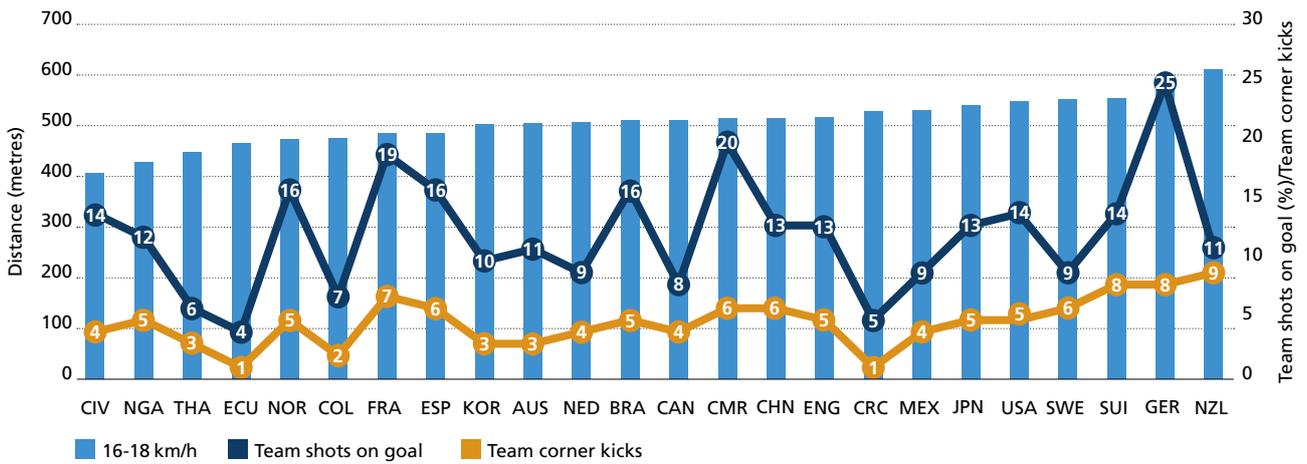


Figure 14: Analysis of distance covered at 16-18km/h correlated to the team shots on goal and corner kicks

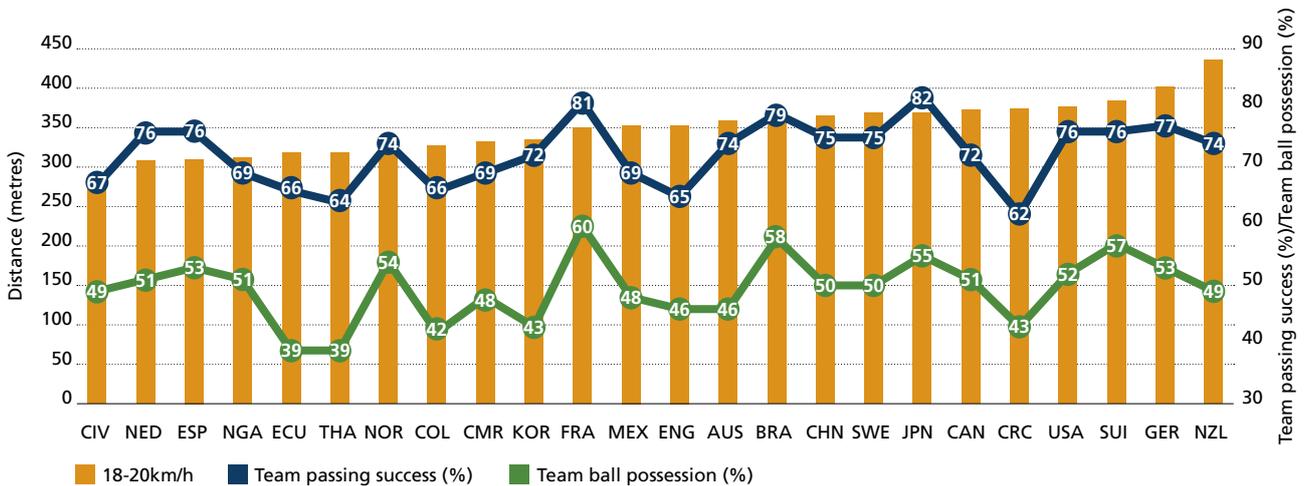


Figure 15: Analysis of distance covered at 18-20km/h correlated to team ball possession and team passing success

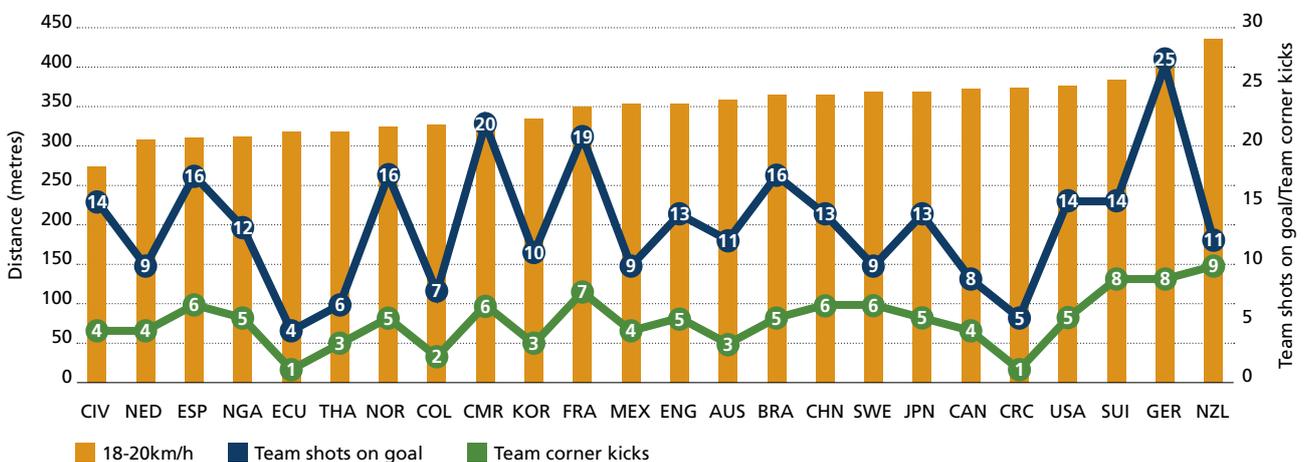


Figure 16: Analysis of distance covered at 18-20km/h correlated to the team shots on goal and corner kicks

**3.2 Analysis of sprint activity (>20km/h)**

**Figure 17** shows a summary of the average distance and number of sprints at 20-23km/h and >23km/h per match. GER (526m) and NZL (521m), followed by BRA, CAN, USA (all 513m), covered the most distance in the combined sprint thresholds. Teams completed an average of  $8.7 \pm 1.3$  (range: 5-10) sprints at 20-23km/h, with ECU completing the least amount of distance at 20-23km/h, and the lowest number of sprints in this speed threshold. The average length of each sprint in 20-23km/h was  $13.9 \pm 1.4$ m, with  $7:29 \pm 0:25$  between each sprint. For the higher sprint zone, >23km/h, teams completed an average number of  $21.3 \pm 1.9$  (range: 18-25) sprints in this top threshold, with NZL (25) and GER (24) completing the most. The average length of each sprint >23km/h was  $13.6 \pm 0.5$ m, with  $5:48 \pm 0:25$  between each sprint. Despite being eliminated in the group stage, NGA were in the top eight for the amount of distance covered in the sprint thresholds. In part, this could be due to their level of opposition, as well as needing a result in a match to ensure progression

out of the group stage. Information of this nature can help coaches and fitness trainers plan programmes and sessions for players to ensure that the physical loading and content reflects the demands that players will face during match-play.

**Figure 18** breaks down the distance covered at 20-23km/h and >23km/h into 15-minute periods during the 2011 and 2015 tournaments. In 2011, players covered on average more distance at 20-23km/h (**Figure 18a**) during the first 15-minute period of the match (34m compared to 31m). In both tournaments, the amount covered then decreased by 23% (2011) and 14% (2015), before plateauing in the period before half-time. In 2011, at the start of the second half, players again covered less distance at 20-23km/h, 12% and 17% for 2011 and 2015 respectively, again suggesting a lack of physical preparation to re-start the match after half-time. In 2011, players completed more distance at 20-23km/h in the final period of the match, 33m in 2011 compared to 30m per player in 2015. This profile was very

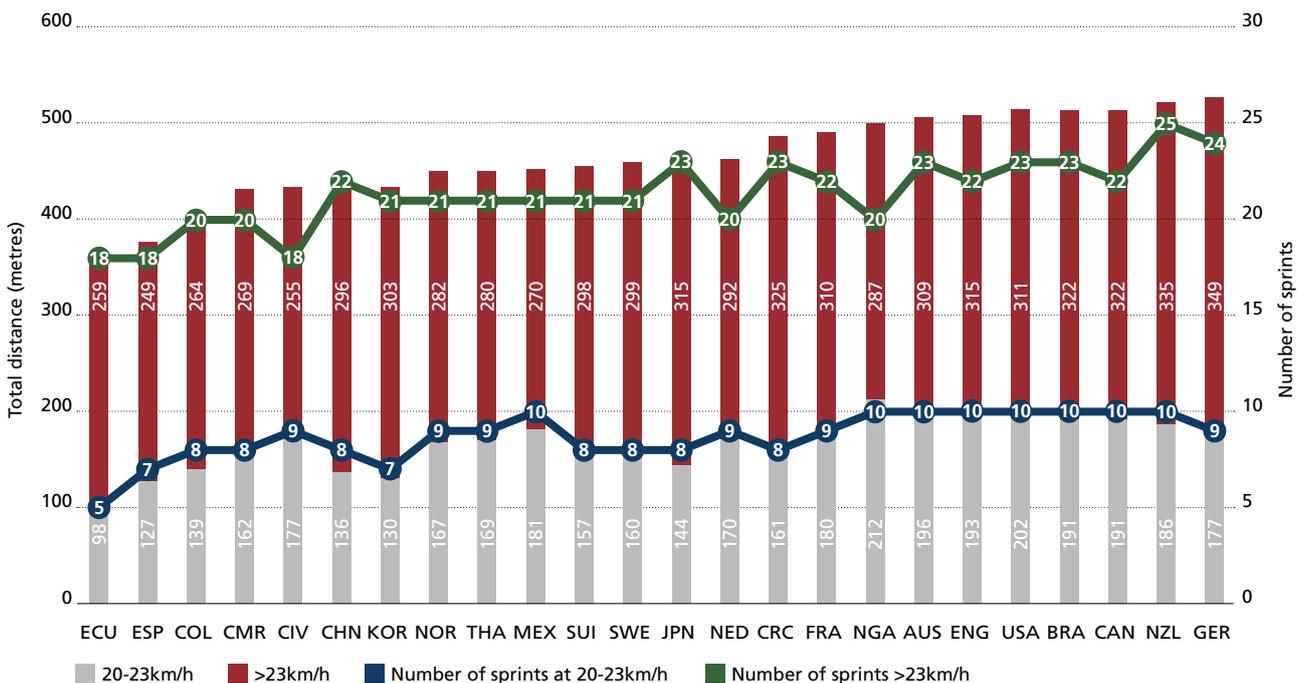


Figure 17: Analysis of distance covered and number of sprints at 20-23km/h and >23km/h

similar for distances >23km/h (Figure 18b), with a decrease from the opening 15-minute period by 18% (2011) and 14% (2015) during 15-30min. At the start of the second period, in 2011 players covered 7% less distance at >23km/h, and 11% less in 2015. In both tournaments, the distance in this threshold dipped before an increase in

the final period of the match. During the final period, players on average completed 6% (2011) and 5% (2015) more than during the opening period of the match, which suggests that players have a good physical capacity to be able to complete more running at speeds >23km/h in the latter stages of matches.

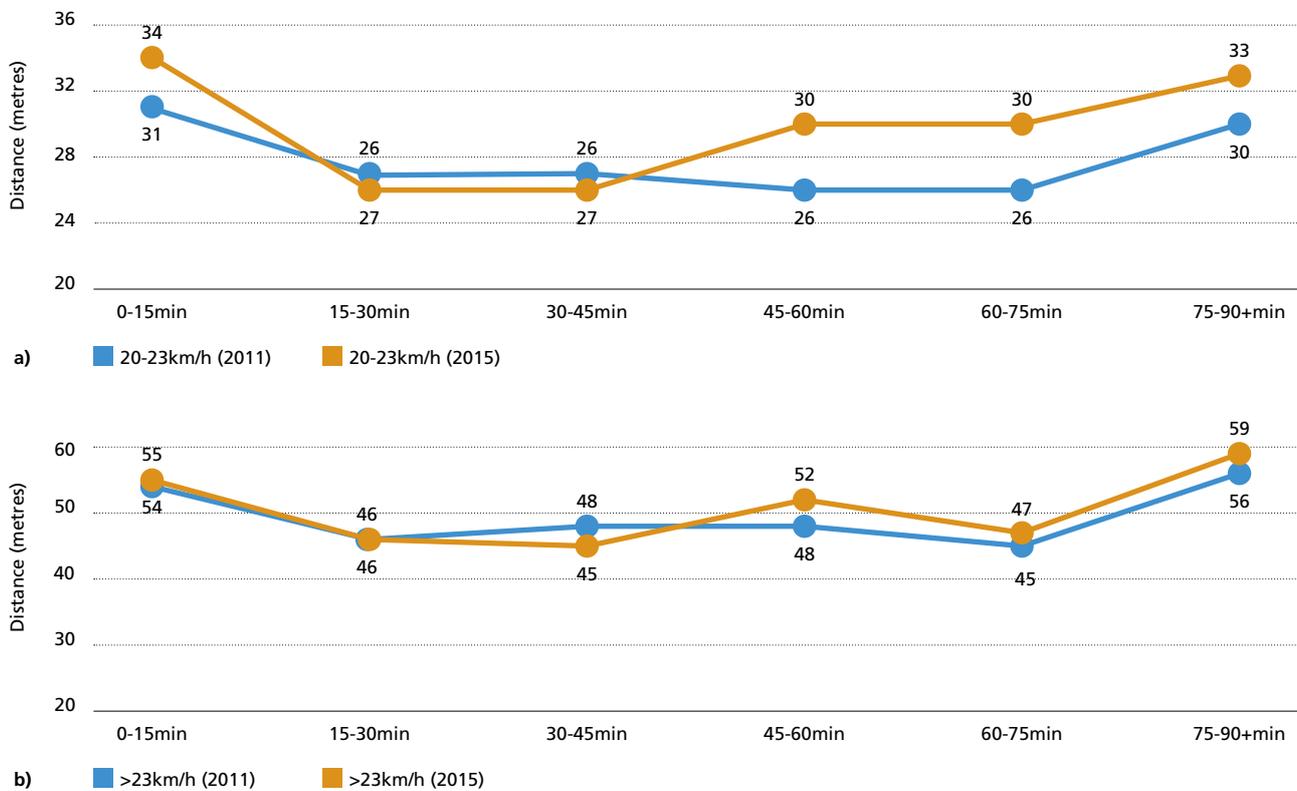


Figure 18: Comparison of distance covered in every 15-minute period of the match for the 2011 and 2015 tournaments

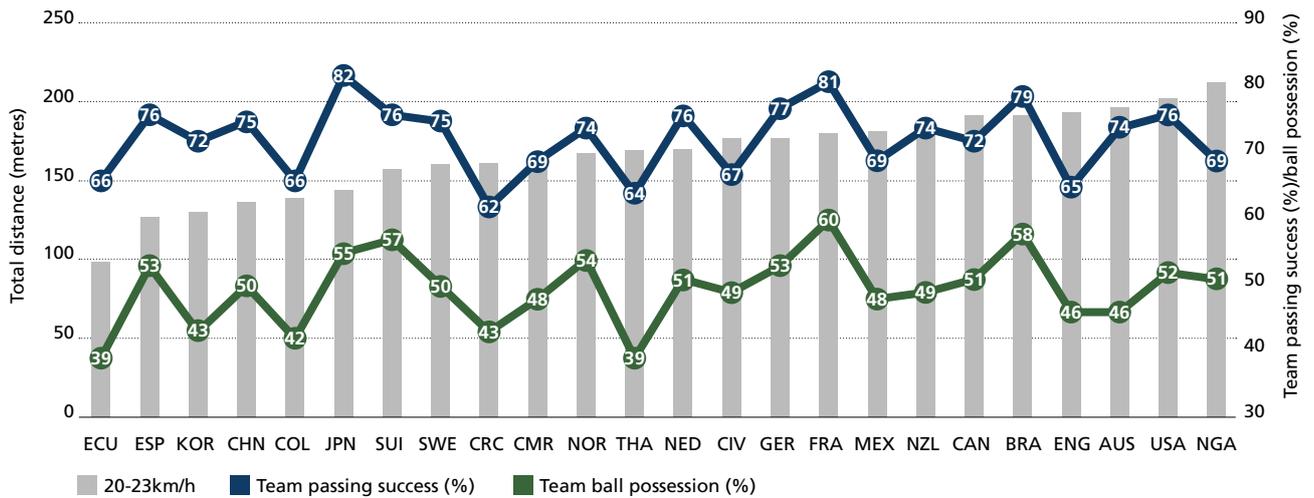


Figure 19: Analysis of distance covered at 20-23km/h correlated to the team ball possession and team passing success

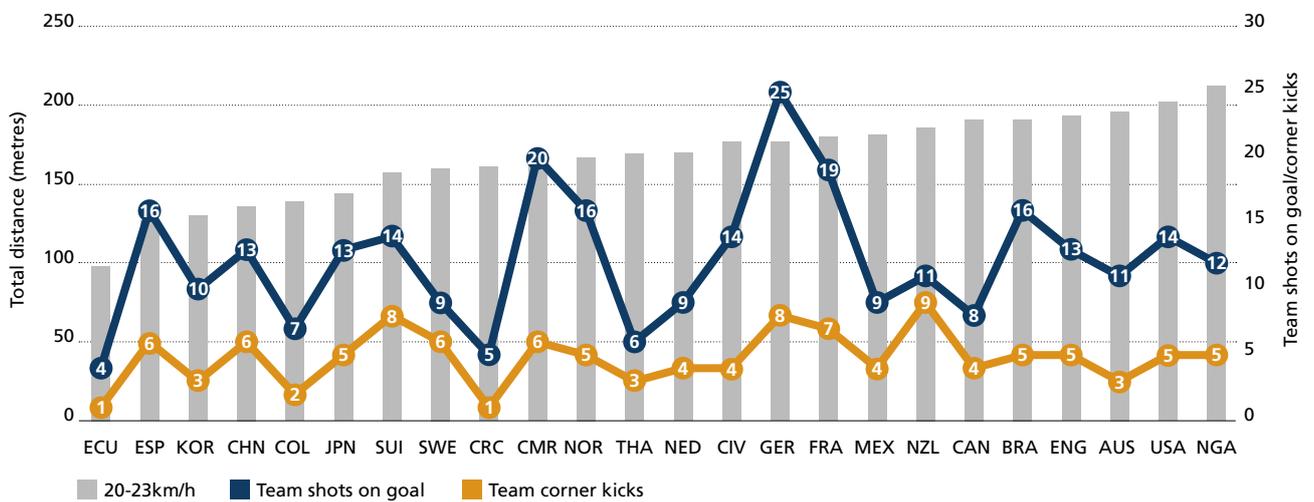


Figure 20: Analysis of distance covered at 20-23km/h correlated to the team shots on goal and corner kicks

Figure 19 shows the distance covered at 20-23km/h plotted against team ball possession and team passing success, with the Figure ranked by lowest distance from left to right. JPN (82%), who had the highest team passing success, were ranked sixth lowest for the amount of distance covered at 20-23km/h. NGA were ranked highest for the distance covered at 20-23km/h, with a team passing success of 69%. The correlation between distance covered at 20-23km/h and team passing success was trivial ( $r=0.08$ ), which is reflected by the results shown. FRA (60%) and BRA (58%), who had the highest team ball possession, ranked higher for the amount of distance covered at 20-23km/h, compared to distances at 16-18km/h and 18-20km/h. There was a moderate correlation between distance covered at 20-23km/h and team ball possession ( $r=0.33$ ), and slightly

higher correlation than with distances at 16-18km/h and 18-20km/h.

Figure 20 shows the relationship between distance covered at 20-23km/h and team shots on goal and corner kicks. GER (25), who had the most shots per match, ranked tenth highest for the amount of distance covered at 20-23km/h, compared to being ranked second for distances at 16-18km/h and 18-20km/h. ECU (4), who had the least number of shots overall, also covered the least amount of distance at 20-23km/h. NZL (9), who had the most corner kicks per match, ranked seventh highest for the amount of distance covered at 20-23km/h. There was a small correlation between distance covered at 20-23km/h and shots on goal ( $r=0.25$ ) and corner kicks (0.29), and the distance covered in this speed

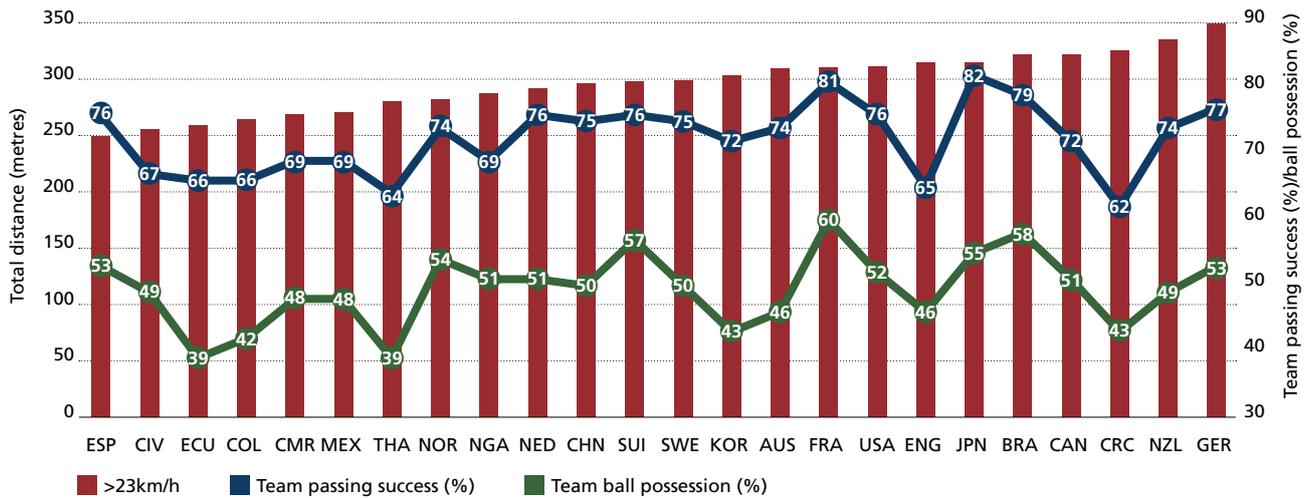


Figure 21: Analysis of distance covered >23km/h correlated to the team ball possession and team passing success

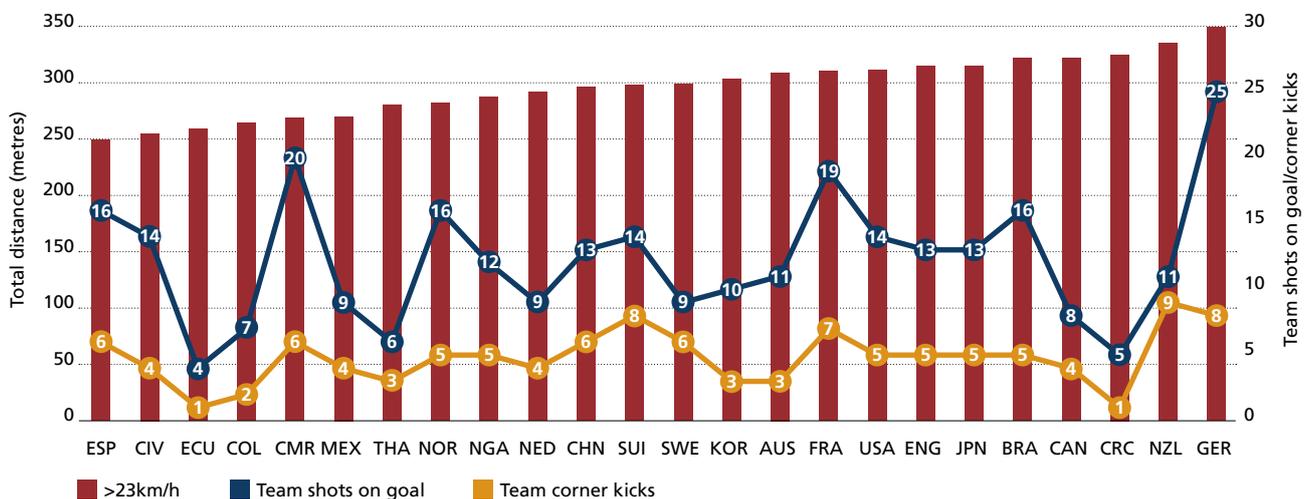


Figure 22: Analysis of distance covered >23km/h correlated to the team shots on goal and corner kicks

zone seems to be the least important for impacting upon the selected attacking technical parameters for teams.

Figure 21 shows the distance covered >23km/h plotted against team ball possession and team passing success, with the figure ranked by distance lowest from left to right. JPN (82%), who had the highest team passing success, were ranked higher for the amount of distance covered >23km/h (sixth) compared to the amount of distance they covered at 20-23km/h (19<sup>th</sup>). There was a moderate correlation between distance covered >23km/h and team passing success ( $r=0.36$ ). Similarly, there was a moderate correlation between distance covered >23km/h and team ball possession ( $r=0.30$ ). ESP ranked lowest in terms of distance covered >23km/h, despite having

good team ball possession and a good percentage of team passing success.

Figure 22 shows the relationship between distance covered >23km/h and team shots on goal and corner kicks. GER (25), who had the most shots per match, were ranked highest for the amount of distance covered >23km/h, with NZL second highest and an average of 11 shots on goal per match. There was a small correlation between distance covered >23km/h and shots on goal ( $r=0.22$ ). Two of the top three teams (NZL, GER) for the number of corner kicks per match also completed the most distance at speeds >23km/h, whilst SUI were 13<sup>th</sup> for the amount of distance >23km/h. There was a moderate correlation between distance covered >23km/h and the number of corner kicks ( $r=0.37$ ).

