THE RISE OF THE WOMEN'S GAME

A PROFESSIONAL PERSPECTIVE

– *Written by Dawn Scott, USA*

I have provided sport science support to elite women's football since 2001 and in that time I have seen the game evolve in many aspects. Initially very few players were paid professionals and instead had to combine full-time jobs with full-time training programmes, meaning that programme quality was often compromised and recovery was sub-optimal. Individual nations are now progressively increasing the funding and support provision for female players, which has resulted in an increase in the professionalism of the sport in recent years, with elite players now employed on either a professional or semi-professional basis. During the 2015 to 2016 season, 168 top-tier women's competitions were organised, representing 80% of the 211 member associations affiliated to FIFA[1]. In Europe, National Federations have increased their spending on women's football[2] and many of the teams competing at the Women's EURO 2017 finals were supported by a holistic staff group including performance coaches, psychologists, video analysts, security and a chef. The hosts, the Netherlands, went on to win the tournament, ending the dominance of Germany who had won the previous six editions. In the USA, the National Women's Soccer League (NWSL), run by the United States Soccer Federation (USSF), is one of the leading professional women's football leagues in the world and is in its record fifth season, with average match attendance of 5500. In an attempt to optimise player development and preparation at the clubs, a comprehensive sport science support programme integrating wellness monitoring, as well as the implementation of heart rate and global positioning satellite (GPS) technology to track and quantify training and game loads has been introduced. Additionally, the USSF has recently launched The Girls' Development Academy, which is part of US Soccer's global leadership position in women's football and connects with its mission to develop world-class players, coaches and referees. The objective of the Academy is to impact the everyday club environment to develop world-class players and provide an improved player development model for the elite female player to focus solely on training, with the appropriate number and level of games. This model focuses on developing the individual player within the club environment, which allows for additional training sessions per season to enhance player development. Consequently, as the professional environment grows in the women's game, more players are training and competing full-time, meaning their physical preparation is paramount to ensure an optimal training dose to enhance development and game preparation, while aiming to reduce injury rates.

Much of the research to date on women's football[3] 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. However, such research has generally consisted of a small number of players and/or a variety of assessment methods, making comparison

difficult. Much less research has focused on training quantification and the physical match demands for female football players.

An understanding of the demands of match play is vital to develop a systematic training model and ensure our methods of training female players are actually relevant and not outdated. Despite there being a plethora of research on the men's game, Davis and Brewer[4] were the first to report any data on female players, with unpublished data on female national team players (n=7) using video-tape methods and stated that players covered a total distance (TD) of 8.47±2.2 km and average sprint distances (thresholds not defined) of 14.9±5.6 m. In this initial work, there was very limited information offered regarding any high-speed activity and no definition of speed thresholds for the sprint distance reported. Bangsbo et al[5] reported that the average elite female player from the Danish league covered approximately 9.5 km during a match, 1 km greater than the figure reported by Brewer and Davis[4]. More recent studies[6-8] have used larger sample sizes (n=13 to 58) and similarly reported that female players generally cover 10 km during match play. Mohr et al[7] found that top international female players covered an average distance of 1.7 km via high-speed running (HSR) during a match, which differed from elite male players who covered approximately 2 to 3 km via HSR during a match[9]. This finding is consistent with the higher endurance levels (senior males completed 97% more distance during the YO-YO IR1 compared to senior female players) found in senior male compared to female players in a professional club[10] and hence a reduced capability to recover and subsequently complete the same amount of HSR as male players. Additionally, previous research has found the amount of HSR performed by female soccer players is related to the competition level and may range between 0.7 and 2.0 km during a match[7,11]. It has also been reported that the same female player covered a greater amount of HSR when playing an international match than when competing in a domestic league match[8].

With advances in technology and women's football in general, and in an attempt to address some of the limitations of the earlier research in women's football, more recent studies have used more advanced analysis methods (GPS technology and semi-automated camera systems) now commonly used during the analysis of male football[12-17]. Hewitt et al[12] were one of the first research groups to use GPS technology during female international match play (n=15) and found players to complete a TD of 9.1±1.0 km, HSR (>16 km/h) of 0.6±0.1 km and with 280±80 sprinting bouts (>25 km/h). However, the GPS technology used in this study was 5 Hz and caution should be applied when analysing HSR activity with any GPS technology with a sampling rate less than 10 Hz[18]. Few studies to date have used GPS technology to determine match demands for female players, in part because its use during games was only sanctioned by FIFA in 2015. In unpublished data collected during the 2016 NWSL season using 10 Hz GPS technology, analysis of 2552 individual game files across 181 games showed the average TD covered by players to be 9.6 km, with an average HSR (>17.8 km/h) of 635 m. On average, players completed 39 high-speed (>17.8 km/h) and 9 sprint (>22.3 km/h) efforts. This analysis shows that the average physical game demands of domestic compared to international football

is very similar in terms of TD and HIR, which contradicts the earlier work by Mohr et al[7]. This could be due to the development of the women's game; increased funding and level of professionalism, and players now training full-time with their clubs. However, comparing data from older studies using video editing with newer GPS technology data, as well as comparison between data from different GPS systems, should be done with caution as the between-system agreement is problematic[19] and simply comparing data between different collection methods is hazardous[20]. The more data that can be collected on female players, the better insight we can gain in terms of the physical demands players face during games. This will help with planning specific conditioning programmes to ensure players are better prepared for those physical demands. Furthermore, with bigger sample sizes and information regarding positional and tactical impact, and age-specific demands for female players, this preparation can become even more refined and specialised.