### Summary

- CHN (13%) and KOR (9%) showed the largest increase in distance >16km/h from the first to the second half. Conversely, ECU (-16%), CIV (-12%), FRA (-12%) and GER (-10%) had the largest decrease in distances covered at the higher speed thresholds, suggesting greater levels of fatigue for those nations.
- Generally, the most distance >16km/h was completed in the first 15-minute period of a match. All players then showed a drop-off during the subsequent periods in the first half, suggesting some effect of fatigue, although of course the technical and tactical decisions of teams and individuals would also have had an impact.
- During the first 15-minute period of the second half, all players tended to cover less distance than during the first 15-minute period of the match, suggesting players were not physically prepared to start the second half of the match. With this in mind, trainers and coaches should review half-time strategies, and then look to introduce a re-warm-up strategy (Lovell et al., 2007) with the players starting the second half.
- The amount of distance covered >16km/h in the final period, 75-90min+, of the matches did increase, suggesting players have the physical capacity to increase their work rate in the latter stages of matches.
- The strongest correlation for the number of team passes ( $r=0.31$ ) was with distance >23km/h, hence the activity that players complete off the ball to find and make space to retain possession and receive the ball was important.
- There was a moderate correlation between ball possession (%) and distance covered >20km/h, with a weaker relationship to distances 16-20km/h.
- The strongest correlation for shots on goal ( $r=0.25$ ) was with distance covered at 20-23km/h; the relationship with other speeds was trivial.
- Of the more attacking technical

measures, the number of corner kicks had the highest correlation with the higher speed thresholds, with a strong correlation with running covered at 16-18km/h and 18-20km/h ( $r=0.51$ ). There was a more moderate correlation with distance covered at 20-23km/h ( $r=0.29$ ) and >23km/h ( $r=0.37$ ).

- The average length of each sprint at 20-23km/h was  $13.9\pm 1.4$ m, with  $7:29\pm 0:25$  between each sprint. For the higher sprint zone, >23km/h, the average length of each sprint was  $13.6\pm 0.5$ m, with  $5:48\pm 0:25$  between each sprint. Training programmes should reflect these sprint characteristics, distance, recovery and number of repetitions, so that players are prepared for the demands of match-play.
- The amount covered in the higher speed thresholds during this last phase of matches, 75-90+min, would also be influenced by any tactical adjustments, changes in formation and/or personnel depending on the result needed in the match.

### 4. Analysis of total distances covered per player per match by confederation

**Table 6** shows a summary of the average distances, and percentage break down, by confederation, for all of the matches at the FIFA Women's World Cup Canada 2015™. Some caution should be exercised when analysing and comparing this data as the number of teams and matches played by each confederation varied, as shown in **Table 6** (number of teams, number of matches). CONCACAF teams (11,123m) covered the highest TD per match, while CAF covered the least (10,137m). CAF teams covered the greatest amount (30.5%) of distance at 0-6km/h of the six confederations, and the least amount at 12-16km/h, suggesting that those teams spent more time walking between more intense running actions. The OFC, which was only represented by one team (NZL), covered the highest percentage of distance at 12-16km/h (19.0%), 16-18km/h (5.7%), 18-20km/h (4.1%) and >23km/h (3.1%) compared to the other confederations.

CAF (270m) covered the least distance >23km/h, with NZL (335m) the most. For the other sprint threshold, 20-23km/h, again NZL (186m) covered the most, with CONMEBOL (143m) the least.

All confederations, other than the OFC (3% increase), covered less meterage for TD in the second half compared to the first half (**Figure 23**) of matches. CAF teams had the lowest overall meterage in both the first and second half. CAF and CONMEBOL

both decreased their meterage by 6% from the first to the second half, whilst CONCACAF teams, on average, decreased their meterage by 5% in the second half of matches. A decrease in meterage could be related to an increase in fatigue and an inability to maintain work rate during the latter stages of matches. It can also be linked to many tactical elements, including the tactical formation of both teams, substitution patterns, and the result needed in the match.

Confederation	TD (m)	0-6km/h		6-12km/h		12-16km/h		16-18km/h		18-20km/h		20-23km/h		>23km/h	
		m	%	m	%	m	%	m	%	m	%	m	%	m	%
AFC (5, 23)	10,772	2,833	26.3	4,664	43.3	1,968	18.3	502	4.7	349	3.2	155	1.4	301	2.8
CAF (3, 9)	10,137	3,090	30.5	4,115	40.6	1,724	17.0	449	4.4	306	3.0	183	1.8	270	2.7
CONCACAF (4, 15)	11,123	2,824	25.4	4,802	43.2	2,108	18.9	530	4.8	369	3.3	184	1.7	307	2.8
CONMEBOL (3, 11)	10,454	2,959	28.3	4,414	42.2	1,835	17.6	484	4.6	337	3.2	143	1.4	281	2.7
OFC (1, 2)	10,724	2,726	25.4	4,389	40.9	2,041	19.0	611	5.7	436	4.1	186	1.7	335	3.1
UEFA (8, 38)	10,999	2,854	25.9	4,741	43.1	2,071	18.8	518	4.7	350	3.2	166	1.5	299	2.7

Table 6: Analysis of the average total distances covered per player per match, by confederation, during the FIFA Women's World Cup Canada 2015™

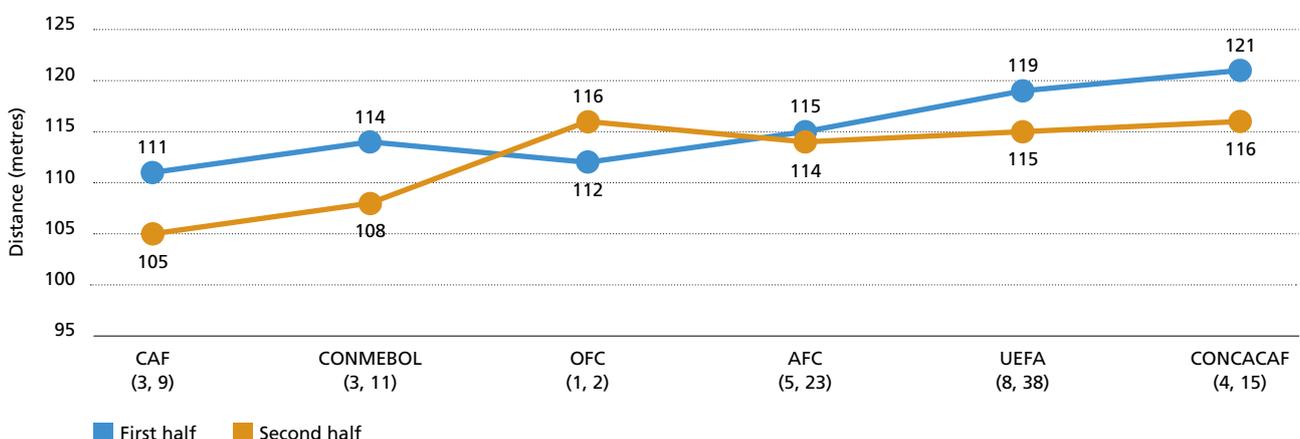


Figure 23: Analysis of the average meterage for TD during the first and second half of matches

CAF teams covered the lowest distance >16km/h in both the first and second half of matches (Figure 24). AFC (7%) and OFC (4%) teams increased the distance covered >16km/h from the first to the second half, whilst all other confederations decreased the amount from the first to the second half, CAF (8%) teams with the greatest decrease. This can be linked to the fitness and fatigued state of individual players, as well as to the technical strategies and substitution patterns employed by teams. OFC's representative completed the most distance >16km/h in the first and the

second half, and 100m higher than any other confederation's teams during the second half.

Figure 25 shows the distances covered <16km/h, and >16km/h, plotted against the average team ball possession for each confederation for all of their matches throughout the tournament. The data is ranked by the amount of distance covered >16km/h, with the lowest values from left to right. Again, as can be seen overall, the OFC covered the most distance >16km/h (1,567m), but UEFA had the highest team

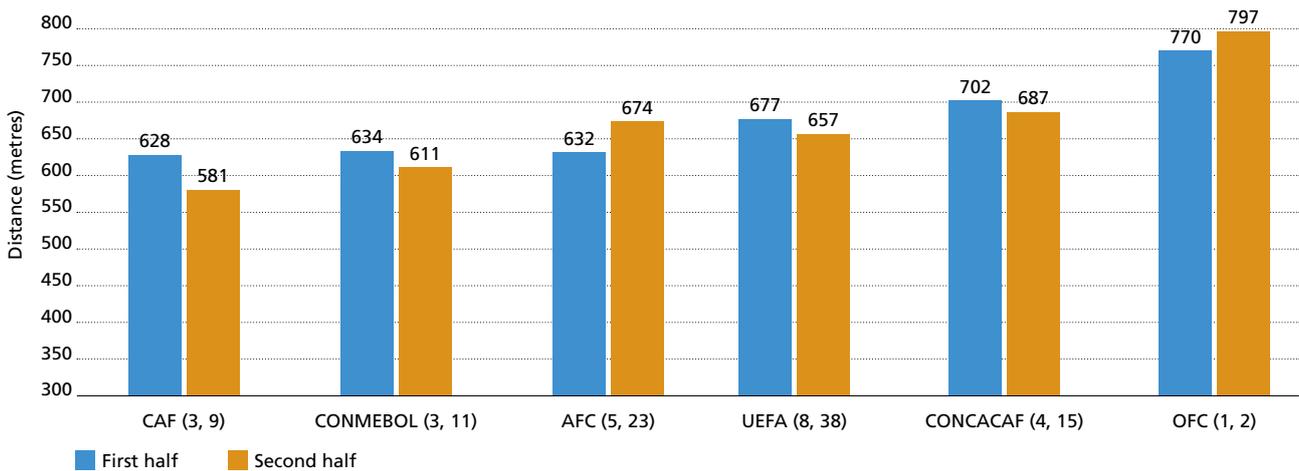


Figure 24: Analysis of the distance covered >16km/h during the first and second half of matches

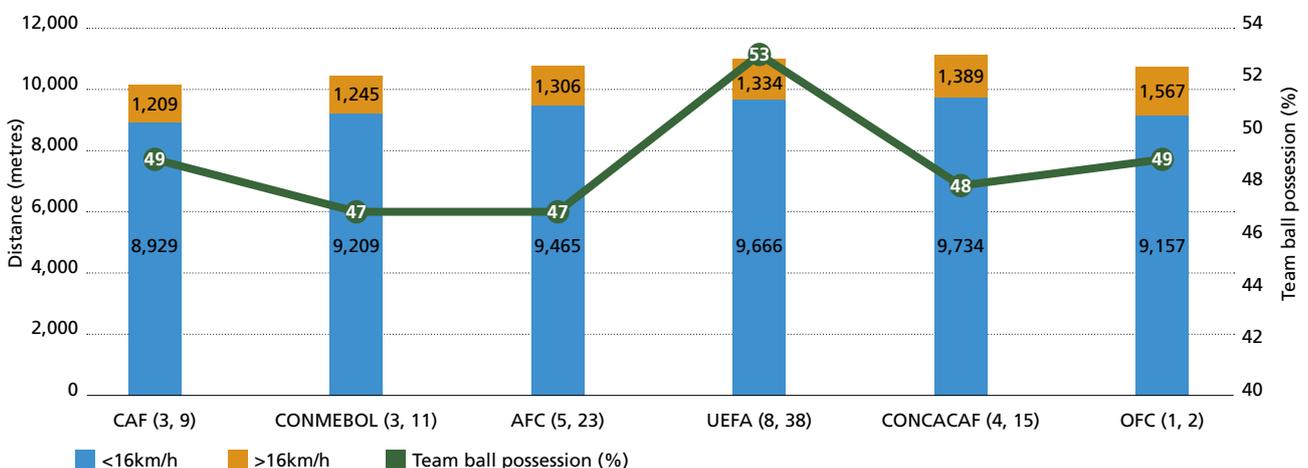


Figure 25: Analysis of distance covered <16km/h and >16km/h by confederation, correlated to the team ball possession

ball possession (53%) and third highest for the amount of distance covered >16km/h (1,334m). CAF teams covered the least distance >16km/h (1,209m) despite being joint second with OFC for team ball possession (49%). CONCACAF teams covered the second highest amount of distance >16km/h (1,389m), but had a similar team ball possession to the AFC and CONMEBOL. UEFA (469) also completed the highest number of passes per match (Figure 26), followed by the AFC (410), and they respectively were ranked third and fourth highest for the amount of

distance completed >16km/h. CONCACAF teams had the lowest number of passes per match (352) of all confederations, but were second highest for the amount of distance covered >16km/h. CAF and UEFA (15) had the most shots on goal per match, although CAF had the least distance >16km/h (Figure 27). The OFC had the most corner kicks (9) per match and the greatest distance >16km/h (1,567m), whilst on average CONMEBOL teams had the least number of corner kicks (3) per match, and covered the second lowest amount of distance >16km/h (1,245m). Generally,

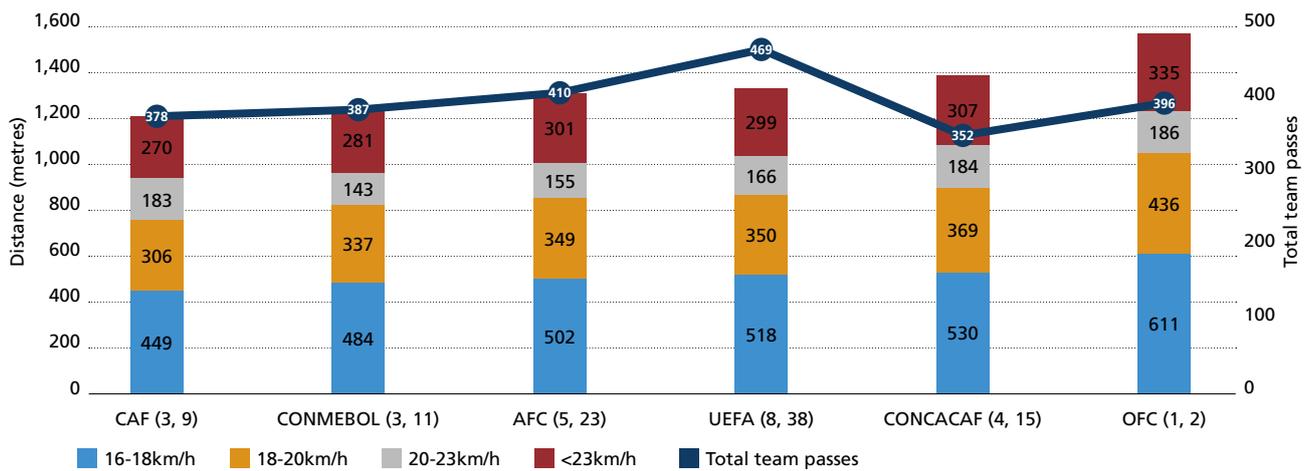


Figure 26: Analysis of distance covered >16km/h by confederation, correlated to the total number of team passes

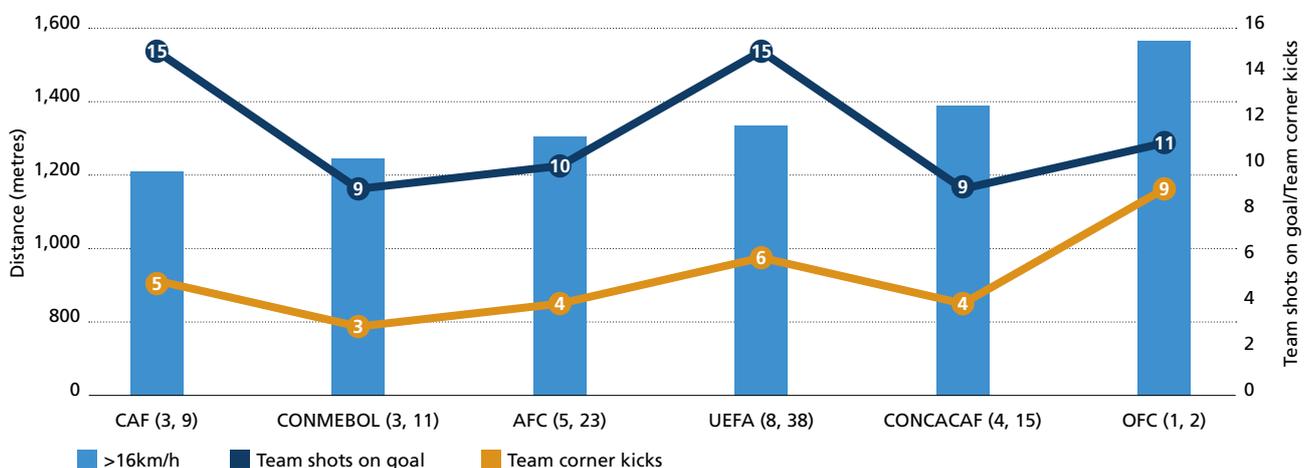


Figure 27: Analysis of distance covered >16km/h by confederation, correlated to the total number of team shots on goal and corner kicks

there was no link between the distance covered >16km/h and shots on goal or corner kicks per match when teams are grouped by confederation.

**Figure 28** shows that CAF teams conceded the highest number of goals per match (2.8), whilst also covering the least amount of distance >16km/h (1,209m). However, CAF also scored the second highest number of goals per match (1.7). This would suggest that their matches were more open, with less rigid tactical formations, with more opportunities for both teams to score goals. CONMEBOL teams conceded the next highest number of goals per match (2.1) and scored the least number of goals per match (0.6) whilst being the second lowest for distance covered >16km/h (1,245m). They also had the least number of shots on goal and the least number of corner kicks per match (**Figure 27**), which suggests a less attacking movement and strategies from those teams. When teams are defending, players react to the attacking movements and runs of the opposition, and at times may be at slower speeds to try to break up/ delay an attack, which could in part explain the lower distances >16km/h and greater number of goals conceded. UEFA teams scored the highest number of goals per match (1.8), whilst conceding the fewest goals per match (0.9) and those teams covered the third highest distance >16km/h.

#### Summary

- CAF teams covered less TD, had a lower work rate (meterage) than other teams, and covered more distance at 0-6km/h, and less in the other speed thresholds compared to other confederations.
- CONCACAF and UEFA teams had the highest meterage for the first and second half of matches, although both showed a reduction from the first to the second half.
- UEFA teams had the highest number of team passes, passing completion rate, shots on goal and number of goals scored per match, but were third highest for the amount of distance >16km/h. Hence, covering more high-speed running does not necessarily lead to more success in football matches.
- The OFC were only represented by NZL, and had the lowest number of matches to average/compare, hence some caution should be exercised when making comparisons with this data set. Generally, the OFC covered the highest amount of distance >16km/h, whilst CAF and CONMEBOL teams covered the least.
- CAF teams had the joint highest number of shots on goal, and were third highest for the number of corner kicks, however those teams also had the highest average number of goals conceded per match (2.8). As already noted, they also covered the least amount of distance >16km/h, which suggests a more open tactical formation and style of play, and possibly a lower physical capability to prevent attacking moves and shots on goal from the opposition.
- CONMEBOL conceded the second highest number of goals per match (2.1), and scored the least number of goals per match (0.6) and were second lowest for the amount of distance covered >16km/h.
- Generally, AFC teams were fourth highest for the amount of distance covered >16km/h, and second highest for the number of team passes. They also increased the amount of distance >16km/h from the first to the second half.

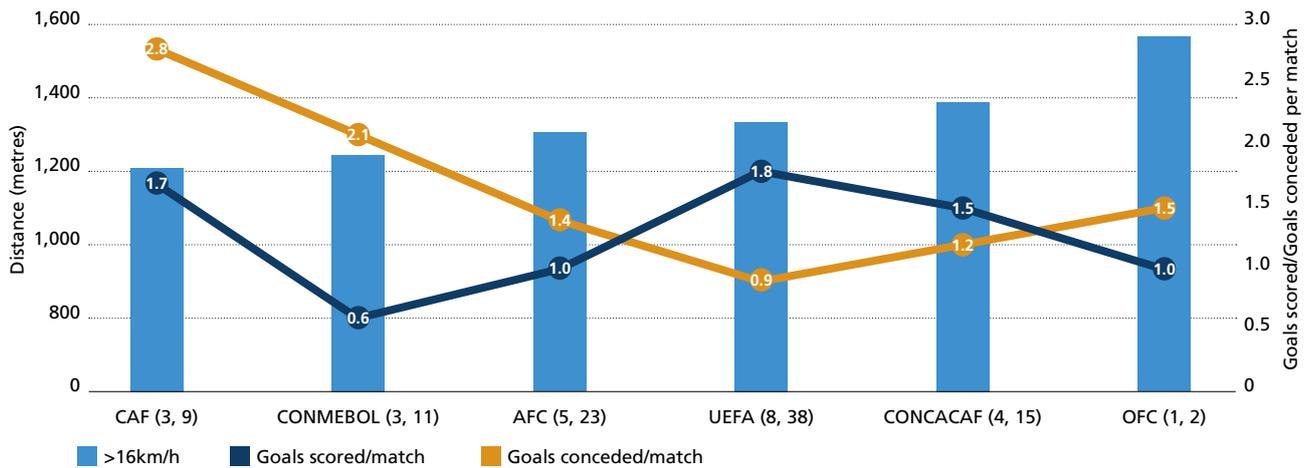


Figure 28: Analysis of distance covered >16km/h by confederation, correlated to the average number of goals scored and conceded per match

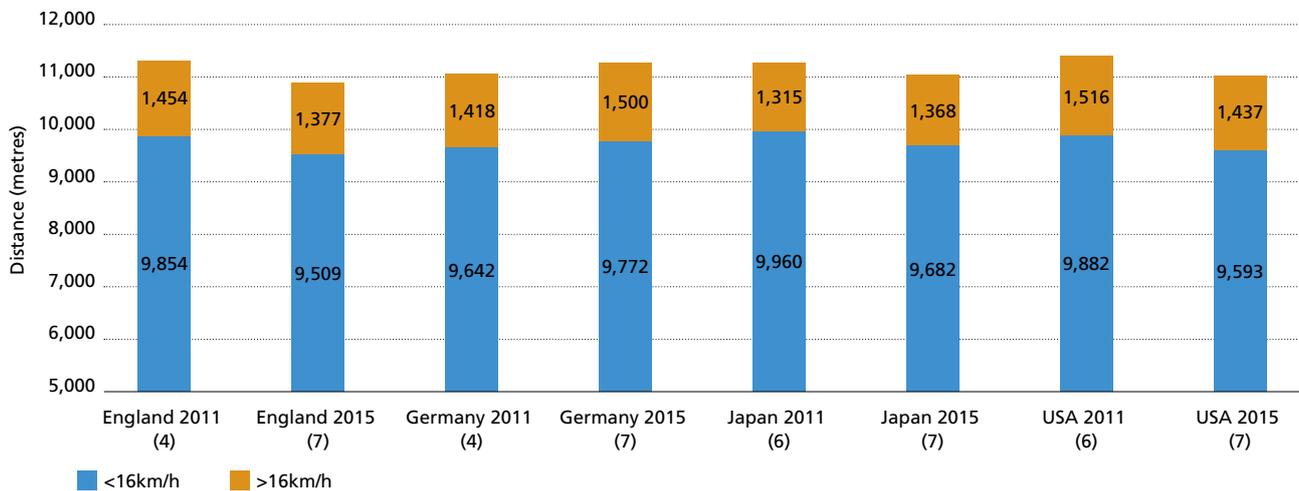


Figure 29: Analysis of the average total distances covered in a match by the final four teams during the 2011 and 2015 tournaments

## 5. Analysis of total distances covered by the final four teams of the FIFA Women's World Cup Canada 2015™

### 5.1 Analysis of the final four teams: 2011 v. 2015 physical performance

The same two teams (JPN, USA) competed in the final of both the FIFA Women's World Cup Canada 2015™ and the FIFA Women's World Cup Germany 2011™, however they both completed one extra match in 2015 due to the increase in number of participating teams compared to 2011. The other two semi-finalists in 2015 (ENG, GER) were both eliminated in the quarter-finals (i.e. the first knockout round) of the 2011 tournament. The following

graphs compare the performance of those four teams (ENG, GER, JPN, USA) during the 2011 and 2015 tournaments.

All of the teams, except GER, covered a greater TD (Figure 29) during the 2011 tournament compared to 2015. In 2011, USA covered the highest TD (11,398m), whilst ENG (10,886m) covered the lowest TD during the 2015 tournament. Similarly, USA completed the most distance >16km/h (1,516m) during the 2011 tournament, with JPN covering the lowest distance >16km/h (1,315m) in 2011. ENG (77m; 6%) and USA (79m; 5% higher) both completed more running >16km/h during 2011, whilst GER (82m; 6%) and JPN (47m; 4%)

both completed more during the 2015 tournament. In 2011, all of the teams, apart from JPN, completed more running at speeds >16km/h, compared to the average for the tournament (1,331m). In 2015, all four teams completed more running >16km/h, compared to the average for the tournament (1,340m), JPN by the least (28m).

All of the teams had small differences between the total distance covered in the first and second half of matches for both the 2011 and 2015 tournaments (**Figure 30**). GER (181m), in 2015, had the greatest drop in distance covered, which equated to a 3% decrease (**Figure 30**). JPN in 2015 had the greatest increase in distance covered (176m), which equated to a 3% increase. All of the other differences were trivial (**Figure 30**). Other than ENG (7%) and JPN (2%) during the 2011 tournament, all other teams decreased the amount of distance

covered >16km/h from the first to the second half of matches.

GER (10%) had the biggest decrease in distance covered >16km/h during 2015, which equated to 79m less in the second half (**Figure 31**). ENG had the biggest increase (7%) in distance >16km/h in 2011, but a 4% decrease in 2015, equating to 27m. USA (5%) also had a bigger decrease in 2011 (35m), with a smaller decrease of 11m in 2015 (**Figure 32**). The higher-intensity runs are when the critical moments happen in football matches, so the greater physical capacity that players have to complete more running in those thresholds, especially later in matches, could have an impact on the outcome of matches. It is noticeable that JPN completed the least amount of running >16km/h in both tournaments when comparing the four teams, 1,315m and 1,368m during 2011 and 2015, respectively



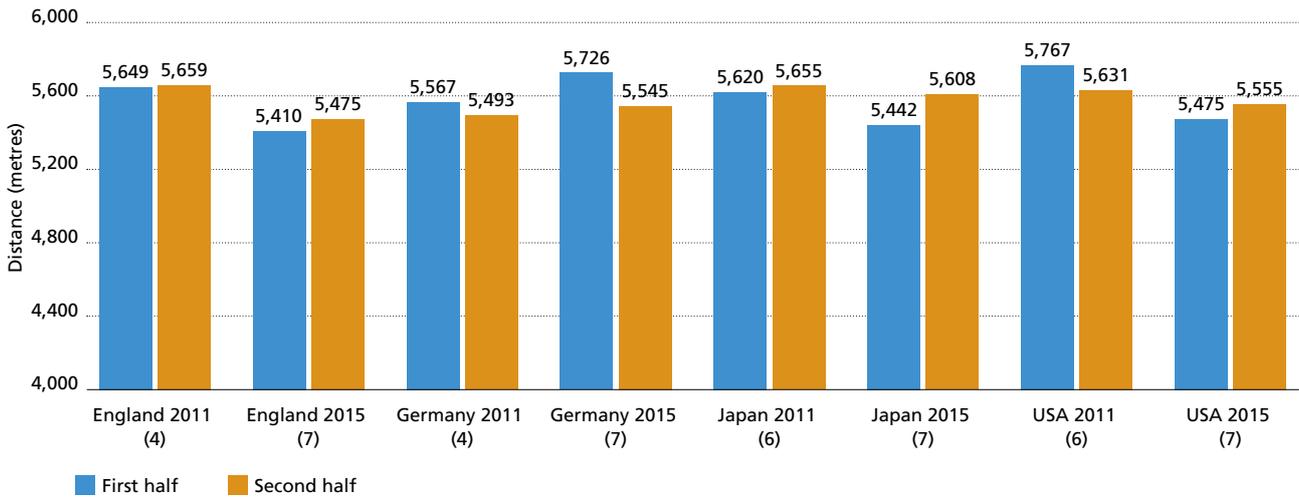


Figure 30: Comparison of the total distances covered in the first and second half of matches by the final four teams during the 2011 and 2015 tournaments

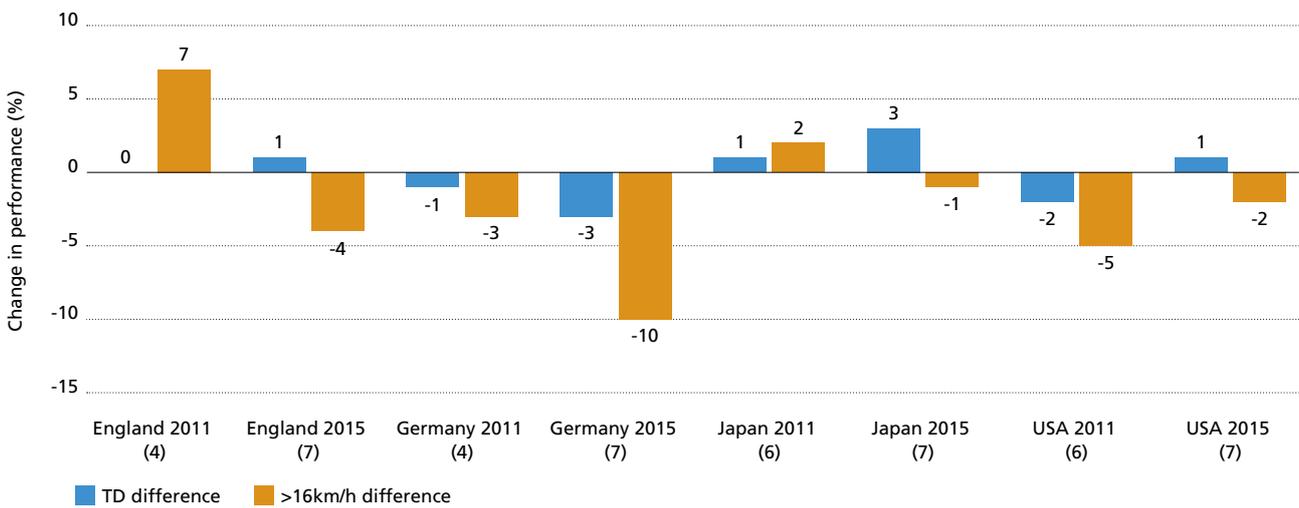


Figure 31: Analysis of change in total distance and distance covered >16km/h between the first and second half of matches

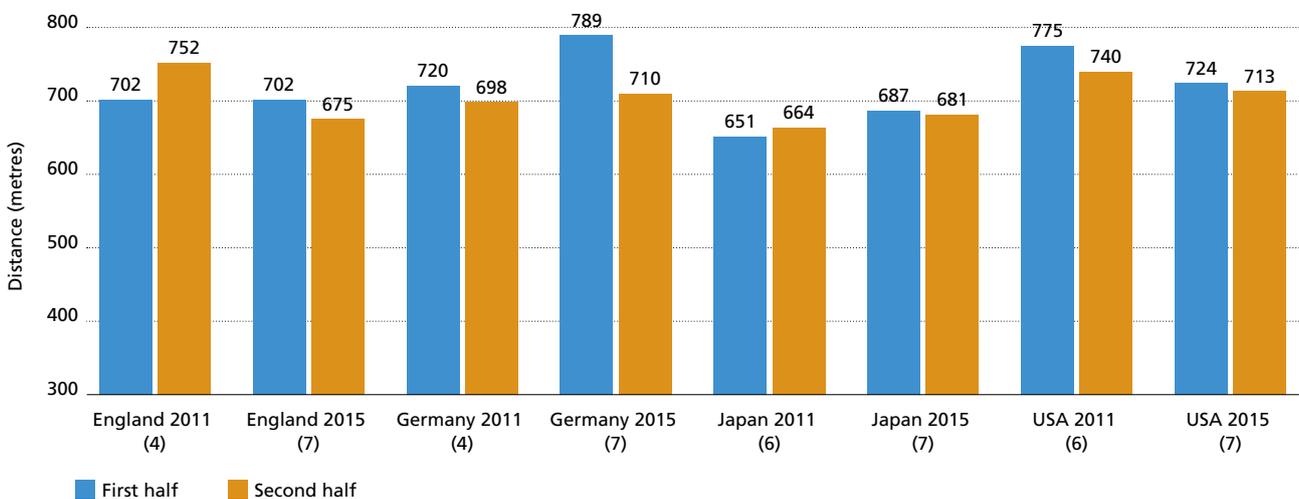


Figure 32: Comparison of the distances covered >16km/h during the first and second half of matches by the final four teams during the 2011 and 2015 tournaments

(Figure 33). However, JPN also completed the most passes in both tournaments, 537 and 562 for 2011 and 2015 respectively. ENG had a decrease in distance >16km/h (77m) and total number of team passes (84) from the 2011 to the 2015 tournament, which suggests a more direct tactical strategy in 2015 compared to 2011 which was more successful for them, as they were ranked third overall in 2015. GER had an increase in both distance >16km/h (82m) and total number of team passes (58), which suggests more of a passing and possession tactic in 2015, which again was more successful for them compared to 2011. USA decreased both distance >16km/h (79m) and total number of team passes (21) from 2011 to 2015. Conversely, JPN increased both elements from 2011 to 2015.

It is also important to note, that more running at the higher intensities does not always correlate with individual or team success (Figure 34). JPN had the highest team passing success rate (82%) in both the 2011 and 2015 tournaments. They also had the highest ball possession (55%), which again was the same in both tournaments. These figures for USA were also very similar, albeit both lower than for JPN. JPN increased the amount of distance covered >16km/h (4%), whilst USA decreased the amount of distance covered >16km/h (5%) from 2011 to 2015. JPN won the tournament in 2011 and USA won the tournament in 2015, yet with no consistent correlation between the technical and physical parameters of match-play. Football match-play is complex and multi-factorial, and as Gregson et al. (2010) found, high-intensity running is variable between matches and should not be used in isolation as a predictor of individual or team performance. Other factors which could impact upon the results of the two tournaments include the different number of matches for ENG and GER in 2011 compared to 2015, an increase in the number of participating teams in 2015 compared to 2011, the change of playing surface, the fitness level of players, a change in technical coaching staff, the

turnover of players and their technical qualities, as well as the general ongoing development and tactical astuteness of women's football players and coaches.

#### Summary

- All of the final four teams, except GER, covered a higher TD during the 2011 tournament compared to 2015.
- In 2011, all teams, except JPN, completed more running >16km/h compared to the average for the tournament.
- In 2015, all teams completed more running >16km/h compared to the average for the tournament.
- GER (10%) had the biggest decrease in distance covered >16km/h during 2015. The higher-intensity runs are when the critical moments happen in football matches, so the greater physical capacity that players have to complete more running in those thresholds, especially later in matches, could have an impact on the outcome of matches.
- In both 2011 and 2015, JPN completed the lowest amount of distance >16km/h, however they had the highest number of team passes, as well as the highest team ball possession and highest passing success rate. Such findings show that to determine the performance of individual players, and ultimately teams, a combination of technical and physical match outcomes should be considered, and the physical parameters should not be used in isolation of the technical match variables as markers of individual or team success.

#### 5.2 Analysis of the final four teams: group stage v. knockout rounds – physical performance

The final part of this section compares the final four teams for their matches during the FIFA Women's World Cup Canada 2015™ only. The following graphs compare the performance of those four teams (ENG, GER, JPN, USA) during the group stage and knockout rounds. JPN had the highest overall TD during the group stage (11,409m), but they also had the lowest TD during the KO rounds (10,781m) with a 6% decrease (Figure 35). ENG had a decrease

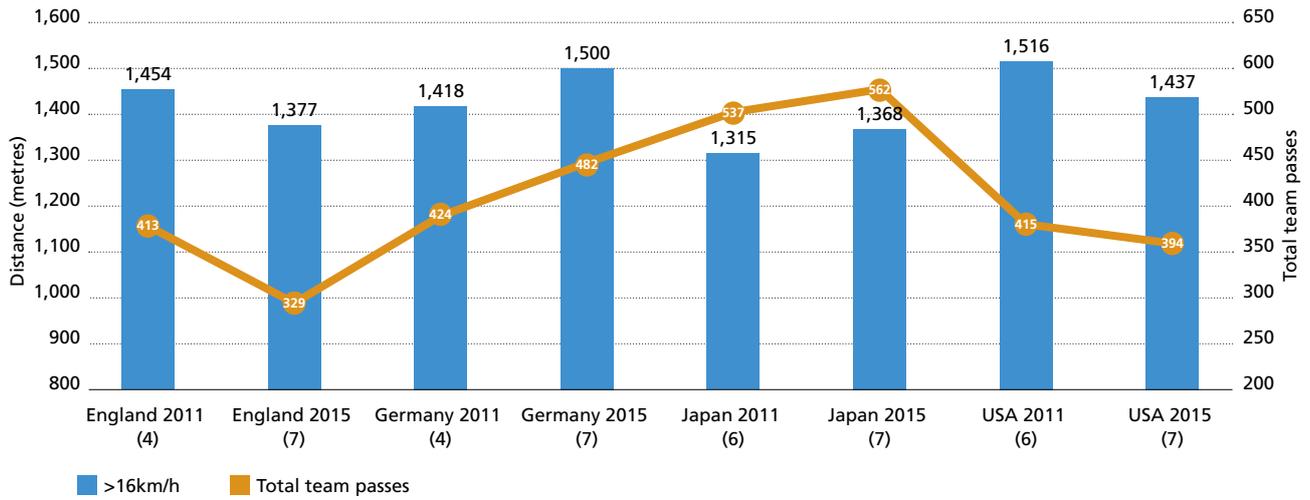


Figure 33: Comparison of the distances >16km/h plotted against total number of team passes by the final four teams during the 2011 and 2015 tournaments

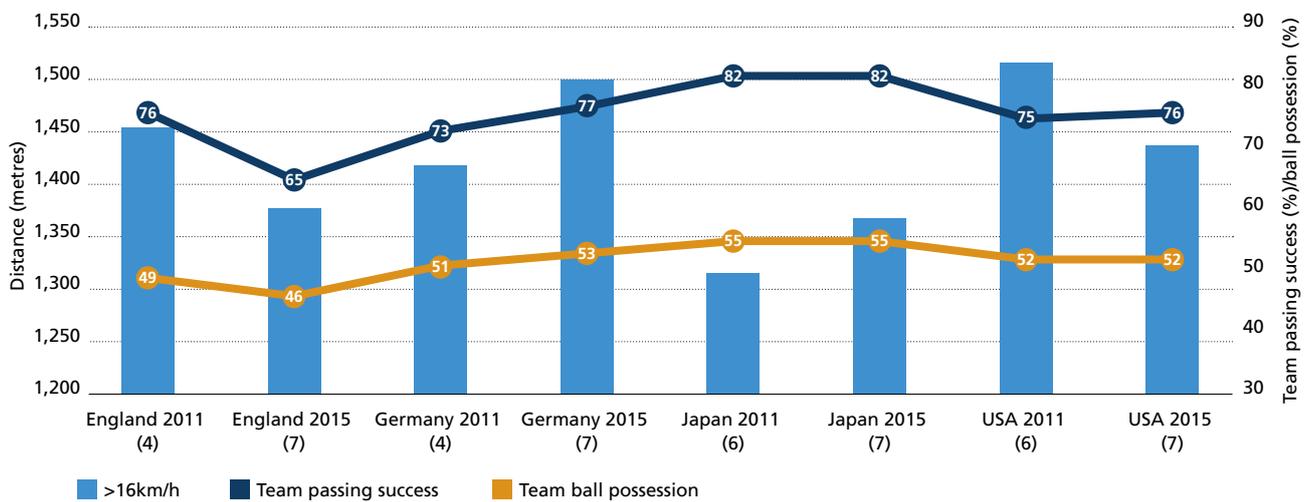


Figure 34: Comparison of the distances >16km/h plotted against team ball possession and team passing success for all four teams during the 2011 and 2015 tournaments

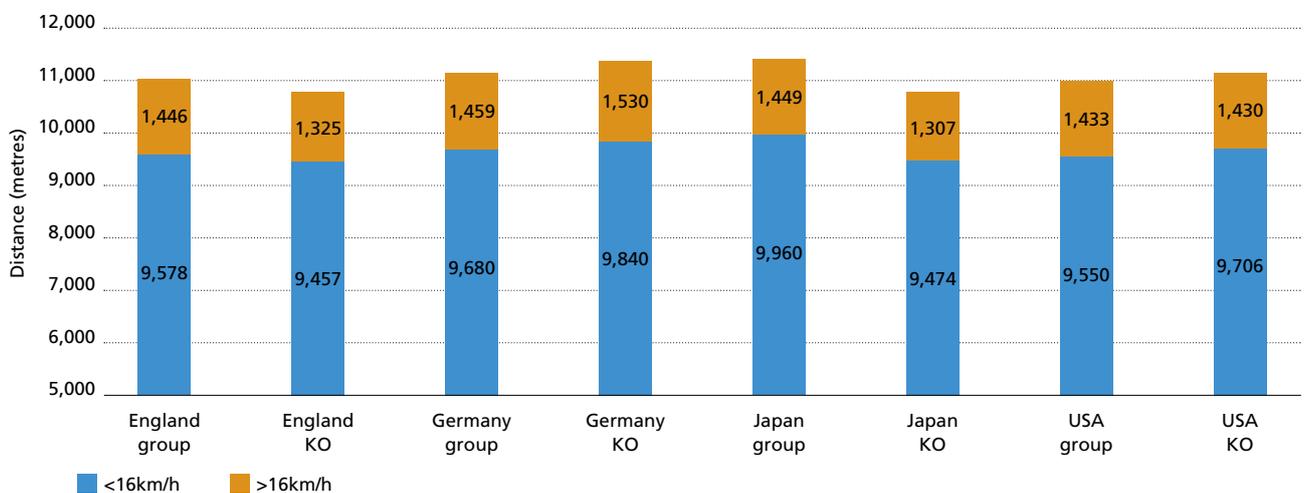


Figure 35: Comparison of the average total distances covered during the group stage and knockout rounds by the final four teams during the FIFA Women's World Cup Canada 2015™

in TD (2%) from the group stage to KO, whilst GER (2%) and USA (1%) both had an increase. GER (1,530m) covered the most distance >16km/h, with a 5% increase from the group stage. Both ENG (8%) and JPN (10%) had large decreases in the amount of distance covered >16km/h from the group stage to the KO rounds. USA had a very negligible (3m) difference. There could be many reasons to explain these differences in TD and distances in the higher-speed thresholds, including the change in standard and ranking of teams from the group stage to the KO rounds, a change in tactical formation, a change in playing personnel, the fatigued state of players and accumulated playing time, and the need to get a result in matches especially as the tournament progressed and teams were potentially pushing to score or prevent a goal being scored later in matches.

GER had a decrease in TD covered from the first half to the second half (Figure 36) of matches, equating to 185m and 178m during the group and KO stages respectively. All other teams increased the TD covered from the first to the second half of matches, with JPN having the greatest increase during the KO stages (4%). For distances >16km/h (Figure 37), other than JPN with a small increase (9m; 1%) during

the KO stages, all other teams showed a decrease from the first to the second half (Figure 37). GER had the largest decreases with 11% (85m) and 9% (75m) during the group stage and KO rounds respectively. ENG had a 5% decrease during the group stage, whilst USA had a 4% decrease during the KO rounds, equating to 26m.

The amount of distance covered >16km/h is shown in Figure 38, along with a trend line for the distance covered across matches (note that the data is missing for the third match for USA). As Gregson et al. (2010) highlighted, covering more distance in the higher-speed thresholds does not necessarily correlate to match outcome, and the amount of distance covered varies greatly between matches. JPN covered less distance in match 7 compared to their first match (13% decrease), whilst ENG (7%), GER (7%) and USA (12%) all covered a higher amount during match 7.

The general physical preparation leading in to a match is to taper the physical loading for the players by reducing training volume and intensity in the days leading up to the match so that players are recovered and optimally prepared physically for matchday. Therefore, it would be assumed that the players would be physically recovered

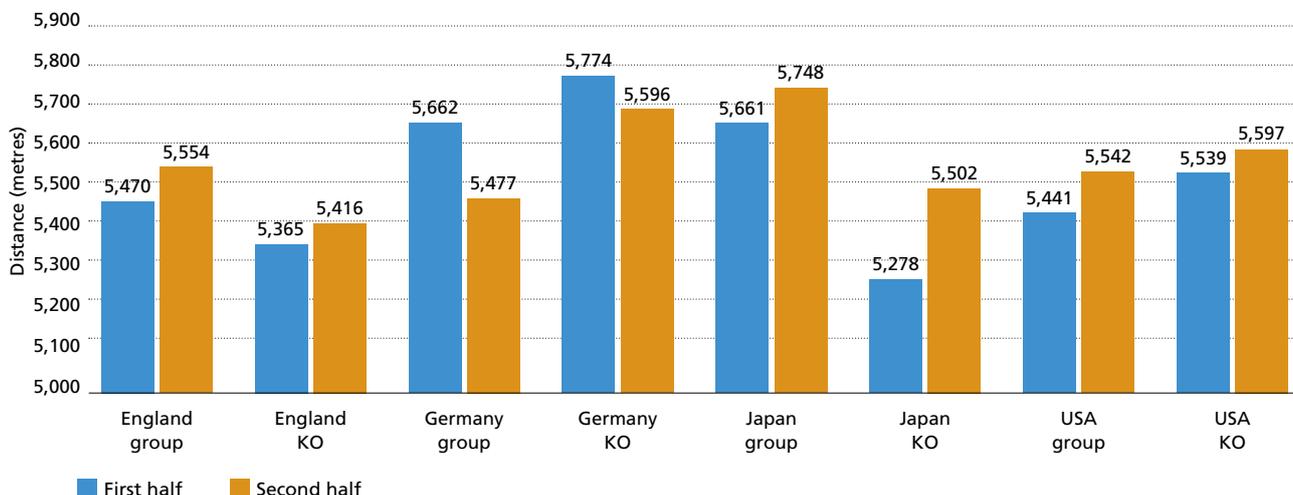


Figure 36: Comparison of the first and second half total distances covered during the group stage and knockout rounds by the final four teams

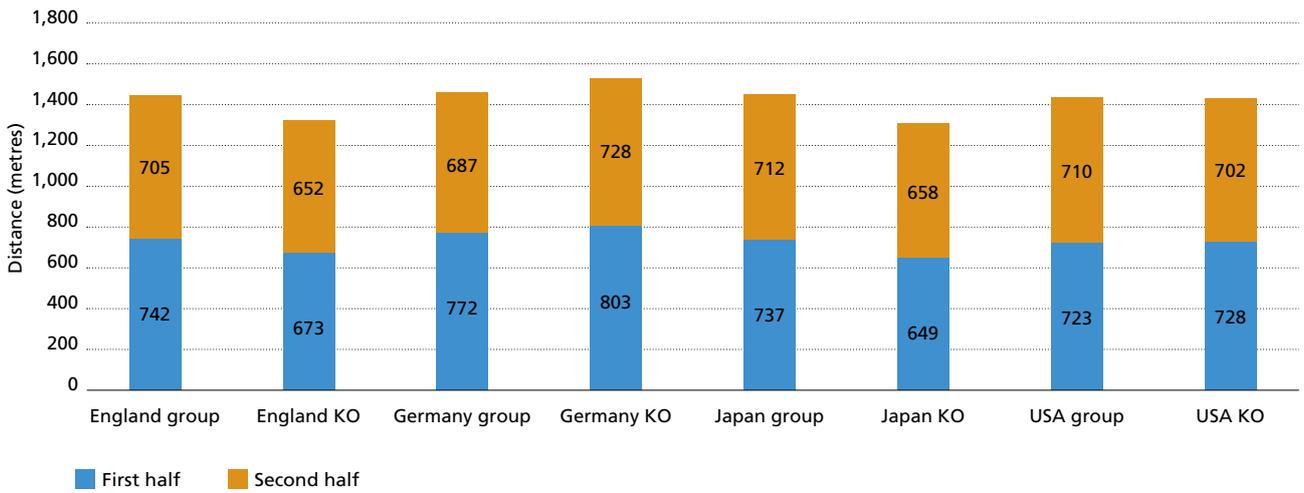


Figure 37: Comparison of the first- and second-half distance covered in >16km/h during the group stage and knockout rounds in a match by the final four teams

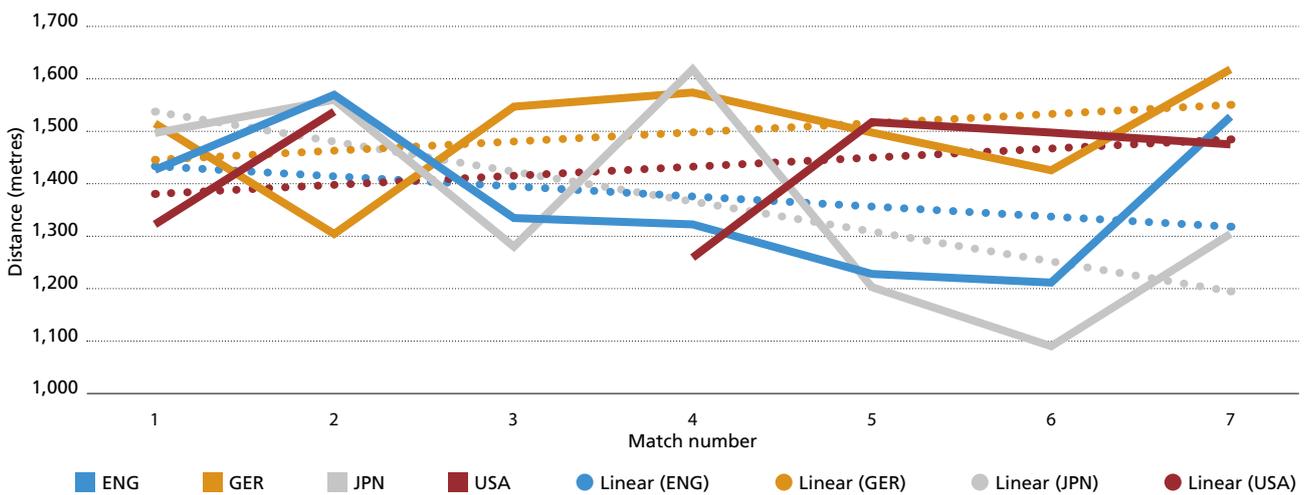


Figure 38: Comparison of the total distance covered >16km/h across each match by the final four teams



and prepared leading in to match 1 and hence have maximal capability to complete running >16km/h. For match performance following the first match, the fitness level of individual players, as well as recovered state, accumulated playing time, playing position and tactical formation employed by the team would have an impact on the ability to complete running >16km/h.

**Table 7** shows the amount of distance covered >16km/h, and then the subsequent change (%) for each match, along with the match outcome and number of team passes for each match. As can be seen, there appears to be no correlation in terms of the amount of distance covered >16km/h and match outcome, and there was a trivial correlation ( $r=0.09$ ) between distance >16km/h and number of team passes. JPN showed the largest decrease (27%) from the distance completed in match 1 to the semi-final against ENG, which they won. Additionally, during

match 5, JPN completed 20% less running >16km/h but completed 239 more team passes and won the match. When analysing player performance, a full review of the technical and physical parameters should be evaluated, as well as match outcome, to enable an accurate analysis and interpretation of match performance.

**Figure 39** shows a comparison of the distance covered >16km/h to the average number of team passes for each phase of the tournament. As highlighted previously, JPN had the highest number of passes during the group and KO stages (although this decreased by 8% during the KO), and the lowest overall distance >16km/h (again this decreased by 10% during the KO). ENG decreased the amount of running >16km/h (8%), as well as the number of passes (19%) from the group stage to the KO, while conversely USA maintained distance covered >16km/h (1,430m compared to

Team	Match 1	Match 2	Match 3	Match 4	Match 5	Match 6	Match 7
ENG	1,429m L, 296	+10% W, 372	-6% W, 438	-7% W, 362	-14% W, 220	-15% L, 289	+7% D, 329
GER	1,519m W, 477	-14% D, 427	+2% W, 591	+4% W, 437	-1% D, 509	-6% L, 431	+7% D, 505
JPN	1,501m W, 430	+4% W, 629	-15% W, 705	+8% W, 544	-20% W, 669	-27% W, 474	-13% L, 483
USA	1,326m W, 392	+16% D, 402	NA	-5% W, 395	+14% W, 462	+13% W, 364	+12% W, 346

Table 7: Change in distance covered >16km/h from match 1 for each team, including match outcome and number of passes

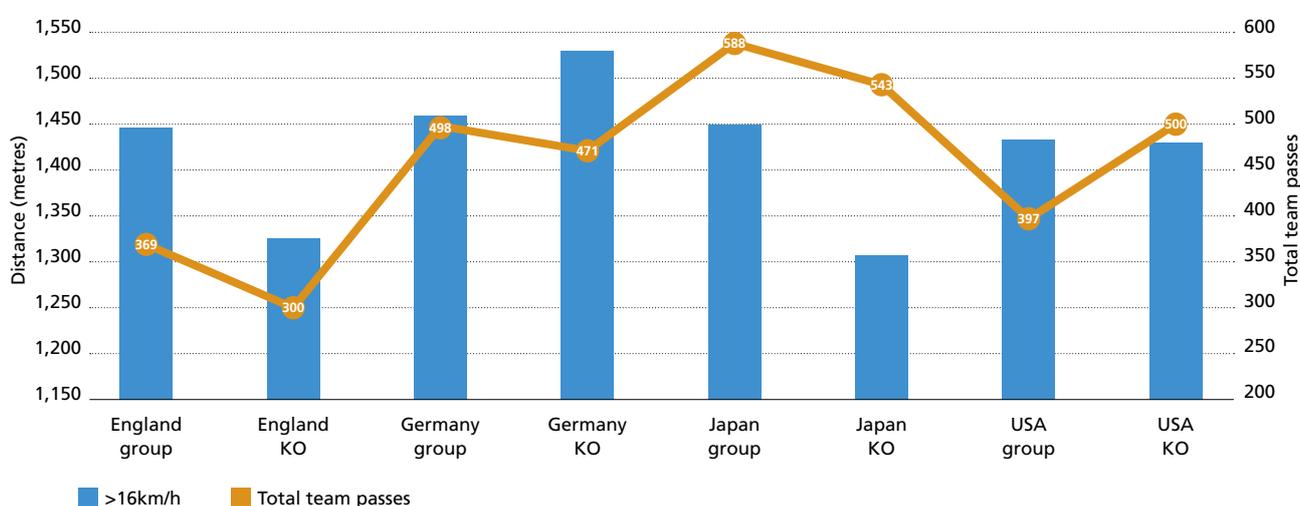


Figure 39: Comparison of the distance >16km/h correlated to the total number of team passes

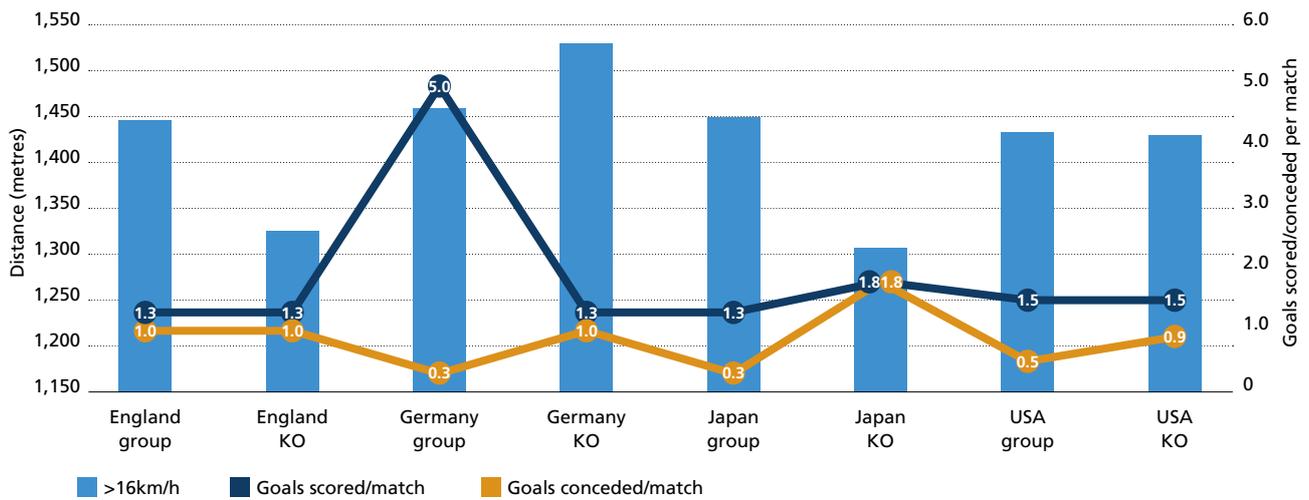


Figure 40: Comparison of the distances spent >16km/h correlated to average goals scored and conceded per match

1,433m during the group stage), whilst increasing the number of passes (26%). GER increased the distance >16km/h (5%), whilst decreasing the number of passes (5%) from the group to the KO stages. The level of opponent during the group stage compared to the KO rounds could impact upon these results, with GER arguably having an easier group and more ball possession and hence team passes during

the group stages. USA were reported in the media to have the “group of death”, and were able to maintain their running >16km/h from the group stage to the KO rounds, with a concurrent increase in number of team passes. This is further highlighted with the average number of goals scored and conceded during the group stage and KO rounds (Figure 40). During the group stage, GER scored



5 goals/match, whilst during the KO this decreased to 1.3 goals/match. Similarly, GER conceded 0.3 goals/match during the group matches and this increased to 1 goal/match during the KO. Both statistics suggest that the level of opposition for GER was much lower during the group matches, compared to the KO. ENG and USA both had similar goals scored and conceded per match for the group and KO stages, with USA conceding slightly more goals during the KO. JPN increased the number of goals scored per match from 1.3 to 1.8 during the KO, however they also conceded 1.5 more goals/match during the KO with 5 goals being scored against them during the final match of the tournament against USA.

**Figure 41** shows the change in distance covered >20km/h across all matches for each team. Trends showed that ENG and JPN tended to decrease how much they sprinted in these top two ST as the matches progressed. This could be due to tactical formation, a change in playing personnel and/or the accumulated fatigue of players. ENG slightly increased their running >20km/h from match 1 to match 2, and then progressively decreased the amount up to a final increase during match 7. GER and USA both showed a trend of increasing the distance covered >20km/h as the tournament progressed. This suggests optimal physical preparation and recovery, with the physical capacity to complete running in the highest speed thresholds.

GER covered the most distance >23km/h during the KO stages of the tournament (366m) and 13% more than they covered during the group-stage matches (**Figure 42**). Similarly, USA had an increase

(23m) from the group stage, amounting to 8%. ENG decreased the amount by 10%, whilst JPN had the biggest drop (63m) with an 18% reduction from the group stage to the KO rounds. ENG also decreased the amount of distance covered at 20-23km/h by 9% (19m), as did USA by 16% (32m). GER had a very similar amount in both the group stage and KO rounds, whilst JPN increased the distance covered at 20-23km/h by 9% (21m). There was no correlation between the number of shots on goal and distance covered at 20-23km/h or >23km/h. However, there was a small correlation ( $r=0.20$ ) between the number of corner kicks and distance covered at 20-23km/h, and a more moderate correlation ( $r=0.32$ ) between corner kicks and distance >23km/h.

#### Summary

- GER (1,530m) covered the most distance >16km/h, with a 5% increase from the group stage. Both ENG (8%) and JPN (10%) had large decreases in the amount of distance covered >16km/h from the group stage to the KO rounds. USA had a very negligible (3m) difference. This could imply that GER and USA were able to maintain their work rates across both stages of the tournament, compared to ENG and JPN. It could also suggest a change in tactical formation and hence physical load during matches.
- GER had the largest decreases in distance >16km/h from the first to the second half, with 11% (85m) and 9% (75m) during the group stage and KO rounds respectively. ENG had a 5% decrease during the group stage, whilst USA had a 4% decrease during the KO rounds. This could be linked to the accumulated fatigue of players, as well as to the tactical formation, and the stage of the match in terms of needing a goal to secure a result.

- Trends showed that ENG and JPN tended to decrease how much they sprinted in the top two ST as the matches progressed. This could be due to the tactical formation, a change in playing personnel and/or the accumulated fatigue of players. ENG slightly increased their running >20km/h from match 1 to match 2, and then progressively decreased the amount up to a final increase during match 7. GER and USA both showed a trend of increasing the distance covered >20km/h as the tournament progressed. This suggests optimal physical preparation and recovery, with the physical capacity to complete running in the highest speed thresholds.
- Generally, from this data, it appears that GER and USA were better able to maintain their running in the higher-speed thresholds, whilst ENG and JPN had larger drop-offs from the group stage to the KO phase of the 2015 tournament. However, some of the key technical measures (number of passes, ball possession and passing success) for JPN were higher than any of the other teams.
- When analysing player performance, a full review of the technical and physical parameters should be evaluated, as well as match outcome, to enable an accurate analysis and interpretation of match performance for individual players and subsequent teams.

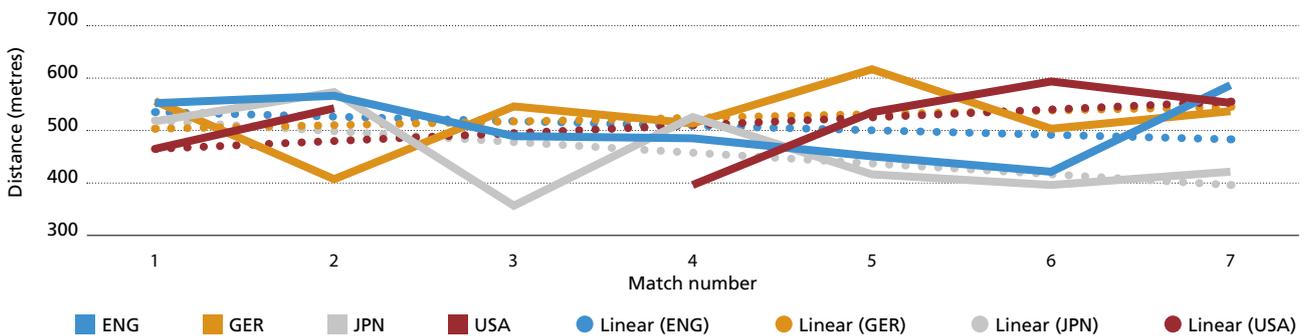


Figure 41: Comparison of the total distance covered >20km/h across each match by the final four teams

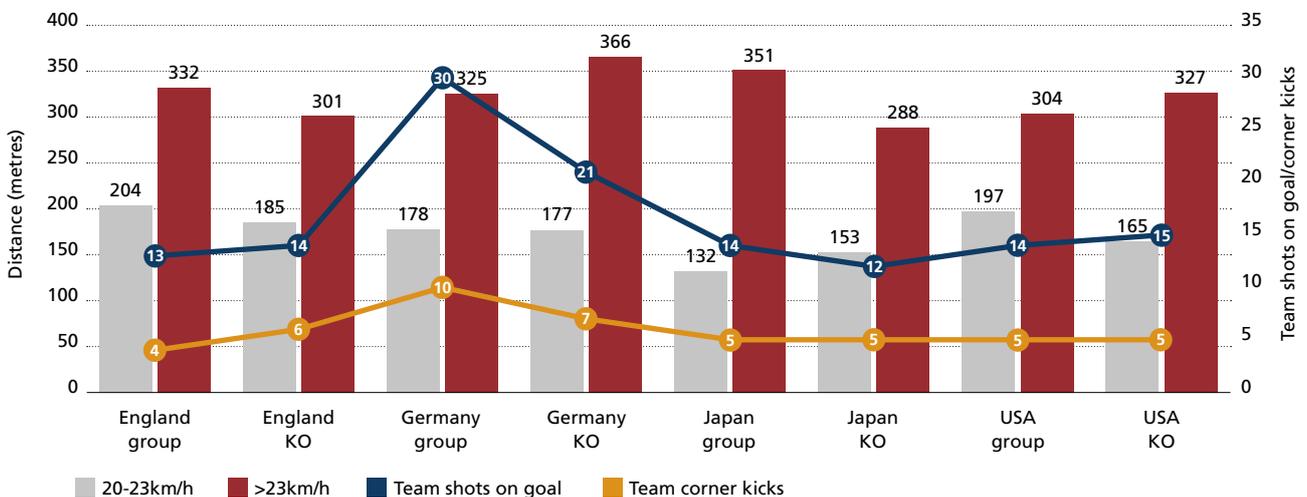


Figure 42: Comparison of the distances covered >20km/h plotted against average team shots on goal and corner kicks

## Positional and individual analyses

### Positional analyses

The positional analyses described in this section include the analysis of the following variables: players' age, body height, weight, and their physical performances during match-play. These analyses are an important part of this report because they helped to identify and highlight the most relevant differences among the various playing positions, which may be useful to derive specific training recommendations that correspond more objectively to the physical match demands of each one of them.

The playing positions were classified as goalkeepers (GK) and outfield players (OP) including central defenders (CD), full-backs (FB), central midfielders (CM), wide midfielders/wingers (WM), and forwards (FW).

### Age, body height and weight

The positional analysis of age, body height and weight (mean±SD) of the players who recorded official playing time during at least one match of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ is summarised in **Table 8** and **9**, respectively. The GK were significantly the oldest, tallest and heaviest players compared to all the other playing positions in both competitions. The CD were the tallest and heaviest players from the

Playing position	Number of players (n)	Age (years)	Height (cm)	Weight (kg)
GK	33	28.9±4.3	173.6±4.9	67±5.2
OP	405	25.7±3.9	166.4±6.6	59.8±6.1
All players (range)	438	25.9±4 (16.6-40)	167±6.7 (140-187)	60.3±6.3 (45-82)
CD	66	26.5±4	170.5±5.1	62.8±5.8
FB	72	25.3±3.7	165.3±5.9	59±6.1
CM	112	25.2±4.1	166±6.6	59.7±5.9
WM	95	25.4±3.7	164.7±6.6	57.9±6.1
FW	60	26.5±3.9	166.9±6.9	60.6±5.8

Table 8: Positional analysis of age, body height and weight of the players who recorded official playing time during at least one match of the FIFA Women's World Cup Canada 2015™

Playing position	Number of players (n)	Age (years)	Height (cm)	Weight (kg)
GK	20	28.1±5	172.7±4	67.3±4.4
OP	263	24.6±4.3	167.4±6.4	61.4±5.9
All players (range)	283	24.9±4.4 (16.4-38.3)	167.8±6.4 (152-187)	61.8±6 (50-82)
CD	39	25.9±3.9	171.5±5.4	64.2±4.8
FB	46	25.1±3.5	167.4±5	60.2±5.3
CM	70	24.7±4.7	166.6±6.7	61±5.8
WM	59	23.8±4.4	165.2±5.8	60±5.5
FW	49	24±4.4	168.1±7	62.6±6.8

Table 9: Positional analysis of age, body height and weight of the players who recorded official playing time during at least one match of the FIFA Women's World Cup Germany 2011™

outfield playing positions followed by the FW, CM, FB and WM in both tournaments. The average age of all participating players was higher but their average body weight was lower in 2015 compared to 2011. No significant differences were identified between the two competitions in the average body height of all participating players.

**Important note:** the players' age, body height and weight information was submitted to the FIFA general secretariat by each participating team according to article 25 of the official tournament regulations. Thus, these values were not measured directly for the purpose of this report. The playing position recorded for each player for the positional analysis of players' age, body height and weight corresponded to the main positional role that each of them had in the most relevant match played with their team during each tournament (e.g. first group match for the eliminated teams after the group phase or the last knockout match for the remaining teams).

### Physical performance parameters

Only the data of the players who completed entire regular-time matches during the FIFA Women's World Cup Canada 2015™ and Germany 2011™ were included for the positional analyses of physical performance parameters. The playing position recorded for each player for these analyses corresponded to the main positional role that each of them had during each match.

#### Total distance

The average total distance covered by playing position during all regular-time matches of both the FIFA Women's World Cup Canada 2015™ and Germany 2011™ is summarised in **Figure 43**. The GK covered significantly less average total distance compared to all other positional roles in both competitions. The CD covered overall the lowest and the CM the largest average total distance compared to the other outfield players in both tournaments. In 2015, the range of total distance values for the GK and OP were 3,458-7,554m and

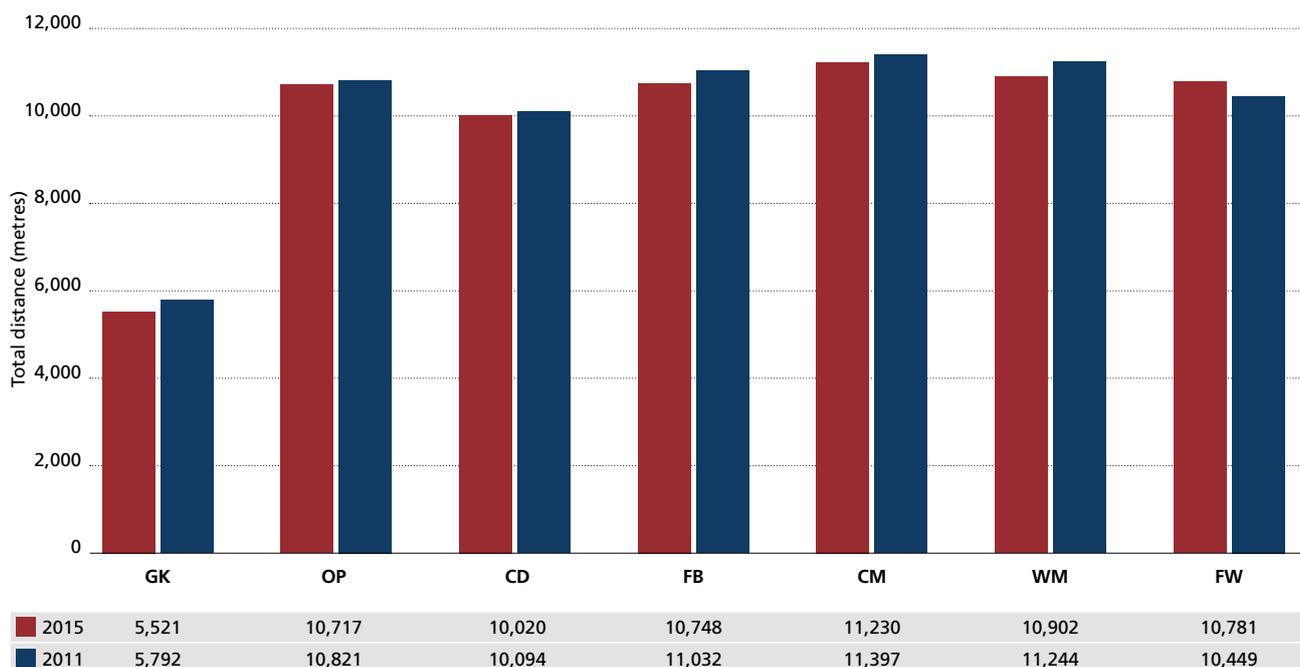


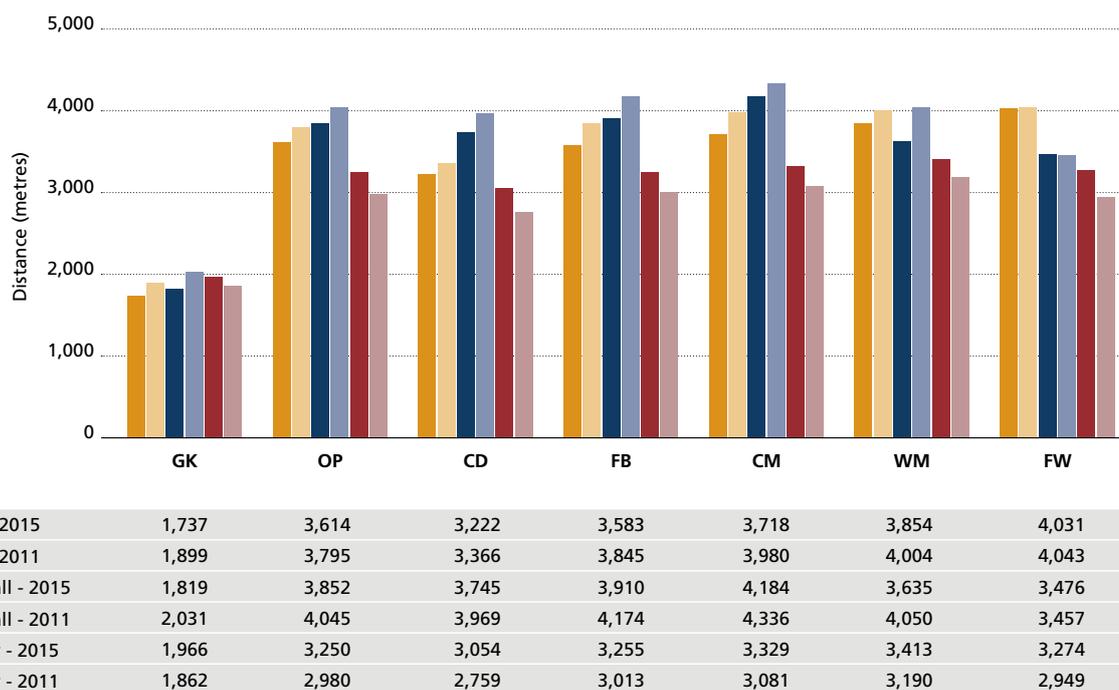
Figure 43: Average total distance covered by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

8,074-12,878m, respectively. In 2011, these values corresponded to 3,588-7,659m for the GK and 8,049-13,877m for the OP. The lowest values of the OP were recorded by a CD in both years and the highest values by a CM in 2015 and a WM in 2011. When comparing the average total distances covered by playing position in each World Cup, significant differences were found between the FB, WM, and FW. On average, the FB and WM ran significantly less distance but the FW more distance in 2015 compared to 2011.

*Distance covered with and without the ball*

The average distance covered with the ball (own team in possession of the ball) and without the ball (own team not in possession of the ball) by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ is illustrated in **Figure 44**. On average, the GK/OP covered approximately 32%/34% of their

corresponding total distance with the ball, 34%/37% without the ball, and 34%/29% when the ball was out of play during both competitions, respectively. In terms of average distance covered with the ball in both years, the GK covered significantly the lowest distance compared to all the other playing positions. From the outfield players, the CD registered the shortest distance, the FW and WM the longest distance in 2015, and the FW, WM and CM the longest distance in 2011. In regard to the distance covered without the ball in each tournament, the GK registered the lowest values compared to all the other playing positions. From the outfield players, the FW and WM logged the lowest values in 2015 and the FW the lowest values in 2011, and the CM the highest values in both tournaments. When the ball was out of play, the lowest average distance was covered by the GK followed by the CD, who registered the lowest average value from the outfield players. The WM covered the



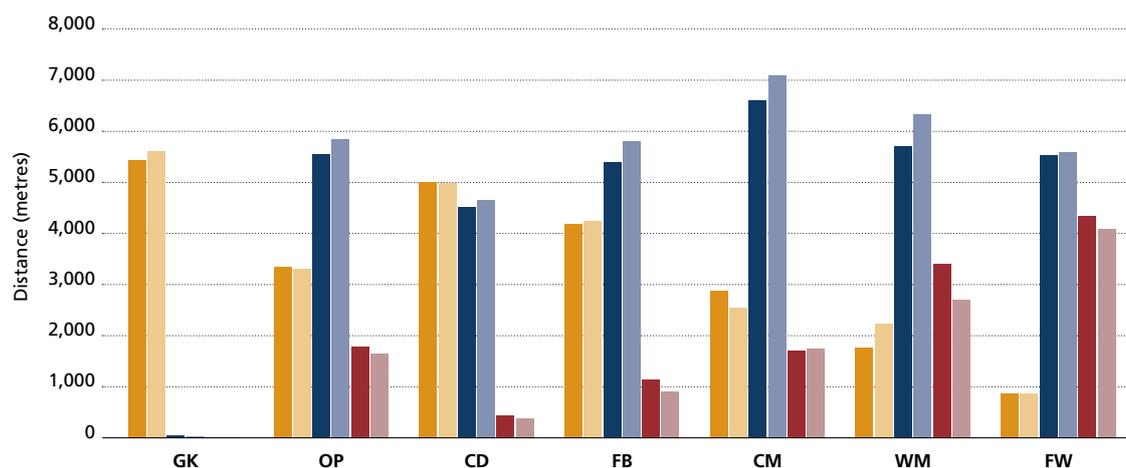
**Figure 44:** Average distance covered with and without the ball by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

largest average distance when the ball was out of play in both tournaments. Overall, most average distances covered with and without the ball for the various playing positions were lower in 2015 compared to 2011; whereas it was the opposite for the average distances covered when the ball was out of play (higher values were registered in 2015 than in 2011). This latter finding might be related to the fact that the ball was out of play for longer in 2015 compared to 2011, causing a significant decrease in average effective playing time (~a 3-minute difference).

#### Distance covered in each third of the pitch

Figure 45 shows the results of average distance covered in each third of the pitch by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™. On average during both World Cup years, the GK registered 99% of their total distance in the defensive third, 1% in the middle

third, and 0% in the attacking third. On the other hand, the same parameters for the OP corresponded to 31%, 53%, and 16%, respectively. In the defensive third, the CD (50% of total distance) covered on average the largest distance followed by the FB (39%), CM (24%), WM (18%), and FW (8%). In the middle third, the CM (61%) registered the longest distance followed by the WM (54%), FW (52%), FB (51%), and CD (47%). In the attacking third, the FW (40%) led the way followed by the WM (28%), CM (15%), FB (9%), and CD (4%). Significant differences among all the playing positions were identified within each tournament and each third of the pitch. However, when comparing the results between the two World Cup years, only the following significant differences were recognised: in the defensive third for CM (2015>2011) and WM (2015<2011); in the middle third for OP, FB, CM, and WM (2015<2011); and in the attacking third for FB and WM (2015>2011). The fact



Defensive third - 2015	5,430	3,346	5,001	4,185	2,882	1,773	874
Defensive third - 2011	5,607	3,306	4,982	4,255	2,552	2,230	866
Middle third - 2015	49	5,552	4,516	5,401	6,616	5,713	5,527
Middle third - 2011	37	5,848	4,655	5,807	7,095	6,339	5,594
Attacking third - 2015	1	1,784	441	1,138	1,704	3,401	4,344
Attacking third - 2011	1	1,654	378	917	1,753	2,709	4,088

Figure 45: Average distance covered in each third of the pitch by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

that the CM spent significantly longer in the defensive third in 2015 than in 2011 might indicate that these players had a more defensive role in 2015. This was compensated by the FB and WM, who logged more distance in the attacking third in 2015 compared to 2011, perhaps indicating a higher participation in their team's attacks in 2015.

#### *Distance covered at the various speed thresholds*

The average distance covered by playing position at the various speed thresholds during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ is summarised in **Figure 46**. Approximately 94%, 5%, 1% and 0% of the total distance covered by the GK during both World Cup years was registered at 0-12, 12-16, 16-20, and >20km/h, respectively. For the OP, these figures corresponded on average to 70% at 0-12km/h, 18% at 12-16km/h, 8% at 16-20km/h, and 4% at >20km/h. We found significant differences within and between each World Cup year for the GK and OP and also among the various outfield player positions at all speed thresholds. The most relevant significant differences are listed below.

Within each World Cup year (only listed when the same difference was identified in both competitions unless otherwise indicated):

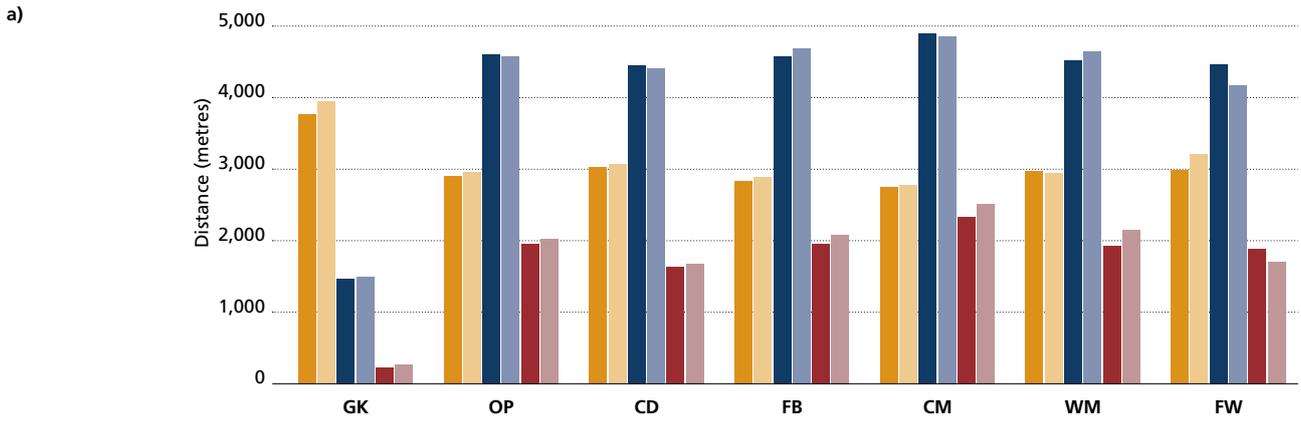
- The GK covered the largest distance and the CM the shortest distance at 0-6km/h compared to all the other playing positions (**Figure 46a**). At the speed thresholds of 6-12km/h and 12-16km/h, the GK registered the lowest

distance and the CM the largest distance compared to all the other positions (**Figure 46a**).

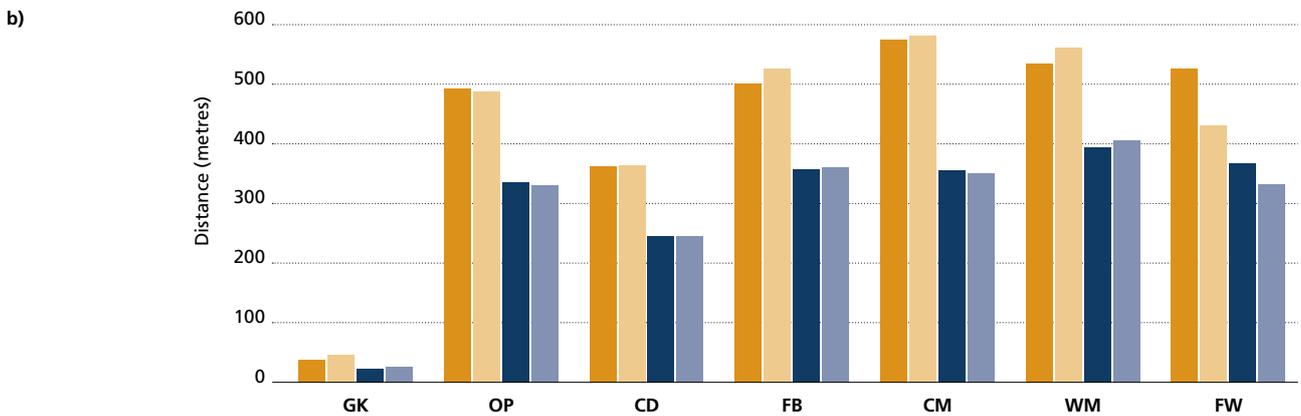
- The GK logged the shortest distance and the CM the longest distance at 16-18km/h compared to all the other playing positions (**Figure 46b**). At 18-20km/h, the GK recorded the lowest distance and the WM the largest distance compared to all the other positions (**Figure 46b**).
- The GK ran the shortest distance and the WM and FW the longest distance at 20-23km/h compared to all the other playing positions (**Figure 46c**). At >23km/h, the GK recorded the lowest distance and the WM, FW, and FB the largest distance compared to the other positional roles (**Figure 46c**).

Between each World Cup year:

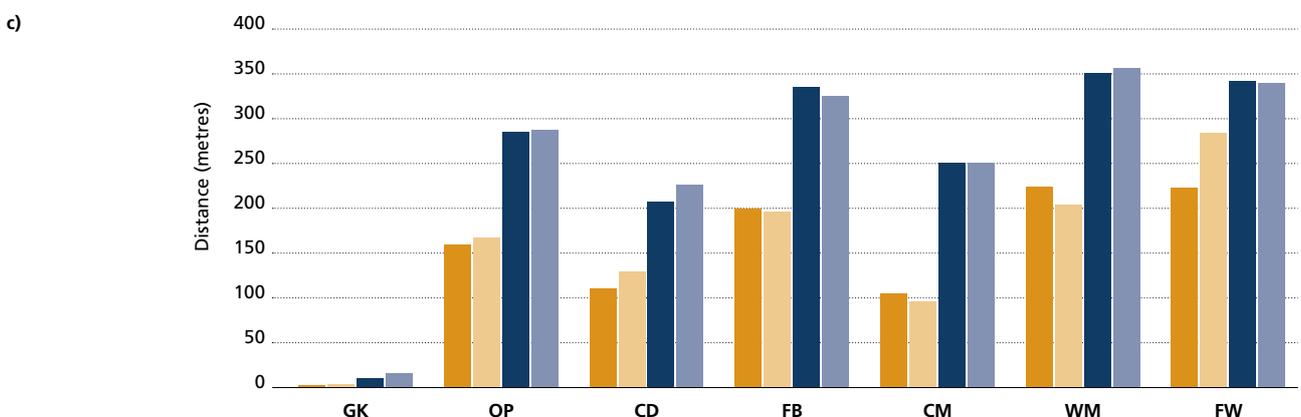
- At 0-6km/h, significant differences were identified for the GK, OP, and FW (2015<2011). At 6-12km/h, significant differences were found for the FW (2015>2011). At 12-16km/h, the distance values of OP, FB, CM, and WM were lower in 2015 than in 2011 but the values of the FW were higher in 2015 compared to 2011 (**Figure 46a**).
- At 16-18km/h, the FW had higher values in 2015 compared to 2011. At 18-20km/h, there were no significant differences (**Figure 46b**).
- At 20-23km/h, the CD and FW logged lower distance values in 2015 than in 2011. At >23km/h, the CD also ran less distance in 2015 than in 2011 (**Figure 46c**).
- Although most positional differences were lower in 2015 compared to 2011, the FW recorded higher distance at 6-12, 12-16, and 16-18km/h in 2015 than in 2011, supporting the fact that the FW were also the only positional group that registered higher overall total distance in 2015 than in 2011.



0-6km/h - 2015	3,757	2,891	3,016	2,835	2,740	2,964	2,979
0-6km/h - 2011	3,943	2,955	3,066	2,878	2,772	2,935	3,200
6-12km/h - 2015	1,465	4,599	4,448	4,569	4,885	4,507	4,456
6-12km/h - 2011	1,491	4,568	4,397	4,674	4,845	4,641	4,159
12-16km/h - 2015	226	1,956	1,632	1,951	2,321	1,929	1,889
12-16km/h - 2011	265	2,026	1,670	2,073	2,504	2,141	1,704



16-18km/h - 2015	37	492	362	500	574	534	525
16-18km/h - 2011	46	487	363	525	580	560	429
18-20km/h - 2015	22	334	245	356	354	393	366
18-20km/h - 2011	26	330	244	360	349	405	332



20-23km/h - 2015	3	160	111	200	105	224	223
20-23km/h - 2011	4	167	130	196	96	204	284
>23km/h - 2015	11	285	207	336	251	351	342
>23km/h - 2011	16	288	226	326	251	357	340

Figure 46: Average distance covered by playing position at the various speed thresholds during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

### *Detailed analysis of runs at the various speed thresholds*

The results of a detailed analysis of runs including the no. of runs, average distance of runs and recovery time between runs at the various speed thresholds during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ are summarised in **Tables 10, 11, and 12**. These findings provide further reference to aid in the development of more specific physical training programmes for each playing position based on the physical match-play demands of each one of them. We found significant differences within and between each World Cup year for the various playing positions and speed thresholds. The most relevant significant differences are listed below.

Within each World Cup year (only listed when the same differences were identified in both competitions unless otherwise indicated):

- The GK recorded higher values than the other playing positions only in the variables of average distance of runs at 0-6km/h and recovery time between runs at 6-12km/h and 12-16km/h. All other values attained by the GK were the lowest compared to the other playing positions. The CD logged the lowest no. of runs at 12-16km/h and CM the highest no. of runs at 6-12km/h and 12-16km/h. No relevant differences were identified among the outfield players in average distance of runs and recovery time between runs at these speed thresholds (**Table 10**).
- The GK obtained the lowest values in all variables at the speed thresholds of 16-18km/h and 18-20km/h, except for recovery time between runs at 16-18km/h, where the GK registered higher recovery times compared to the other playing positions. In the no. of runs, the CD recorded the lowest values both at 16-18km/h and 18-20km/h. The CM logged the highest no. of runs at 16-18km/h and the WM at 18-20km/h. In recovery time between runs, the CD enjoyed the longest values at both speed thresholds. No relevant differences

among the outfield players were found in the average distance of runs at these speed thresholds. (**Table 11**).

- The GK also registered the lowest values in all variables at the speed thresholds of 20-23km/h and >23km/h. The recovery time between runs at these speeds for the GK could not be calculated because less than two runs were recorded. In no. of runs, the CD and CM registered the lowest values at 20-23km/h and the CD also attained the lowest values at >23km/h; the FW had the highest number of runs at 20-23km/h but only in 2011 and the FB, WM and FW recorded the highest number of runs at >23km/h. In average distance of runs, the CM logged the lowest values and the FW the highest values at 20-23km/h but only in 2011; the FB, WM and FW achieved the highest values at >23km/h. In recovery time between runs, the CM and FW had the shortest values at 20-23km/h; the FB, WM and FW showed the shortest values and the CD the longest values at >23km/h compared to the other outfield playing positions (**Table 12**).

Between each World Cup year:

- At 0-6km/h, significant differences were noticed in the no. of runs for the CD (2015>2011) and in the average distance of runs for the OP (2015<2011). At 6-12km/h, significant differences in the no. of runs were identified for the OP, FB, WM (2015<2011), and FW (2015>2011). At 12-16km/h, significant differences in the no. of runs were recognised for the OP, FB, CM, WM (2015<2011) and FW (2015>2011); in recovery time between runs for the FB (2015>2011). No relevant practical differences were found in the average distance of runs at 6-12km/h and 12-16km/h (**Table 10**).
- At 16-18km/h, there were significant differences only for the FW (2015>2011) in the no. of runs, the average distance of runs (2015>2011), and recovery time between runs (2015<2011). At 18-20 km/h, the only significant difference corresponded to the FW in the no. of runs (2015>2011) (**Table 11**).

	GK	OP	CD	FB	CM	WM	FW
No. of runs at 0-6km/h - 2015	227	396	402	389	398	394	396
No. of runs at 0-6km/h - 2011	223	393	392	395	394	397	386
Average distance of runs at 0-6km/h (m) - 2015	20	7	8	7	7	8	8
Average distance of runs at 0-6km/h (m) - 2011	21	8	8	7	7	8	8
Recovery time between runs at 0-6km/h (min:sec) - 2015	0:03	0:07	0:06	0:07	0:07	0:07	0:07
Recovery time between runs at 0-6km/h (min:sec) - 2011	0:03	0:07	0:06	0:07	0:07	0:07	0:06
No. of runs at 6-12km/h - 2015	233	509	498	501	533	498	505
No. of runs at 6-12km/h - 2011	232	515	498	522	541	524	482
Average distance of runs at 6-12km/h (m) - 2015	6	9	9	9	9	9	9
Average distance of runs at 6-12km/h (m) - 2011	6	9	9	9	9	9	9
Recovery time between runs at 6-12km/h (min:sec) - 2015	0:28	0:08	0:08	0:08	0:07	0:08	0:08
Recovery time between runs at 6-12km/h (min:sec) - 2011	0:26	0:07	0:08	0:07	0:07	0:08	0:08
No. of runs at 12-16km/h - 2015	28	196	171	194	226	192	193
No. of runs at 12-16km/h - 2011	33	201	174	206	237	212	175
Average distance of runs at 12-16km/h (m) - 2015	8	10	10	10	10	10	10
Average distance of runs at 12-16km/h (m) - 2011	8	10	10	10	10	10	10
Recovery time between runs at 12-16km/h (min:sec) - 2015	4:43	0:29	0:33	0:29	0:24	0:30	0:29
Recovery time between runs at 12-16km/h (min:sec) - 2011	4:17	0:28	0:32	0:26	0:23	0:28	0:31

Table 10: Detailed analysis of runs registered at 0-6km/h, 6-12km/h and 12-16km/h during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	GK	OP	CD	FB	CM	WM	FW
No. of runs at 16-18km/h - 2015	4	51	38	52	60	54	55
No. of runs at 16-18km/h - 2011	5	51	39	54	59	57	46
Average distance of runs at 16-18km/h (m) - 2015	4	10	9	10	10	10	10
Average distance of runs at 16-18km/h (m) - 2011	5	10	9	10	10	10	9
Recovery time between runs at 16-18km/h (min:sec) - 2015	6:01	2:20	3:05	2:18	1:54	2:10	1:58
Recovery time between runs at 16-18km/h (min:sec)- 2011	5:32	2:21	3:03	2:06	1:55	2:08	2:21
No. of runs at 18-20km/h - 2015	2	30	22	32	32	35	33
No. of runs at 18-20km/h - 2011	2	29	22	32	31	36	30
Average distance of runs at 18-20km/h (m) - 2015	3	11	11	11	11	11	11
Average distance of runs at 18-20km/h (m) - 2011	3	11	11	11	11	11	11
Recovery time between runs at 18-20km/h (min:sec) - 2015	3:41	4:16	5:29	3:58	3:54	3:43	3:48
Recovery time between runs at 18-20km/h (min:sec) - 2011	3:41	4:16	5:18	3:55	4:05	3:29	3:55

Table 11: Detailed analysis of runs registered at 16-18km/h and 18-20km/h during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

- At 20-23km/h, there were significant differences only for the CD and FW in the no. of runs (2015<2011) and for the FW in the average distance of runs (2015<2011). At >23km/h, no relevant differences were observed (Table 12).

#### Average speed and average maximum speed

The average speed and average maximum speed achieved by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™

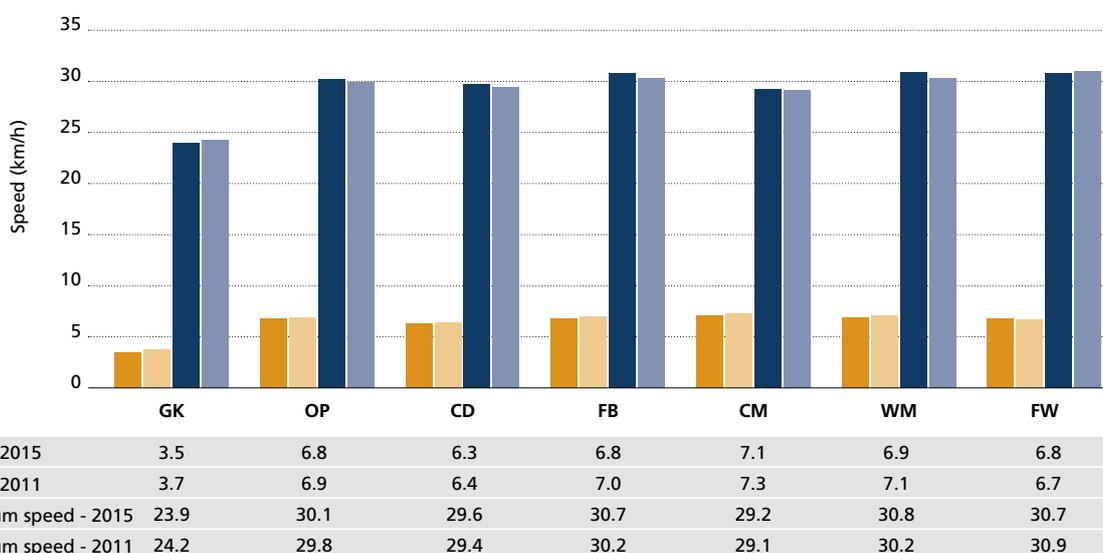


Figure 47: Average speed and average maximum speed attained by playing position during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	GK	OP	CD	FB	CM	WM	FW
No. of runs at 20-23km/h - 2015	0.2	8	6	10	6	11	11
No. of runs at 20-23km/h - 2011	0.3	9	7	10	5	11	14
Average distance of runs at 20-23km/h (m) - 2015	1	13	11	16	10	17	16
Average distance of runs at 20-23km/h (m) - 2011	1	14	13	16	10	15	18
Recovery time between runs at 20-23km/h (min:sec) - 2015	N/A	7:19	7:17	7:49	6:40	7:41	7:18
Recovery time between runs at 20-23km/h (min:sec) - 2011	N/A	7:15	7:15	7:44	6:54	7:33	6:43
No. of runs at >23km/h - 2015	1	20	15	24	18	25	25
No. of runs at >23km/h - 2011	1	20	16	23	18	25	25
Average distance of runs at >23km/h (m) - 2015	2	13	13	14	13	14	14
Average distance of runs at >23km/h (m) - 2011	2	13	13	14	13	14	14
Recovery time between runs at >23km/h (min:sec) - 2015	N/A	5:52	7:07	5:03	6:12	5:14	4:49
Recovery time between runs at >23km/h (min:sec) - 2011	N/A	5:44	6:41	5:20	5:55	5:06	4:46

Table 12: Detailed analysis of runs registered at 20-23km/h and >23km/h during all regular-time matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

and Germany 2011™ is presented in **Figure 47**. Within each World Cup year, the GK attained significantly the lowest values in both average speed and average maximum speed compared to the other playing positions in both years; from the outfield players, the CD registered the lowest average speed and the CM logged the highest average speed values in both competitions; the CM and CD achieved the lowest average maximum speed

values and the FW, WM, and FB higher values than the other outfield players in both tournaments. Between the two World Cup years, there were significant differences for all playing positions in average speed, except for the CD and FW. These significant differences were lower in 2015 than in 2011. For average maximum speed, significant differences were identified only for the OP and FB (2015>2011).



### Individual analyses

The average physical performances of the FIFA All-Star players and FIFA Official Award winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ are described next. Only the physical data of the players who played entire matches during regular time were considered for this analysis. Detailed lists of the FIFA All-Star players and FIFA Official Award

winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ are shown in **Tables 13** and **14**, respectively. These tables provide the players' full name as well as their country and jersey number inside parentheses. Further information about these lists and awards can be found in the official technical report of each tournament (FIFA, 2011, 2015).

FIFA Women's World Cup 2015™		FIFA Women's World Cup 2011™	
All-Star goalkeepers	All-Star outfield players	All-Star goalkeepers	All-Star outfield players
Nadine Angerer (GER, 1)	<b>Central defenders</b>	Ayumi Kaihori (JPN, 21)	<b>Central defenders</b>
Karen Bardsley (ENG, 1)	Kadeisha Buchanan (CAN, 3)	Hope Solo (USA, 1)	Saskia Bartusiak (GER, 3)
Hope Solo (USA, 1)	Steph Houghton (ENG, 5)		Erika (BRA, 13)*
	Julie Johnston (USA, 19)		Laura Georges (FRA, 4)
	Wendie Renard (FRA, 2)		<b>Full-backs</b>
	<b>Full-backs</b>		Sonia Bompastor (FRA, 8)
	Saori Ariyoshi (JPN, 19)		Elise Kellond-Knight (AUS, 8)
	Lucy Bronze (ENG, 12)*		Alex Scott (ENG, 2)
	Meghan Klingenberg (USA, 22)		<b>Central midfielders</b>
	<b>Central midfielders</b>		Shannon Boxx (USA, 7)
	Amandine Henry (FRA, 6)		Louisa Necib (FRA, 14)*
	Elise Kellond-Knight (AUS, 8)		Homare Sawa (JPN, 10)
	Anja Mittag (GER, 11)*		Jill Scott (ENG, 4)
	Rumi Utsugi (JPN, 13)*		Caroline Seger (SWE, 5)
	Mizuho Sakaguchi (JPN, 6)		<b>Wide midfielders/wingers</b>
	<b>Wide midfielders/wingers</b>		Lauren Cheney (USA, 12)*
	Aya Miyama, (JPN, 8)*		Kerstin Garefrekes (GER, 18)
	Megan Rapinoe (USA, 15)		Aya Miyama, (JPN, 8)
	Elodie Thomis (FRA, 12)		Shinobu Ohno (JPN, 11)
	<b>Forwards</b>		<b>Forwards</b>
	Ramona Bachmann (SUI, 10)*		Anonman (EQG, 10)*
	Lisa De Vanna (AUS, 11)*		Marta (BRA, 10)*
	Eugénie Le Sommer (FRA, 9)		Lotta Schelin (SWE, 8)
	Carli Lloyd (USA, 10)*		Abby Wambach (USA, 20)
	Celia Šašić (GER, 13)		

**Table 13: List of FIFA All-Star players of the FIFA Women's World Cup Canada 2015™ and Germany 2011™**

Note: \* indicates the players who played in more than one position during each tournament. In 2015, Bronze also played as WM, De Vanna as CM and WM, Lloyd and Miyama as CM, Mittag as FW, and Utsugi as FB. In 2011, Anonman also played as WM, Cheney as FW, Erika as CM, Marta and Necib as WM.

### Analysis of FIFA All-Star players

The overall analysis of the physical performances of the All-Star players classified by goalkeepers and outfield players during the FIFA Women's World Cup Canada 2015™ and Germany 2011™ is shown in **Table 15**. The All-Star goalkeepers covered significantly shorter distance values than the All-Star outfield players during both competitions. When comparing the results between the two World Cup years, significantly lower values were only found in distance covered at 18-20km/h for the All-Star goalkeepers (2015<2011). For the All-Star outfield players, there were significantly lower values in total distance and distance covered at 18-20km/h and >23km/h (2015<2011).

The average total distances covered by all the non-All-Star goalkeepers and

outfield players who played entire regular-time matches during the FIFA Women's World Cup Canada 2015™ were 5,359m and 10,687m, respectively. For the FIFA Women's World Cup Germany 2011™, these numbers corresponded to 5,718m and 10,747m. Thus, the FIFA All-Star players covered approximately 2-15% more total distance than their non-All-Star counterparts. In terms of the distances covered at >16km/h and >20km/h, the FIFA All-Star outfield players ran on average 5% more distance in 2015 and 22-24% more distance in 2011 at these speeds than the non-All-Star outfield players.

A detailed analysis of speed variables and runs >16km/h also showed that the results of the All-Star goalkeepers were significantly lower than those of the All-Star outfield players, except for the

FIFA Official Award	FIFA Women's World Cup 2015™	FIFA Women's World Cup 2011™
adidas Golden Glove	1. Hope Solo (USA, 1)	1. Hope Solo (USA, 1)
adidas Golden Ball	1. Carli Lloyd (USA, 10)	1. Homare Sawa (JPN, 10)
adidas Silver Ball	2. Amandine Henry (FRA, 6)	2. Abby Wambach (USA, 20)
adidas Bronze Ball	3. Aya Miyama, (JPN, 8)	3. Hope Solo (USA, 1)
adidas Golden Boot	1. Celia Šašić (GER, 13)	1. Homare Sawa (JPN, 10)
adidas Silver Boot	2. Carli Lloyd (USA, 10)	2. Marta (BRA, 10)
adidas Bronze Boot	3. Anja Mittag (GER, 11)	3. Abby Wambach (USA, 20)
Hyundai Young Player Award	1. Kadeisha Buchanan (CAN, 3)	1. Caitlin Foord (AUS, 9)

Table 14: List of FIFA Official Award winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	FIFA Women's World Cup 2015™		FIFA Women's World Cup 2011™	
	All-Star goalkeepers	All-Star outfield players	All-Star goalkeepers	All-Star outfield players
Total distance (m)	6,171	10,936	6,154	11,203
Distance covered at <16km/h (m)	6,102	9,605	6,055	9,709
Distance covered at 16-18km/h (m)	37	515	48	559
Distance covered at 18-20km/h (m)	17	352	35	392
Distance covered at 20-23km/h (m)	2	168	4	205
Distance covered at >23km/h (m)	13	296	12	339

Table 15: Average distance covered by the All-Star goalkeepers and outfield players at the FIFA Women's World Cup Canada 2015™ and Germany 2011™

recovery time at 16-18km/h where higher values were noted (Table 16). When comparing the results between the two World Cup years, significant differences were identified for the All-Star goalkeepers only in the no. of runs and average distance of runs at 18-20km/h (2015<2011). For the All-Star outfield players, significant differences were found only in the average distance of runs at 20-23km/h and >23km/h (2015<2011). Approximately 2-15% higher values in average speed were noticed between the All-Star players and their non-All-Star counterparts. Furthermore, most physical performance values of the FIFA All-Star players were superior to the overall positional averages of all the participating players completing entire matches.

#### Analysis of FIFA Official Award winners

The tables 17-20 show a summary of selected physical performance variables of the FIFA Official Award winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ including the adidas Golden Glove, adidas Golden Ball, adidas Golden Boot, and Hyundai Young Player Award. For the adidas Golden Ball and adidas Golden Boot awards, only the players obtaining the 1<sup>st</sup> place were included in this analysis. All of these world-class players demonstrated not only outstanding technical, tactical and mental ability throughout both tournaments but also impressive physical performances that were for the most part above the corresponding averages of

	FIFA Women's World Cup 2015™		FIFA Women's World Cup 2011™	
	All-Star goalkeepers	All-Star outfield players	All-Star goalkeepers	All-Star outfield players
Average speed (km/h)	3.9	6.9	3.9	7.1
Average maximum speed (km/h)	23.5	30.1	24.4	30.2
No. of runs at 16-18km/h	4	53	5	58
Average distance of runs at 16-18km/h (m)	4	10	5	10
Recovery time between runs at 16-18km/h (min:sec)	6:00	2:18	5:24	2:18
No. of runs at 18-20km/h	2	31	3	34
Average distance of runs at 18-20km/h (m)	2	11	4	11
Recovery time between runs at 18-20km/h (min:sec)	3:12	4:03	4:18	3:36
No. of runs at 20-23km/h	0.1	9	0.2	10
Average distance of runs at 20-23km/h (m)	0.3	13	0.6	15
Recovery time between runs at 20-23km/h (min:sec)	N/A	6:53	0:30	6:42
No. of runs at >23km/h	1	21	1	24
Average distance of runs at >23km/h (m)	2	13	2	14
Recovery time between runs at >23km/h (min:sec)	N/A	5:29	1:42	5:18

Table 16: Detailed analysis of speed variables and >16km/h runs of the All-Star goalkeepers and outfield players at the FIFA Women's World Cup Canada 2015™ and Germany 2011™

Note: the recovery time between runs at 20-23km/h and >23km/h for the All-Star goalkeepers could not be calculated because less than two runs were recorded.

	FIFA Women's World Cup 2015™	FIFA Women's World Cup 2011™
adidas Golden Glove (1 <sup>st</sup> place)	Hope Solo (USA, 1)	Hope Solo (USA, 1)
Main playing position	GK	GK
Total distance (m)	5,417	6,419
Distance covered at 16-20km/h (m)	46	105
Distance covered at >20km/h (m)	12	16
Average speed (km/h)	3.4	4.1
Average maximum speed (km/h)	22.8	24.8

Table 17: Physical performance variables of the adidas Golden Glove winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	FIFA Women's World Cup 2015™	FIFA Women's World Cup 2011™
adidas Golden Ball (1 <sup>st</sup> place)	Carli Lloyd (USA, 10)	Homare Sawa (JPN, 10)
Main playing position	CM/FW	CM
Total distance (m)	11,685	11,677
Distance covered at 16-20km/h (m)	1,214	919
Distance covered at >20km/h (m)	429	339
Average speed (km/h)	7.4	7.4
Average maximum speed (km/h)	30.1	29.3

Table 18: Physical performance variables of the adidas Golden Ball winners (1st place) of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	FIFA Women's World Cup 2015™	FIFA Women's World Cup 2011™
adidas Golden Boot (1 <sup>st</sup> place)	Celia Šašić (GER, 13)	Homare Sawa (JPN, 10)
Main playing position	FW	CM
Total distance (m)	11,995	11,677
Distance covered at 16-20km/h (m)	1,088	919
Distance covered at >20km/h (m)	715	339
Average speed (km/h)	7.6	7.4
Average maximum speed (km/h)	29.8	29.3

Table 19: Physical performance variables of the adidas Golden Boot winners (1st place) of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

	FIFA Women's World Cup 2015™	FIFA Women's World Cup 2011™
Hyundai Young Player Award	Kadeisha Buchanan (CAN, 3)	Caitlin Foord (AUS, 9)
Main playing position	CD	FB
Total distance (m)	9,871	10,191
Distance covered at 16-20km/h (m)	541	633
Distance covered at >20km/h (m)	386	529
Average speed (km/h)	6.2	6.5
Average maximum speed (km/h)	30.6	29.7

Table 20: Physical performance variables of the Hyundai Young Player Award winners of the FIFA Women's World Cup Canada 2015™ and Germany 2011™

the non-All-Star players, the FIFA All-Star players, and the overall positional averages of all the participating players completing entire regular-time matches during both World Cups. The two recipients of the Hyundai Young Player Award (**Table 20**), which is awarded only to players aged 20 or younger, were the only players who did not considerably outperform the physical values obtained by the non-All-Star players, the FIFA All-Star players, and the overall positional averages of their corresponding playing positions. This may be related in part to their young age and still being in a developmental phase when compared to the physical performances of older players.

Goalkeeper Hope Solo (USA, 1) was the only player to be selected for a major FIFA official award (adidas Golden Glove) in both 2015 and 2011, and most of her physical performance values were higher in 2011 compared to 2015 (**Table 17**). Both players who finished in first place for the adidas Golden Ball (**Table 18**) and adidas Golden Boot (**Table 19**) awards showed similar physical performance values, except for the distance covered at 16-20km/h and >20km/h, in which they covered significantly higher values in 2015 compared to the award winners in 2011. The physical performance values of the Hyundai Young Player Award winner in 2015 (Kadeisha Buchanan (CAN, 3)) were considerably lower than those of her counterpart in 2011 (Caitlin Foord (AUS, 9)), possibly due to their different positional role. The average maximum speed was

the only variable, in which Buchanan registered a slightly higher value than Foord (**Table 20**).

#### Summary

- This section provided an overview of the results of the positional and individual analyses of the FIFA Women's World Cup Canada 2015™, including a comparison to the results of the FIFA Women's World Cup Germany 2011™. Variables of age, body height, weight, and physical performance during match-play were examined. For the positional analyses, the playing positions were classified as goalkeepers (GK) and outfield players (OP) including central defenders (CD), full-backs (FB), central midfielders (CM), wide midfielders/wingers (WM), and forwards (FW). The individual analyses comprised the description of the average physical performances of the FIFA All-Star players and FIFA Official Award winners during both competitions.
- The positional analysis of age, body height and weight showed that in both tournaments the GK were significantly the oldest, tallest and heaviest players compared to the other playing positions. The CD were the tallest and heaviest players from the outfield playing positions. These findings might be relevant for player selection and assignment of positional role.
- In total distance covered, the GK had the lowest values compared to all the other playing positions in both competitions. The CD covered overall the shortest and the CM the largest distance compared to the other outfield player positions in both tournaments. There were significant differences between the two World Cups for the FB, WM and FW. The

FB and WM ran less distance but the FW more distance in 2015 than in 2011.

- In distance covered with and without the ball, the GK had the lowest values and also when the ball was out of play compared to the other playing positions. The FW registered the highest distance values with the ball, the CM without the ball, and the WM when the ball was out of play. Most average distances covered with and without the ball were lower in 2015 than in 2011 but the values for average distance when the ball was out of play were higher in 2015 than in 2011, mainly due to the fact that the ball was longer out of play in 2015 than in 2011 (resulting in lower effective playing time).
- In distance covered in each third of the pitch, the GK (99% of total distance) covered on average the largest distance in the defensive third followed by the CD (50%), FB (39%), CM (24%), WM (18%), and FW (8%). In the middle third, the CM (61%) registered the longest distance followed by the WM (54%), FW (52%), FB (51%), CD (47%), and GK (1%). In the attacking third, the FW (40%) led the way followed by the WM (28%), CM (15%), FB (9%), CD (4%), and GK (0%). Significant differences among all the playing positions were identified within each tournament and each third of the pitch. An interesting discrepancy between the two World Cup years showed that the CM spent more distance in the defensive third and the FB and WM more distance in the attacking third in 2015 than in 2011, perhaps indicating a more defensive role for the CM compensated by higher participation in the team's attacks by the FB and WM. These findings could be useful to design physical training programmes that target more specifically the percentages of total distance that are covered in each third of the pitch by playing position.
- In distance covered at the various speed thresholds, the GK logged the shortest distance at all speed thresholds compared to all other playing positions (except for 0-6km/h, the speed at which they covered the longest distance compared to all the other playing positions). The CD covered more distance than the FB and CM at 0-6km/h. The CM covered the longest distance at the speed thresholds of 6-12km/h, 12-16km/h and 16-18km/h. The WM recorded the largest distance at the speed threshold of 18-20km/h. The WM and FW ran the longest distance at 20-23km/h. The WM, FW, and FB recorded the largest distance at >23km/h compared to the other positional roles. The CD logged the shortest distance at 12-16km/h, 16-18km/h, 18-20km/h and >23km/h of the outfield player positions. The CM covered the shortest distance at 0-6km/h and 20-23km/h compared to the other playing positions.
- In distance covered at the various speed thresholds between each World Cup year, most of the positional differences were significantly lower in 2015 than in 2011, including the GK at 0-6km/h, OP at 0-6km/h and 12km/h, CD at 20-23km/h and >23km/h, FB at 12-16km/h, CM at 12-16km/h, WM at 12-16km/h, and FW at 0-6km/h and 20-23km/h. The exception was the FW positional group who covered significantly more distance in 2015 than in 2011 at the speed thresholds of 6-12km/h, 12-16km/h and 16-18km/h.
- In the no. of runs at the various speed thresholds, the GK logged the shortest no. of runs at all speed thresholds compared to all other playing positions. From the outfield players, the CD logged the shortest no. of runs at the speed thresholds of 12-16km/h, 16-18km/h, 18-20km/h, 20-23km/h and >23km/h; the CM logged the largest no. of runs at 6-12km/h, 12-16km/h and 16-18km/h but the shortest at 20-23km/h together with the CD; the WM registered the largest no. of runs at 18-20km/h. Finally, the WM together with the FW and FB registered the largest no. of runs at >23km/h.
- In the average distance of runs at the various speed thresholds, the GK logged the shortest values at all speed thresholds compared to the other playing positions, except at 0-6km/h in which they registered the largest values.

From the outfield players, the CM had the lower values while the FW (only in 2011) had the highest values at 20-23km/h; the FB, WM and FW recorded the largest values at >23km/h.

- In recovery time between runs at the various speed thresholds, the GK logged the shortest values at 0-6km/h but the largest values at 6-12km/h, 12-16km/h and 16-18km/h compared to all other playing positions. The CD logged the largest values at 16-18km/h, 18-20km/h, and >23km/h compared to all other outfield playing positions. The CM registered the shortest recovery time between runs at 20-23km/h. The FB, WM and FW logged the shortest recovery time values at >23km/h.
- Between the two World Cup years, most positional differences were significantly lower in 2015 than in 2011. For instance, the CD recorded smaller values in the no. of runs at 20-23km/h; the FB at 6-12km/h and 12-16km/h; the CM at 12-16km/h; the WM at 6-12km/h and 12-16km/h; and the FW at 20-23km/h. Only the FW registered the largest values in the no. of runs at 6-12km/h, 12-16km/h, 16-18km/h, and 18-20km/h in 2015 than in 2011. In the average distance of runs at the various speed thresholds, the FW recorded the largest values at 16-18km/h but smaller values at 20-23km/h in 2015 than in 2011. In recovery time between runs at the various speed thresholds, the FW recorded smaller values at 16-18km/h in 2015 than in 2011.
- In average speed and average maximum speed within each World Cup year, the GK attained significantly the lowest values in both parameters compared to the other playing positions in both years; from the outfield players, the CD registered the lowest average speed and the CM logged the highest average speed values in both competitions; the CM and CD achieved the lowest average maximum speed values and the FW, WM, and FB the highest values in both tournaments. Between the two World Cup years, there were significant differences for all playing positions in average speed, except for the CD and FW. These significant differences were lower in 2015 than in 2011. For average maximum speed, significant differences were identified only for the OP and FB but their values were higher in 2015 than in 2011.
- The individual analyses of the FIFA All-Star players revealed that they outperformed their non-All-Star counterparts and the positional averages of all participating players completing entire matches in most physical performance values during both World Cups. The All-Star goalkeepers registered inferior physical performance parameters than the All-Star outfield players in both competitions. There were a few significant differences between the two World Cup years, which were lower in 2015 than in 2011.
- The individual analyses of the FIFA Official Award winners showed that these players demonstrated impressive physical performances that were for the most part above the corresponding averages of the non-All-Star players, the FIFA All-Star players, and the overall positional averages of all participating players completing entire matches during both World Cups. The two recipients of the Hyundai Young Player Award, which is awarded only to players aged 20 or younger, were the only players from the FIFA Official Award winners who did not considerably outperform the physical values obtained by the non-All-Star players, the FIFA All-Star players, and the overall positional averages of their corresponding playing positions. This may be related in part to their young age and still being in a developmental phase when compared to the physical performances of older players.
- The results of these analyses are an important part of this report because they helped to identify and highlight the most relevant differences among the various playing positions, which may be useful to derive specific training recommendations that correspond more objectively to the physical match demands of each one of them.

## Analysis of the final: USA v. Japan 5-2 (4-1)

The final was the pinnacle of the tournament, and as such it deserves a more in-depth analysis of the teams' physical performances. It was interesting to see a rematch of the 2011 final (between the USA and Japan). While the 2011 final was decided after penalty kicks in favour of Japan (2-2 a.e.t. (1-1, 0-0) 3-1 PSO), the 2015 final was effectively decided as a contest when the USA scored four goals in the first 16 minutes and ended up winning in regular time with an impressive three-goal margin, 5-2 (4-1). Some of the most relevant physical performance variables of the finalists (including the results for the outfield players and goalkeepers) will be described below, incorporating mostly regular-time comparisons between the 2015 and 2011 finals. Additionally, a few extra-time results from the 2011 final are included for the first time. This detailed analysis might help readers to gain a better understanding of the importance of the teams' physical performance in relation to the match results, but it should not be

forgotten that other technical, tactical, psychological, and various other factors also play a crucial role.

### Match duration

**Table 21** summarises the match duration and effective playing time of both the 2015 and 2011 finals during regular time (including additional time but no extra time). The total match duration was 1.7% higher for the 2015 final. However, the effective playing time (ball in play) was 15% (~9min) lower in 2015 compared to 2011. There were also considerable drops in the effective playing time in the 2<sup>nd</sup> half compared to the 1<sup>st</sup> half of each game. This large discrepancy may be explained by multiple factors such as environmental conditions, playing surface (artificial turf v. natural grass), game strategy, player and team characteristics, match development and events/stoppages, among others.

The 2011 final went to extra time, meaning that both teams had to play two additional periods of 15 minutes plus additional time. The effective playing time was only about 58% of the total extra-time duration (**Table 22**). The total match duration and effective playing time of the full game

Variable	2015 final			2011 final		
	1 <sup>st</sup> half	2 <sup>nd</sup> half	Match	1 <sup>st</sup> half	2 <sup>nd</sup> half	Match
Match duration (min:sec)	46:02	48:02	94:05	45:16	47:14	92:30
Effective playing time (min:sec)	28:29	23:53	52:22	31:38	30:04	61:42
% of match duration	62	50	56	70	64	67

Table 21: Match duration comparison between the 2015 and 2011 finals during regular time

Variable	2011 final in extra time		
	1 <sup>st</sup> extra time	2 <sup>nd</sup> extra time	Total extra time
Extra time duration (min:sec)	15:11	17:29	32:40
Effective playing extra time (min:sec)	8:48	10:13	19:01
% of extra time duration	58	58	58

Table 22: Match duration variables of the 2011 final during extra time

(min:sec), including regular time and extra time, were 125:10 and 80:43 (64% of the total match duration), respectively.

### Physical performance parameters

#### Outfield player results

##### Total distance

Total distance (TD) covered by team and match half during regular time is shown in **Figure 48**. During the 2015 final, the USA covered approximately 2.7% more TD than Japan while the difference in 2011 was only 0.3% in favour of the USA. Both finalists registered slight drops in TD in the 2<sup>nd</sup> half compared to the 1<sup>st</sup> half (USA – 4.3% in 2015 and 1.6% in 2011 and Japan – 1.3% in 2011), except for Japan in 2015 showing a light increase of 0.8% in the 2<sup>nd</sup> half. The TD and the distance covered by half by each team were higher in 2011 compared to 2015. The highest individual total distances registered in the 2015 and 2011 finals were 12,718m (by central midfielder #12 Lauren Holiday from the USA) and 12,685m (by forward #9 Nahomi Kawasumi from Japan), respectively.

##### Distance covered with and without the ball

The distance covered during regular time with and without the ball by each team during the 2015 and 2011 finals is illustrated in **Figure 49**. Japan covered 8.5% more distance with the ball than the USA in 2015 but 3.9% less in 2011. Conversely, the USA covered 14.4% more distance without the ball than Japan in 2015 but 4.1% less in 2011. The difference between the finalists in terms of the distance covered when the ball was out of play was only 2-3%. On average, the finalists covered more distance without the ball (35.4% from TD in 2015 and 39.3% in 2011) than with the ball (33.9% from TD in 2015 and 36.7% in 2011). The remaining distance was covered when the ball was out of play (30.7% from TD in 2015 and 24% in 2011).

##### Distance covered in each third of the pitch

**Figure 50** shows the distribution of the distance covered by each team in each third of the pitch during the 2015 and 2011 finals. In 2015, the USA registered 12.1% more distance in the defensive third, 3.3% less distance in the middle third, and 2% more distance in the attacking third than Japan. In 2011, Japan registered 33.1% more distance in the defensive third, 5.9% less distance in the middle third, and 36.2% less distance in the attacking third than the USA. On average, the finalists covered



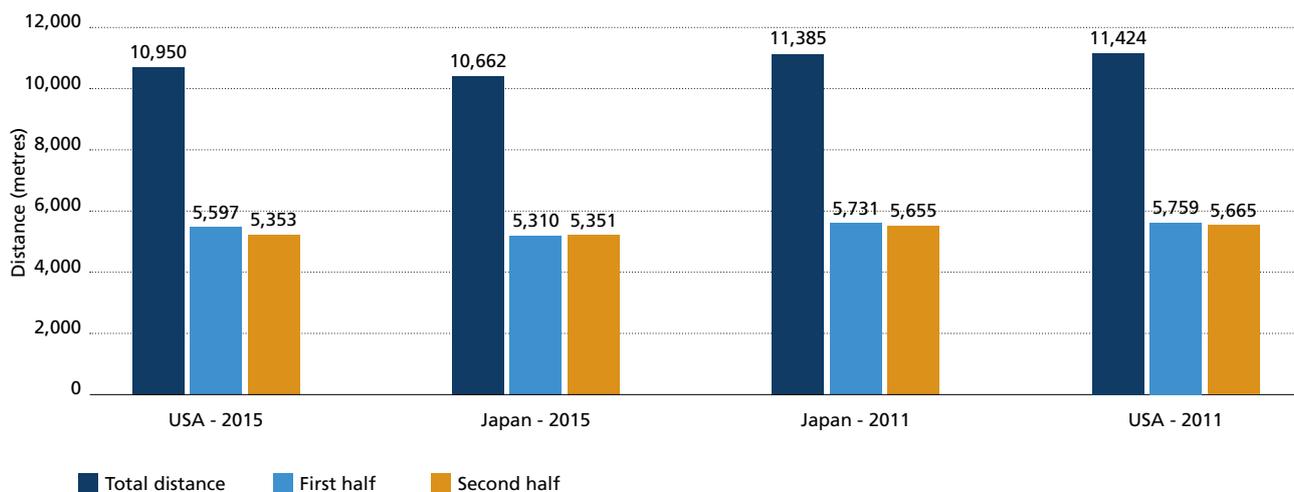
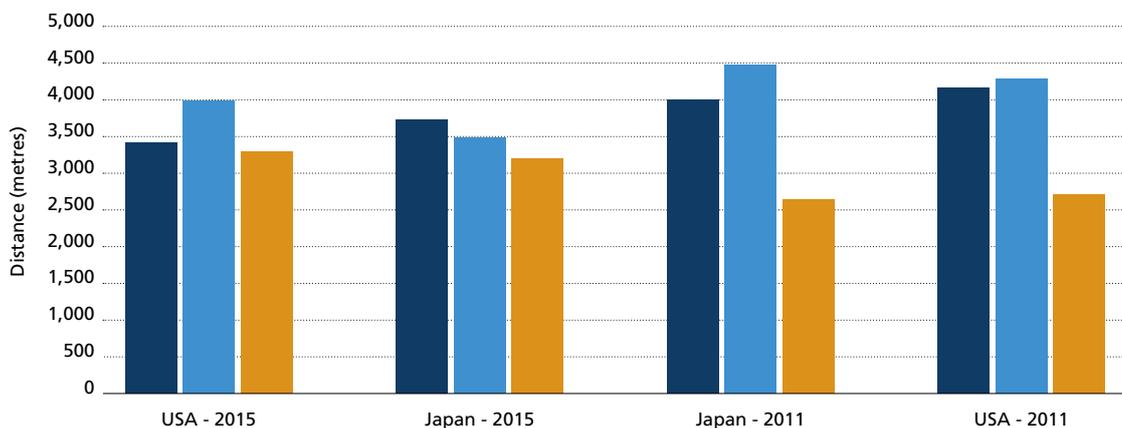
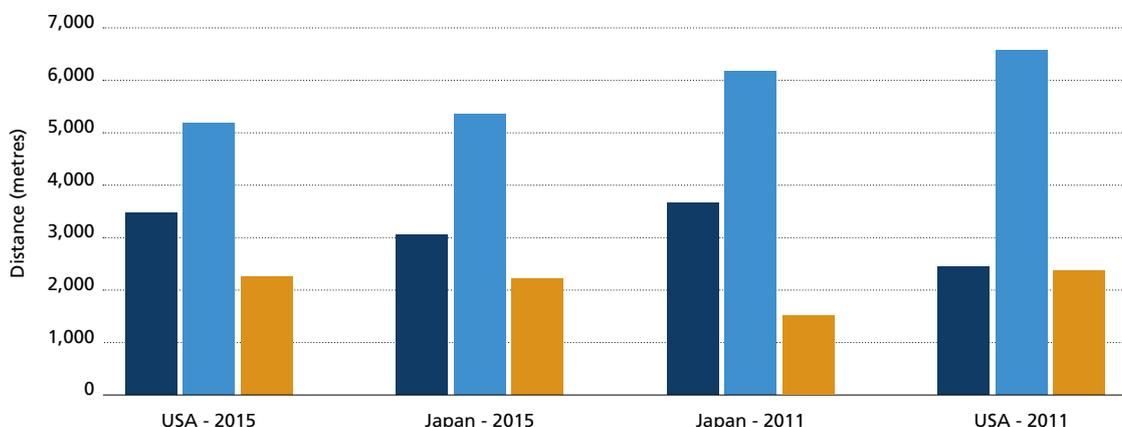


Figure 48: Total distance covered by team and match half during regular time of the 2015 and 2011 finals



Category	USA - 2015	Japan - 2015	Japan - 2011	USA - 2011
With the ball	3,496	3,819	4,098	4,262
Without the ball	4,087	3,573	4,577	4,389
Ball out of play	3,368	3,269	2,710	2,773

Figure 49: Distance covered with and without the ball by each team during regular time of the 2015 and 2011 finals



Category	USA - 2015	Japan - 2015	Japan - 2011	USA - 2011
Defensive third	3,478	3,057	3,664	2,453
Middle third	5,191	5,364	6,188	6,578
Attacking third	2,265	2,223	1,517	2,378

Figure 50: Distance covered by each team in each third of the pitch during regular time of the 2015 and 2011 finals

more distance in the middle third (48.9% from TD in 2015 and 56% in 2011) than in the defensive third (30.2% from TD in 2015 and 26.8% in 2011) and the attacking third (20.8% from TD in 2015 and 17.1% in 2011).

*Distance covered at the various speed thresholds*

On average, 25% of the total distance during the 2015 and 2011 finals was covered at 0-6km/h, 43% at 6-12km/h, 19% at 12-16km/h, 5% at 16-18km/h, 3% at 18-20km/h, 2% at 20-23km/h, and 3% at >23km/h by the teams during regular time of the 2015 and 2011 finals (Figure 51).

When the combined speed thresholds are reported, 68% of the total distance was covered at <12km/h, 87% at <16km/h, 13% at >16km/h, 8% at >18km/h, and 5% at >20km/h. In both finals, the USA registered more absolute distance at speeds >16km/h (high-speed and sprinting movement categories) than Japan, except for the distance covered at >23km/h in 2011 (Figure 51).

The distance covered by the USA during the 2015 final at 16-18km/h and 18-20km/h (high-speed running thresholds) decreased from the 1<sup>st</sup> half to the 2<sup>nd</sup> half of the game

but it increased at the sprinting speeds of 23-23km/h and >23km/h. In the same year, Japan showed increments at all these thresholds and they were higher than those of the USA (Figure 52a). During the 2011 final, both finalists showed distance drops in the 2<sup>nd</sup> half compared to the 1<sup>st</sup> half, except for Japan at 20-23km/h with a slight distance increase of 3%. The distance drops at these speed thresholds were higher for Japan than for the USA (Figure 52b).

**Detailed analysis of runs at high-speed running and sprinting thresholds, average speed and average maximum speed**

Table 23 shows a detailed analysis of runs at speeds of >16km/h as well as average speed and average maximum speed values of the outfield players during regular time of the 2015 and 2011 finals. Most parameters were lower in the 2015 final compared to the 2011 final, and the USA outperformed Japan in most of them in both finals. The highest individual values registered during both finals for average speed and maximum speed were 8.2km/h (by forward #9 Nahomi Kawasumi from Japan in 2011) and 34.7km/h (by wide defender #11 Alex Krieger from USA in 2015), respectively.

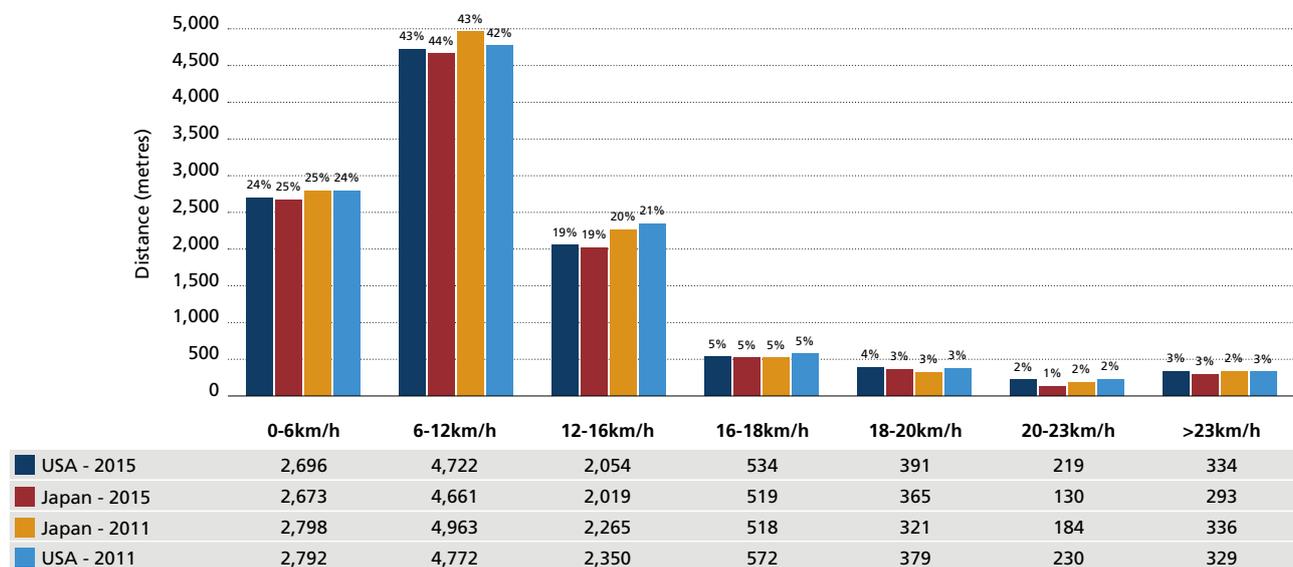


Figure 51: Distance covered by each team at the various speed thresholds during regular time of the 2015 and 2011 finals



Figure 52: Distance covered by team and match half at the speed thresholds of high intensity and sprinting during regular time of the 2015 (a) and 2011 (b) finals

	USA - 2015	Japan - 2015	Japan - 2011	USA - 2011
No. of runs at 16-18km/h	57	57	52	53
Average distance of runs at 16-18km/h (m)	10	10	11	11
Recovery time between runs at 16-18km/h (min:sec)	2:12	2:27	2:12	2:05
No. of runs at 18-20km/h	34	35	27	32
Average distance of runs at 18-20km/h (m)	12	11	12	12
Recovery time between runs at 18-20km/h (min:sec)	3:52	3:36	3:23	3:57
No. of runs at 20-23km/h	12	7	8	10
Average distance of runs at 20-23km/h (m)	14	12	16	17
Recovery time between runs at 20-23km/h (min:sec)	5:52	6:36	6:46	6:41
No. of runs at >23km/h	25	22	22	21
Average distance of runs at >23km/h (m)	14	13	15	14
Recovery time between runs at >23km/h (min:sec)	5:07	5:10	5:01	5:40
Average speed (km/h)	7.0	6.8	7.4	7.4
Average maximum speed (km/h)	31.2	28.8	28.9	29.4

Table 23: Detailed analysis of runs at high-speed running and sprinting thresholds, average speed and average maximum speed of the outfield players during regular time of the 2015 and 2011 finals

*Distance covered during extra time of the 2011 final*

The 2011 final was very competitive. It went to extra time and was decided after penalty kicks in favour of Japan. Both teams covered a similar total distance during the extra-time period (**Figure 53**). Nevertheless, Japan covered more distance than the USA at lower speeds (<12 km/h), and USA covered more distance than Japan at medium and higher speeds (>12km/h). The highest individual total distance during extra time of the 2011 final was registered by the American wide midfielder #9 Heather O’Reilly, with a value of 4,109m. The average total distance covered during the whole match (regular time + extra time) for Japan and the USA was 15,021m and 15,119m, respectively.

**Goalkeeper results**

Most physical performance parameters of the goalkeepers were higher during regular time of the 2011 final compared to the 2015 final, and the American goalkeeper (Hope Solo) registered overall higher parameters than her Japanese counterpart (Ayumi Kaihori) in both tournaments (**Table 24**). Both goalkeepers registered the majority of their distance covered in their defensive third of the pitch, and their distances covered at speeds >16km/h (high-speed running and sprinting) were minimal – the majority of their distance covered took place at speeds of <16km/h

(**Table 24**). The total distance covered by the goalkeepers from Japan and the USA during extra time of the 2011 final was 1,927m and 1,848, respectively. Therefore, the total distance covered during the whole match (regular time + extra time) was 7,564m for Ayumi Kaihori and 7,849m for Hope Solo.

**Other relevant variables**

Football performance is influenced by several factors including the physical, technical, tactical and psychological characteristics of the participating players and teams as well as the environmental, match, and tournament conditions, together with the playing surface on which matches take place. Therefore, it is important to consider some of these variables when comparing the physical performances of the finalist teams in 2015 and 2011 (**Table 25**). For instance, the American players were on average older, heavier and taller than the Japanese players in both finals, which may in part explain the overall dominance of the USA team in most physical performance variables in these matches. The environmental conditions (temperature, % humidity and wind speed) of the 2015 final were more challenging than those of the 2011 final. Additionally, due to an increase in the number of teams (from 16 in 2011 to 24

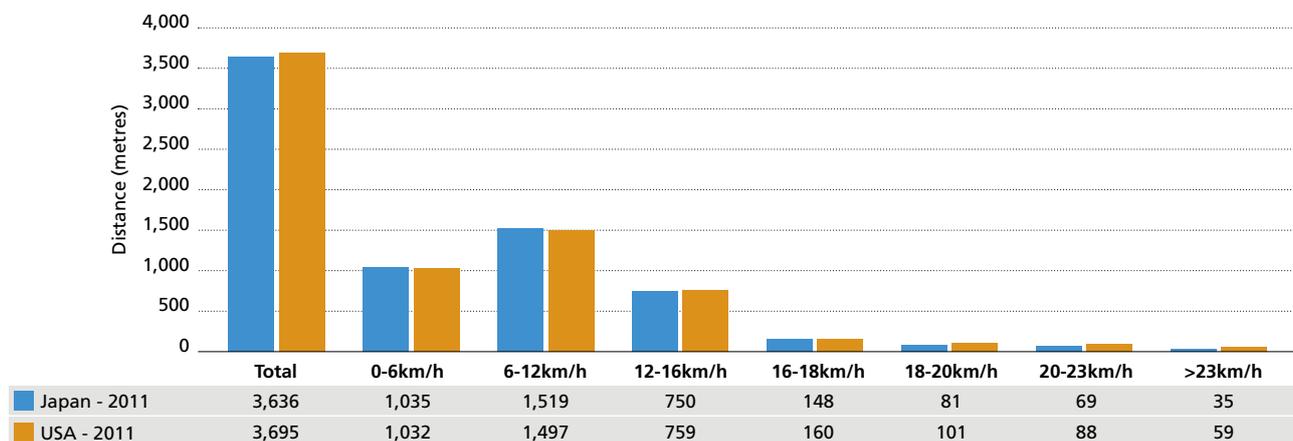


Figure 53: Total distance and distance covered by each team at the various speed thresholds during extra time of the 2011 final

	USA - 2015	Japan - 2015	Japan - 2011	USA - 2011
	Hope Solo	Ayumi Kaihori	Ayumi Kaihori	Hope Solo
Total distance (m)	5,412	4,825	5,637	6,001
Average speed (km/h)	3.5	3.1	3.7	3.9
Average maximum speed (km/h)	26.6	22.9	24.0	21.6
Distance covered with the ball (m)	1,645	1,650	1,956	2,212
Distance covered without the ball (m)	1,883	1,563	2,149	2,308
Distance covered when ball out of play (m)	1,885	1,612	1,532	1,481
Distance covered in defensive third (m)	5,391	4,768	5,635	5,966
Distance covered in middle third (m)	16	53	0	33
Distance covered in attacking third (m)	0	0	0	0
Distance covered at 0-6km/h (m)	3,735	3,346	3,891	4,064
Distance covered at 6-12km/h (m)	1,522	1,162	1,463	1,464
Distance covered at 12-16km/h (m)	131	211	242	362
Distance covered at 16-18km/h (m)	8	31	41	66
Distance covered at 18-20km/h (m)	17	36	0	46
Distance covered at 20-23km/h (m)	0	0	0	0
Distance covered at >23km/h (m)	0	40	0	0

Table 24: Physical performance parameters of the goalkeepers during regular time of the 2015 and 2011 finals

	USA - 2015	Japan - 2015	Japan - 2011	USA - 2011
Age (years)	29.4	28.3	25.7	27.7
Body height (cm)	169.3	164.8	163.1	169.5
Body mass (kg)	64.0	57.4	56.5	64.9
Temperature (°C)	25		16	
Humidity (%)	50		77	
Wind speed (km/h)	21		7	
Playing surface	artificial turf		natural grass	
Main tactical formation	4-4-2	4-4-2	4-4-2	4-4-2
Ball possession (%)	46.5	53.5	50.3	49.8
Passing success (%)	77.6	79.1	79.8	80.3
Shots on goal	9	3	4	5
Corner kicks	7	3	4	8

Table 25: Comparison of other miscellaneous variables between the 2015 and 2011 finals

in 2015), the finalist teams played an extra knockout round in 2015 before reaching the final. Jet lag and travel fatigue was also a bigger challenge for the finalist teams in 2015 than in 2011 due to the larger size of Canada as the host country (using six match venues spread across five different time zones) compared to Germany in 2011 (using nine match venues but only

one time zone). All of these differences in environmental, match, and tournament conditions may have contributed to the lower physical performance of both teams in 2015 compared to 2011.

The change of playing surface (artificial turf in 2015 compared to natural grass in 2011) may also have influenced the

physical performances of the finalist teams by decreasing both the effective playing time (time when the ball is in play) and the amount of running performed by the participating players and teams. The harder nature of artificial turf compared to the softer natural grass surface causes more unpredictable bounces of the ball, making it harder for it to be controlled by the players, which might partially explain the lower effective playing time and physical performance values of the finalist teams in 2015 compared to 2011. Finally, the technical-tactical characteristics of the participating players and teams may have also influenced their overall physical performance in both finals. For example, although both teams used the same main tactical formation for the most part of both finals (4-4-2 with a midfield line), their styles of play were completely different. The Japanese playing style was based on more ball possession using short low passes (resulting in less absolute distance covered) while the Americans pursued more long diagonal aerial passes to exploit open space and take advantage of their athletic, tall, and powerful players (resulting in more absolute distance covered). The direct and physical dominant playing style of the USA team triumphed in 2015. However, the indirect and possession-oriented playing style of the Japanese team prevailed in 2011. Thus, although a high level of fitness and physical dominance are important for success in football, there are other relevant factors such as the ones mentioned above that play a crucial role and must be considered.

### Summary

- This section offered an in-depth analysis of match duration and physical performance variables of the finalist teams in the finals of the FIFA Women's World Cup Canada 2015™ and Germany 2011™.
- Having the same teams (the USA and Japan) in both FIFA Women's World Cup™ final matches in 2015 and 2011 provided a unique opportunity to compare results.
- Results were presented mostly for the regular time of each final. However, for the first time, some extra-time results of the 2011 final were also described.
- Results for both outfield players and goalkeepers were included.
- The effective playing time was considerably lower in 2015 than in 2011.
- The USA team outperformed the Japanese team in most physical performance variables in both finals.
- Most absolute physical performance values were lower in 2015 than in 2011.
- The distance covered at >16km/h dropped in the 2<sup>nd</sup> half compared to the 1<sup>st</sup> half of match-play during the 2011 final for both teams. However, it increased after half-time for Japan at >16km/h and for the USA at >20km/h in the 2015 final.
- This detailed analysis of the final matches of the FIFA Women's World Cup™ in 2015 and 2011 might help readers to gain a better understanding of the importance of the teams' physical performance in relation to the match results, but it should not be forgotten that other technical, tactical, psychological, and various other factors also play a crucial role and must be considered.

## CONCLUSION

This report provides a comprehensive analysis of the physical match demands of elite women's football using a unique cohort of female players competing at the highest level of the game, with a special focus on the FIFA Women's World Cup Canada 2015™. Additionally, the match data of the FIFA Women's World Cup Germany 2011™, used in the previously published physical analysis report of this competition (FIFA, 2012), was re-analysed applying the same speed thresholds and data analysis procedures employed in the present report in order to compare results more accurately between the two competitions and to derive more general and powerful conclusions about the findings of this report. The match data of 721 female national team players from 26 different countries (438 players at the FIFA Women's World Cup Canada 2015™ and 283 players at the FIFA Women's World Cup Germany 2011™), including a total of 80 matches and 2,188 individual match performance data sets, were analysed as part of this report. Thus, the findings derived from this unique cohort of elite female players represents to date the largest and most diverse database available worldwide on the physical demands of elite women's football match-play.

The analyses and results of this report were divided into three main categories: team analyses, positional and individual analyses, and analysis of the final: USA v. Japan. Practical recommendations for the physical training of elite female footballers and a sample training session were also included at the end of this report. Furthermore, it is hoped that the speed thresholds used in this analysis can help to create a global consensus for their use in the quantification of physical match performance of elite female footballers, facilitating the comparison of data among different countries and groups of players and the design of more specific physical training programmes for each playing position. This publication also serves as a great reference for interested players, coaches, technical directors, physical trainers and support staff involved in women's football about

the current physical match performance standards of the top women's teams and most outstanding female players in the world in order to inspire them to keep working hard and smart towards the further improvement of the physical status of players worldwide. This can only serve to further increase the level and intensity of match-play in the women's game, reduce injury risk, and keep the best players on the pitch, which in turn will help to continue raising the popularity of women's football worldwide.

Some of the key findings of the main analyses of this report are summarised below.

Key findings of the team analyses:

- The effective playing time was lower during the 2015 tournament compared to 2011.
- Relevant differences in the physical performance results of individual teams by tournament, match period (e.g. full game, first and second half, and 15-minute intervals), tournament phase (group phase and knockout rounds), confederation membership, and final tournament ranking were identified.
- When analysing the overall match performance of teams, an integrated review of technical-tactical and physical parameters should be evaluated, as well as match outcome, in order to enable an accurate analysis and interpretation of results.

Key findings of the positional and individual analyses:

- The positional differences found in players' age, body height and weight might be relevant for player selection and assignment of positional role.
- There are several significant differences in the physical match performances of the various playing positions, which should be taken into account to develop more effective and specific training programmes for each positional role.
- The FIFA All-Star players and FIFA Official Award winners recorded, for the most part, higher physical match

performances than their non-All-Star counterparts and the positional averages of all the participating players, indicating that they enjoy superior physical preparation and fitness level than the other players.

Key findings of the analysis of the final: USA v. Japan:

- Having the same teams (the USA and Japan) in both final matches of the FIFA Women's World Cup Canada 2015™ and Germany 2011™ provided a unique opportunity to compare results.
- Most absolute physical performance values of the finalist teams were lower in 2015 than in 2011, and the USA outperformed Japan in most physical performance parameters during both finals.
- This detailed analysis of the FIFA Women's World Cup™ final matches in 2015 and 2011 might help readers to gain a better understanding of the importance of the teams' physical performance in relation to the match results, but it should not be forgotten that other technical, tactical, psychological, and various other factors also play a crucial role and must be considered.

Some limitations of the present report should be addressed. Due to technical difficulties with the measurement system, there was some missing match data (three matches in the 2015 tournament and one match in the 2011 tournament) that could not be included in the data analyses. The age, body height and weight of the participating players were submitted to the FIFA general secretariat by each team prior to the tournament start according to the official regulations, but they were not measured directly by FIFA representatives in a standardised manner for the purpose of this report. Consequently, it is unknown how these measurements took place within each participating team. Additionally, players' playing positions were assigned based on the main positional role that each player had for most of each match. Although in both tournaments most players

played a single position throughout each match, there were a few who changed positions within the same match due to tactical changes or key injuries to other players. We were unable to account for this, and thus, there might be some positional overlaps in some of the data sets. These limitations should be taken into account for the interpretation and generalisation of the findings of this report.

Due to the increased popularity and participation numbers of women's football worldwide, combined with still scarce scientific research on the physical demands of match-play and the physical training of female players, further research in this area should be conducted. A few ideas that could be considered in the near future by FIFA and other external research groups to continue expanding the knowledge base of the various levels of the women's game (e.g. top-international tournaments and lower competitive levels) are listed below.

- Evaluation of the impact of players' fitness status (e.g. speed and sport-specific endurance test results) on their physical performance during match-play.
- Evaluation of the effect of fitness status and physical match performance in relation to injury incidence.
- Development and efficacy evaluation of fitness tests/protocols, physical training programmes, and recovery strategies specific to the physical match demands of each playing position (intervention-based studies).
- Analysis of the physical match performance of elite female referees (including both central and assistant referees).
- Evaluation of the relationship between players' physical match performance and injury incidence in relation to playing surface (e.g. grass v. turf).
- Evaluation of the impact of the tactical formation and quality of the opposing team on players' physical match performance.
- Analysis of the physical performances of elite youth players during top-international women's football



tournaments (such as the FIFA U-17 and U-20 Women's World Cups) in order to compare age differences and aid in the development of more specific training programmes appropriate to their age, competitive level, and playing position.

- Integrated measurement and analysis of teams'/players' physical and technical-tactical parameters during future FIFA Women's World Cups™ at all age groups in order to conduct cross-sectional and longitudinal studies.
- Integration of research findings into coaching education courses and materials specific to the women's game with the ultimate objective of contributing to the further development of the women's game worldwide.

In conclusion, the specificity of training principle in sports science states that the

most effective training is the one that resembles the game as closely as possible. Therefore, the findings of the current report provide an objective and in-depth understanding of the physical demands of women's football match-play at the highest competitive level, aiding in the development of sport-specific and individualised conditioning programmes for elite female football players. During a football match, the physical state of a player notably impacts upon her technical and tactical skills, mental concentration, and fatigue and injury resistance. Therefore, the overall football performance of female football players could be further enhanced by improving their physical capacity through age-, level- and position-specific conditioning programmes. Nonetheless, further research is warranted in this area.

## PRACTICAL RECOMMENDATIONS FOR PHYSICAL TRAINING AND SAMPLE TRAINING SESSION

As has been seen throughout this report, football performance is complex and multi-factorial. For coaches to be able to train football players effectively, the physical demands of match-play must be determined (Figure 54), which has been the main focus of this report. Trainers and coaches can then develop programmes to prepare players for those match demands, individualising those for the positional demands that are apparent in football.

To be able to complete the physical demands during football match-play, players should follow programmes that cover all of the fitness parameters (Figure 55) required to prevent injury and increase performance potential. The amount and type of each fitness component vary between players, dependent on factors such as age, level of competition, initial fitness level, individual fitness level and position.

Depending on the phase of the season, players will be following training programmes aimed at developing the different components of fitness in preparation for the competition phase of their season. Once players are in season, then the main aim is to be prepared for match-play, subsequently recover from match-play and have some training

stimulus throughout the week to maintain fitness. Below is an example of a training session that players could complete to develop some of the fitness components outlined in Figure 55.

### Sample training session

Session component	Duration
Warm-up	15min
Speed	15min
Intensive endurance OR RSA (position-specific)	32min/18min
Cool-down	10min

### Warm-up

The main aim of the warm-up is to prepare the body for the activity which it is about to complete. Therefore, the warm-up should consist of actions which the player will be required to complete throughout a match, or in the training session. Warm-up exercises increase the cardiac output from the heart and hence blood flow to the muscles to be used during the session. The duration of the warm-up should be 10-15 minutes depending on what activity the player will be completing following this period. Generally, the warm-up should consist of three phases:

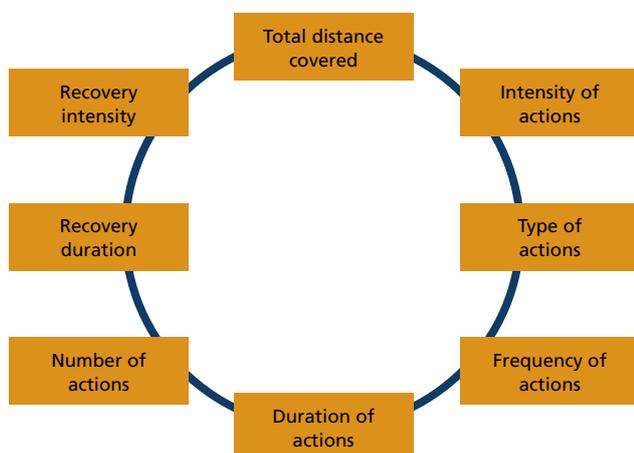


Figure 54: Defining physical match demands

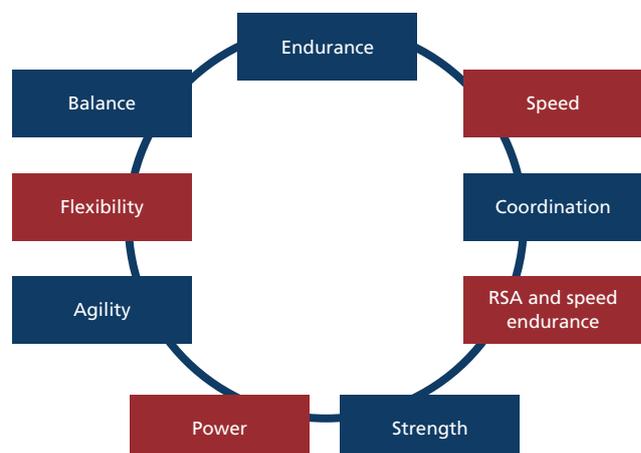


Figure 55: Key fitness components for football

### 1. Jogging (5-7min)

The first part of the warm-up should consist of the players completing continuous jogging and functional movements (skipping, side-steps, backwards jogging).

### 2. Stretching (5-7min)

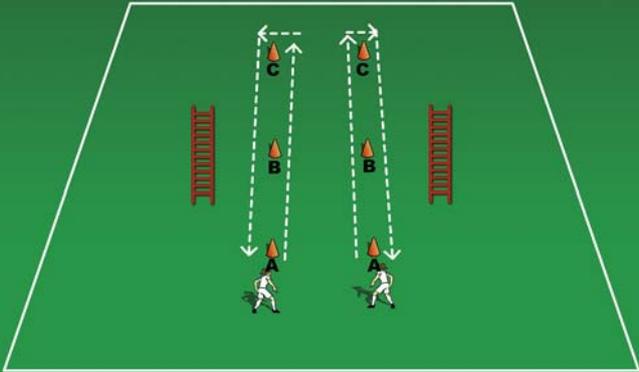
Following the initial phase of the warm-up, the players should complete some stretching. The majority of this should be short static stretching (for a maximum of 5-6 seconds) followed by dynamic stretching, where the player moves in to the stretch. For example, a hamstring stretch should consist of the players holding that stretch and then following it with controlled straight leg kicks. The players should think about how they could stretch other parts of their body dynamically. The players should also be given some time to complete their own stretches, as well as any prehab-type work.

### 3. Higher intensity (5-7min)

The final part of the warm-up should consist of the player completing higher-intensity activity, such as striding and sprinting. The main aim of this final part is to prepare the players for the activity which they are about to complete.

When possible and appropriate, a ball could be incorporated throughout the warm-up. A warm-up session is outlined below, which players could complete prior to any training session they are doing. The FIFA 11+ is also an appropriate warm-up as it was developed specifically for football players.





**Session information**  
Duration: 10-15min

**Session set-up**  
Equipment: 6 cones and 2 ladders.  
Place cones and ladders as shown. 10m x 20m

**Session detail**

- Start at position A, with players in two lines.

**First phase (jog and dynamic movements):**

- Jog forwards to B, then backwards to C, then jog forwards back to A
- Skip forwards to B, backwards to C
- Side skip left leg lead to B, right leg lead to C
- Carioca left leg lead to B, carioca right leg lead to C

**Second phase (stretching – hold each stretch for 3-4 seconds, then stretch the opposite leg, walking forwards each time):**

- Knee hug to B then walking march to C
- Calf stretch to B then skip to C
- Quad stretch to B then heel flicks to C

- Hamstring stretch to B then controlled leg kicks to C
- Lunge forward to B, then high knees to C
- Wide squat to B, then lateral kicks to C
- Groin stretch to B, then side step to C
- Stop and give players 1-2 minutes to stretch anything else.

**Third phase (higher intensity – do each movement twice):**

- Jog to B, then run faster to C, jog back to A
- Jog out to the ladder and perform the following movements:
  - One foot through the ladder then run faster to C, walk back to A
  - Single leg hop through the ladder (1 rep left and 1 right)
  - Two foot jumps through the ladder
  - Hop scotch through the ladder

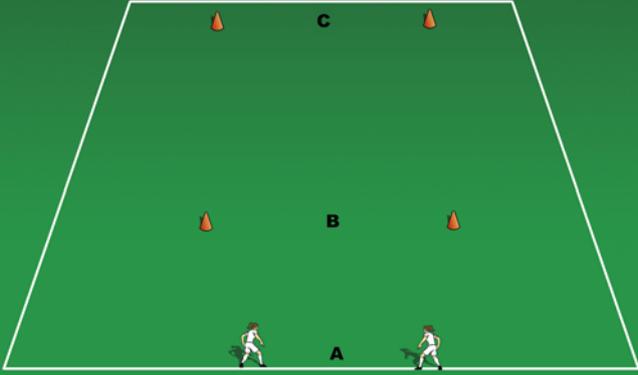
Figure 56: Set-up for the warm-up

## Speed

Speed training has many components encompassing running mechanics, acceleration (up to 20m), maximum speed (over 20m), reaction speed and deceleration. It is important to ensure that speed sessions are varied and cover the different components, as well as being position-specific in terms of the actual movements and sprint characteristics. As has been seen during this analysis, WM (11) and FW (11) complete the most sprints during matches at 20-23km/h, over distances of 17m and 16m respectively. CD and CM (6) cover the least number of sprints at this speed. For sprints >23km/h, again WM and FW (25) complete the most repetitions, and with an average distance of 14m per sprint. FB on average complete 24 sprints >23km/h, over an average distance of 14m. CD (15) and CM (18) complete the least sprints >23km/h during matches. Whilst it is important to

know the number and average duration of sprints during match-play for each position, the methods for developing speed remain the same despite those varying demands. Therefore, speed training for all players and positions should in some ways be generic, encompassing strength training, speed mechanics, and speed over varying distances. The speed sessions can then be made more position-specific by varying the type of footwork and movements that players complete at high intensities, thereby mimicking match-play movements for players.

Speed training should ideally be done at the start of sessions after the warm-up when players are fresher as maximal effort is required for each sprint for this training to be most effective. It is also important that players have full recovery after each sprint. If a sprint lasts 2s then players need

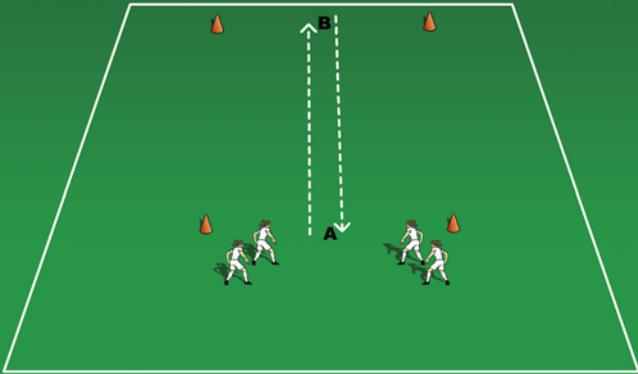


**Session information**  
 Reps: 8  
 Sets: 1-2  
 Recovery: 3min between sets

**Session set-up**  
 Equipment: 4 cones, as shown  
 10m x 20m.

**Session detail**  
 Players start in two lines. Jog from A to B, sprint maximally from B to C. Walk back to the start.

Figure 57: Set-up for speed exercise 1

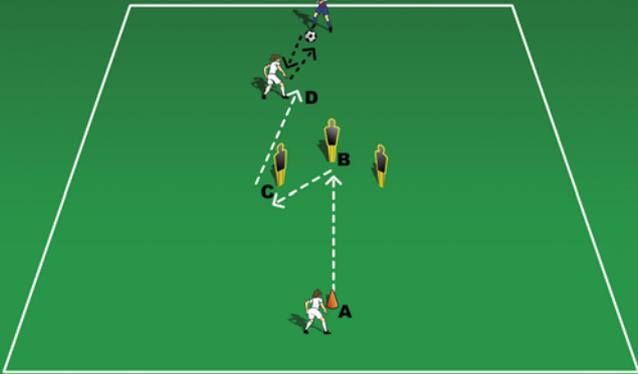


**Session information**  
 Reps: 6-8  
 Sets: 1-2

**Session set-up**  
 Equipment: 4 cones, as shown. 10m x 10m

**Session detail**  
 Players start in two lines. When the player behind touches the front player on the back, the front player sprints from A to B and back to A again.

Figure 58: Set-up for speed exercise 2

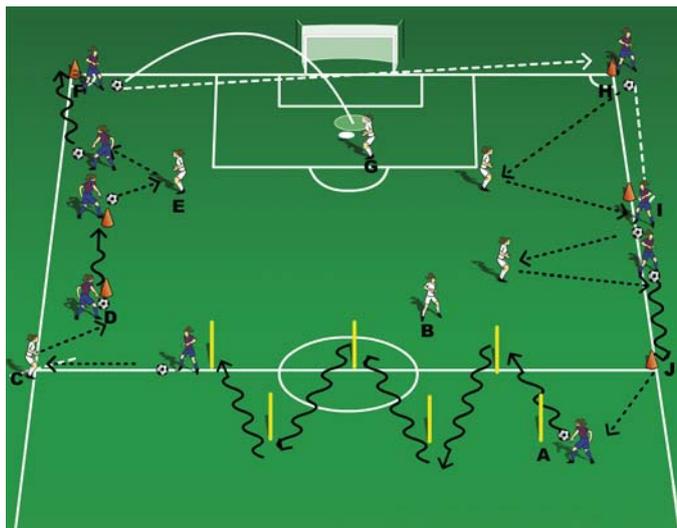


**Session information**  
 Reps: 6-8 (3-4 each side)  
 Sets: 1

**Session set-up**  
 Equipment: 3 mannequins, 1 ball, 1 cone, as shown. 15m x 10m

**Session detail**  
 A player sprints maximally (10m) from the cone to the mannequin, then back pedals (2m) around the mannequin to the left, then immediately sprints forward (5m) to receive a pass from the server. Walk back to the start and repeat the movement around the mannequin to the right.

Figure 59: Set-up for speed exercise 3



#### Session information

Work: 4-6min  
Recovery between sets: 2-4min  
Sets: 4-6  
RPE: 7-10 for work periods

#### Session set-up

Equipment: 6 poles, 6 cones, 1 ball per player. Place cones and poles as shown.

#### Session detail

- Players can start anywhere on the circuit. A squad of 20 players could complete this session, with half of the players acting as servers during the first period, and 10 players working. The players can then switch at the appropriate time period.
- Starting at position A, the player should run at pace around the poles, play a 1-2 pass with the player at position B, then continue running around the poles.
- At position C, the player should play a 1-2 pass with the player.
- At position D, the player should perform a skill between the two cones (small ball touches, drag ball backwards, roll ball forwards, etc.).
- At position E, the player should play a 1-2 pass with the player.
- The player should run around the cone at position E, then cross a ball to the player at position G.
- The player should retrieve the ball from the player at position G, and run with the ball to cone H.
- The player should play a 1-2 pass with the player and run to cone I, and the player should then do the same with the next player to cone J.
- From cone J, the player should run with the ball at pace to cone A and continue the same circuit.
- Players should continue to do this until they have worked for 4min.
- The players should then switch over, with the working players now being the servers, with 4min of active recovery before repeating the exercise in the opposite direction.

**Players should be running maximally during the work periods!**

Figure 60: Set-up for the intensive endurance session

at least 10s recovery. The ratio of work:rest should be at least 1:5. You should also aim to vary how you start each speed exercise, by varying the cues (visual/verbal/sound/movement), distances, starting positions and starting direction.

#### Intensive endurance

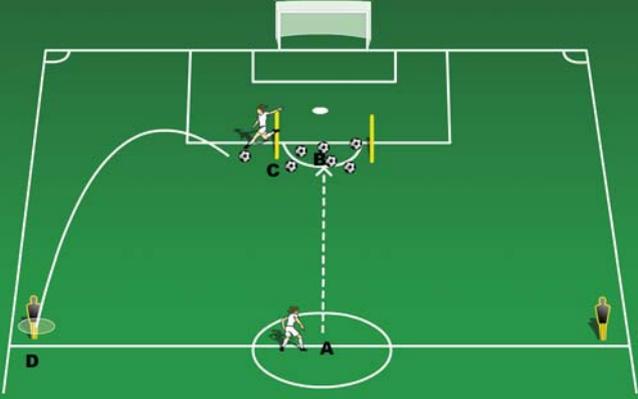
The aim during intensive endurance training is to build a player's endurance capacity to be able to complete more high-intensity running during a match, as well as to recover quickly following each sprint or explosive movement. The analysis in the current report has shown that for outfield players, on average CM (11,230m) covered the highest TD, with CD (10,020m) the lowest. It can be seen (Table 26) that WM and FW covered the most distance in the

higher-speed thresholds, and consequently it is important that players who compete in those positions have a higher level of endurance fitness. Those players should aim to complete a greater number of intensive endurance sessions, with longer work periods and more sets per session.

Position	CD	FB	CM	WM	FW
>16km/h	925m	1,392m	1,284m	1,502m	1,456m

Table 26: Distance covered >16km/h by position during the 2015 tournament

The aim during intensive endurance sessions is to complete longer work intervals with a heart rate response >90% HR<sub>max</sub> (HR<sub>max</sub> should be determined



**Session information**  
 Work: 10s maximally then 20s recovery – do this 6 times  
 Recovery between sets: 3min  
 Sets: 3  
 RPE: 9-10 for work periods

**Session set-up**  
 Equipment: 2 poles, 6 balls. Place balls as shown in diagram on the left, and the poles as shown.

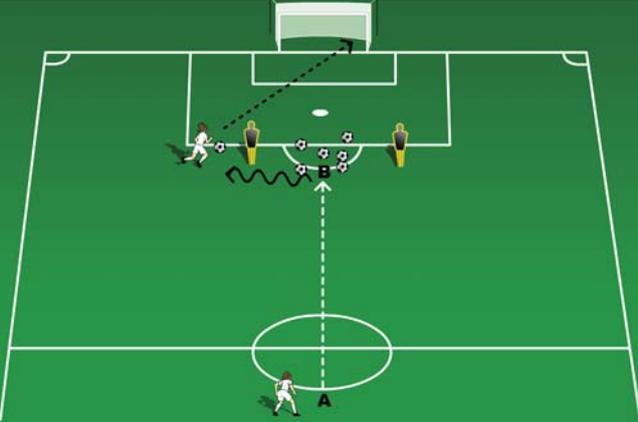
**Session detail**

- CD and FB players should start at position A.
- The player should run maximally from position A to one of the balls (this should take roughly 7/8 seconds so the player may need to adjust the start position).
- The player should take a touch of the ball past one of the poles, then turn and clear the ball long to one of the targets (D) on the touch line.
- As soon as the player strikes the ball, the player should immediately jog back to the starting position on the halfway line.
- Following 20 seconds of rest, the player should run maximally from position A to another ball and do the same.

- The players should continue to do this until they have done 6 repetitions.
- Each player should have 3 minutes' recovery before repeating the exercise, using the recovery time to replace the balls.

**Players should be sprinting maximally during the work periods!**

Figure 61: Set-up for the RSA session for defenders



**Session information**  
 Work: 10s maximally then 20s recovery – do this 6 times  
 Recovery between sets: 3min  
 Sets: 3  
 RPE: 9-10 for work periods

**Session set-up**  
 Equipment: 2 mannequins or poles, 6 balls. Place balls as shown in diagram on the left, and the mannequins as shown.

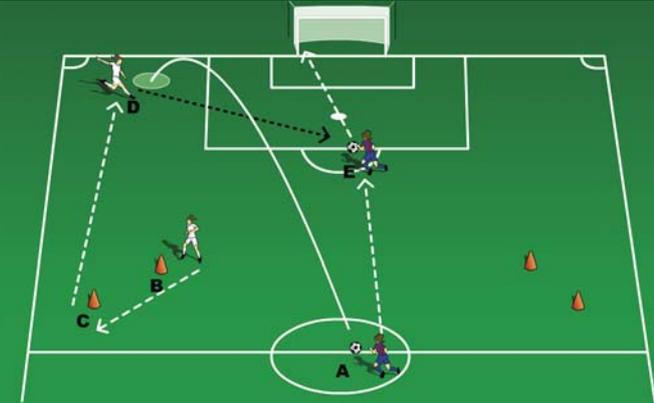
**Session detail**

- FW players should start at position A.
- The player should run maximally from position A to one of the balls (this should take roughly 7/8 seconds so the player may need to adjust the start position).
- The player should take a touch of the ball past one of the mannequins, and then take a shot on goal.
- As soon as the player strikes the ball, the player should immediately jog back to the starting position on the halfway line.

- Following 20 seconds of rest, the player should run maximally from position A to another ball and do the same.
- The players should continue to do this until they have done 6 repetitions.
- Each player should have 3 minutes of recovery before repeating the exercise, using the recovery time to replace the balls.

**Players should be sprinting maximally during the work periods!**

Figure 62: Set-up for the RSA session for forwards



**Session information**  
 Work: 10s maximally then 20s recovery – do this 6 times  
 Recovery between sets: 3min  
 Sets: 3  
 RPE: 9-10 for work periods

**Session set-up**  
 Equipment: 4 cones, 6 balls (per pair of players).  
 Place the balls as shown in diagram on the left, and the cones as shown.

**Session Detail**

- CM players start at position A, and WM players start at position B.
- Player A should touch the ball out of the feet, player B should then run to cone C and then sprint maximally towards the goal line.
- Player A should play a ball to position D for player B to run on to.
- As soon as player A plays the ball, player A sprints maximally to the edge of the penalty box.
- Player B should play the ball in to the box to player A for player A to have a shot on goal.
- As soon as both players have touched the ball, they should immediately jog back to the starting position on the halfway line.
- Following 20 seconds of rest, they should repeat the movement.
- The players continue to do this until they have done 6 repetitions.
- Each player should have 3 minutes of recovery before repeating the exercise, using the recovery time to replace the balls.

**Players should be sprinting maximally during the work periods!**

Figure 63: Set-up for the RSA session for midfield players

during fitness tests), or rating of perceived exertion (RPE) > 7-10. The work periods should be 4-6 minutes (longer for WM, FW and FB). The rest periods should be 2-4 minutes. Players should aim to complete 4-6 sets. You should aim to vary the set-up, and be creative to get the desired training response. It is also possible to use small-sided games (6v6, 5v5, 4v4, 3v3) to train this fitness component, although the physical demands for players could be more varied due to individual work rate and perceived effort for players during a more randomised set-up.

### Repeated sprint ability (RSA)

The aim of RSA sessions is to complete repeated long sprints with inadequate rest so that the body has to adapt physiologically under a fatigued condition. The aim is to complete a 30-40m sprint including a football technical action during this work period, and then recover for 20 seconds. Players should aim to complete 3 sets of 6 repetitions. RSA sessions are good to complete in-season when time may be limited as they are a low-volume (duration) session. It is possible to vary the set-up and make it specific to player position. Again, whilst the work:rest durations would be

similar between player positions, the set-up should be varied to mimic the actions that players would be doing at high intensities during match-play, as can be seen in the variations described in Figures 61-63.

### Cool-down

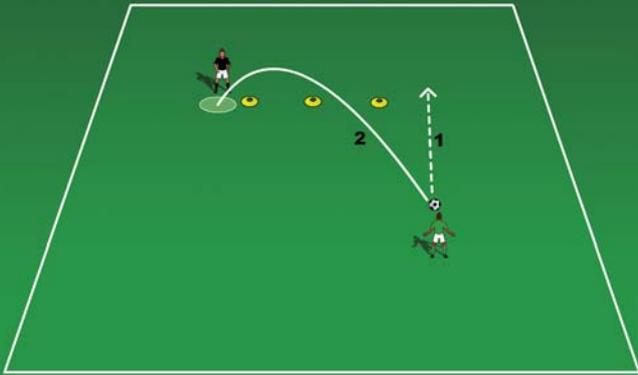
As soon as the players finish one training session or match, they are preparing for the next session. The purpose of the cool-down is to bring the heart rate back down to resting levels and to get the blood circulating freely back to the heart. The cool-down should also include stretching to help relax the muscles which worked hard during the activity. The cool-down stretches also increase flexibility, and might help to prevent DOMS (delayed onset muscle soreness) although this has not been proven. The cool-down should consist of the following:

- 5 minutes of light jogging
- Stretching (holding for no longer than 4-5 seconds) including the following muscles: calf, quads, hamstrings, hip flexor, groins
- 5 minutes of light jogging/skipping/dynamics
- Hydration

### Goalkeepers

Goalkeepers have different physical requirements to outfield players as they do not cover as much distance during matches or training sessions, and cover very little distance at the higher speeds.

However, goalkeepers do need to have a good baseline of endurance fitness so that they can recover rapidly following each explosive action that they complete so that they are able to do the next action with the same quality and speed. It is also



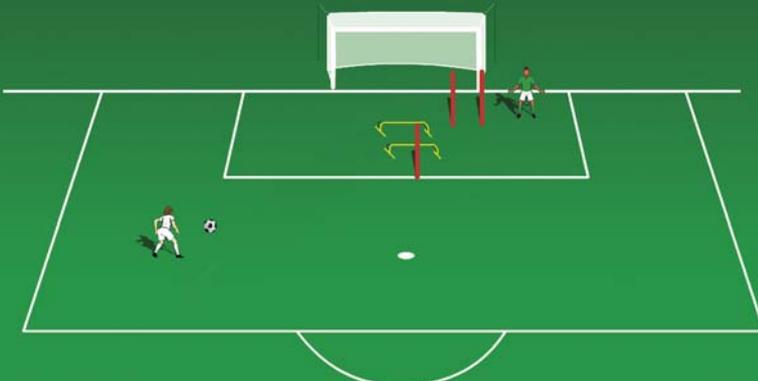
**Session information**  
 Reps: 8  
 Sets: 1-2  
 Recovery: 3min between sets

**Session set-up**  
 Equipment: 3 cones, as shown  
 10m x 10m

**Session Detail**

- GK uses footwork to get through cones and sets for a volley to the hands of the server (1).
- Footwork can be: lateral double touch, forward double touch, forward shuffle, backward shuffle, forward-backward step lateral.
- Progression: Change service to half-volley, strike from ground, side-volley into ground.
- Add second serve (2) after the set and toss a high ball for the GK to step back across the way they came from and take at the highest point.

Figure 64: Training session for goalkeepers



**Session information**  
 Reps: 8  
 Sets: 1-2  
 Recovery: 3min between sets

**Session set-up**  
 Equipment: 3 poles, 2 hurdles, as shown

**Session Detail**

- High intensity
- GK works through poles with forward-backward movement, 2-foot jumps over hurdles, around outside of pole and into line with server for shot into body.
- Server: volleys – half-volley – strike from ground – side-volley
- Adaptations: height of hurdles low to high, add 3rd hurdle, increase time or number of reps.
- Work both sides.

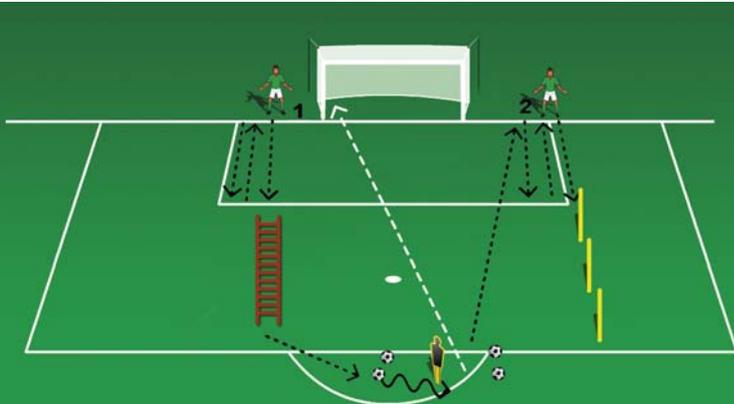
Figure 65: Training session for goalkeepers

important that they have a good base of strength so that they can then develop good power and explosive capabilities. Training for goalkeepers should largely involve goalkeeper-specific actions combined with physical attributes (speed, power, footwork) that goalkeepers need to possess.

Goalkeepers could complete the same warm-up as outfield players. For speed

and agility, they should aim to complete the first exercise (Figure 64). To also incorporate power, goalkeepers should complete the exercise outlined in Figure 65. Figure 66 shows the outline of an intensive endurance session specifically for goalkeepers.

Goalkeepers should then complete a cool-down, similar to outfield players.



**Session information**  
 Work: 2-4min  
 Recovery between sets: 2-4min  
 Sets: 4-6  
 RPE: 7-10 for work periods

**Session set-up**  
 Equipment: 3 poles, 1 ladder, 1 mannequin and 4 balls. Place equipment as shown

**Session Detail**

- Intensive endurance 1
- Start at position 1. Sprint forward to the edge of the 6-yard box, then immediately back to the end line. Then sprint forward and complete some sort of footwork through the ladder. Collect a ball, take a touch past the mannequin and the shoot the ball at goal, aiming for the upper third of the goal. Then jog to position 2. Once at position 2, sprint forward to the edge of the 6-yard box, then back-pedal to the end line, then sprint forward again and through the poles, to a ball, dribble a ball past the mannequin and shoot at the top of the goal. Jog to position 1. Do this continuously for 4 minutes. Then recovery for 3 minutes and collect the balls. Do 4 sets in total.

Figure 66: Training session for goalkeepers

## LIST OF ABBREVIATIONS

<b>a.e.t.</b>	After extra time
<b>AFC</b>	Asian Football Confederation
<b>ANOVA</b>	Analysis of variance
<b>AUS</b>	Australia
<b>BRA</b>	Brazil
<b>CAF</b>	Confederation of African Football
<b>CAN</b>	Canada
<b>CD</b>	Central defenders
<b>CHN</b>	China
<b>CIV</b>	Côte d'Ivoire
<b>CM</b>	Central midfielders
<b>CMR</b>	Cameroon
<b>COL</b>	Colombia
<b>CONCACAF</b>	Confederation of North, Central America and Caribbean Association Football
<b>CONMEBOL</b>	South American Football Confederation
<b>CRC</b>	Costa Rica
<b>DC</b>	Distance covered
<b>DOMS</b>	Delayed onset muscle soreness
<b>ECU</b>	Ecuador
<b>ENG</b>	England
<b>EQG</b>	Equatorial Guinea
<b>ESP</b>	Spain
<b>FB</b>	Full-backs
<b>FIFA</b>	Fédération Internationale de Football Association
<b>FRA</b>	France
<b>FW</b>	Forwards
<b>GER</b>	Germany
<b>GK</b>	Goalkeepers
<b>GPS</b>	Global Positioning System
<b>G</b>	Group stage
<b>HR</b>	Heart rate
<b>JPN</b>	Japan
<b>KO</b>	Knockout round(s)
<b>KOR</b>	Korea Republic
<b>MEX</b>	Mexico
<b>n</b>	Number of cases or sample size
<b>NED</b>	Netherlands
<b>NGA</b>	Nigeria
<b>NOR</b>	Norway
<b>NZL</b>	New Zealand
<b>OFC</b>	Oceania Football Confederation
<b>OP</b>	Outfield players
<b>PSO</b>	Penalty shoot-out
<b>r</b>	Pearson product-moment correlation coefficient
<b>RSA</b>	Repeated sprint ability
<b>RT</b>	Recovery time
<b>SD</b>	Standard deviation
<b>ST</b>	Speed threshold
<b>SUI</b>	Switzerland
<b>SWE</b>	Sweden
<b>TD</b>	Total distance
<b>THA</b>	Thailand
<b>U</b>	Under
<b>UEFA</b>	Union of European Football Associations
<b>USA</b>	United States of America
<b>UTC</b>	Coordinated Universal Time
<b>WM</b>	Wide midfielders/wingers

## GLOSSARY OF TERMS

Term	Definition
<b>ANOVA</b>	Statistical method for making simultaneous comparisons between two or more sets of data.
<b>Average distance</b>	Mean distance covered.
<b>Average distance of runs</b>	Mean distance between two runs.
<b>Average meterage</b>	Mean work rate (m/min) calculated for each team by dividing the team's total distance covered by the exact duration of the first half, second half, and/or full match.
<b>Average recovery time between runs</b>	Mean recovery time between two runs.
<b>Average speed</b>	Mean speed achieved.
<b>Coordinated Universal Time</b>	Primary time standard by which the world regulates clocks and time.
<b>Distance covered</b>	Amount of distance run.
<b>Distance covered in attacking third</b>	Overall distance run in the attacking third of the pitch.
<b>Distance covered in defensive third</b>	Overall distance run in the defensive third of the pitch.
<b>Distance covered in middle third</b>	Overall distance run in the middle third of the pitch.
<b>Distance covered with the ball</b>	Distance run when a team is in possession of the ball (excludes distance covered when ball is out of play).
<b>Distance covered without the ball</b>	Distance run when a team does not have possession of the ball (excludes distance covered when ball is out of play).
<b>Delayed onset muscle soreness</b>	Pain and stiffness felt in muscles usually within 24 to 72 hours after unaccustomed or strenuous exercise is performed.
<b>Effective playing time</b>	Total time when the ball is in play or in control of either team. The total value is the sum of both team values.
<b>Match duration</b>	Total time duration of the match or each half.
<b>Maximum heart rate</b>	Highest heart rate that can be attained by an individual in strenuous activity.
<b>Maximum speed</b>	Highest speed achieved.
<b>Number of runs</b>	Total number of runs recorded for each team or individual player.
<b>Per cent team ball possession</b>	Per cent of each team's collective ball possessions out of both teams' collective ball possessions.
<b>Per cent team passing success</b>	Per cent of successful passes that were received by another player of the same team out of the total number of passes recorded for each team.
<b>Product-moment correlation coefficient</b>	Measure of the linear correlation between two variables X and Y, giving a value between +1 and -1 inclusive, where 1 means total positive correlation, 0 no correlation, and -1 total negative correlation.
<b>p-value</b>	Value used in statistics as a function of the observed sample results (expressed as a test statistic) that is used for testing a statistical hypothesis.
<b>Repeated sprint ability</b>	Ability to perform repeated sprints ( $\leq 10$ s) interspersed with brief recovery periods (usually $\leq 60$ s).
<b>Standard deviation</b>	Measure of the dispersion of a set of data from its mean.

Term	Definition
Speed threshold	Speed range that defines a particular movement category.
Team corner kicks	Number of attacking corners obtained by a particular team per match.
Team final tournament ranking	Final place achieved by each team during each tournament.
Team goals conceded per match	Number of goals conceded by each team per match.
Team goals scored per match	Number of goals scored by each team per match.
Team shots on goal	Total number of shots on target by each team per match.
Total team passes	Total number of passes completed by each team per match.
t-test	Statistical method used to see if two sets of data differ significantly.



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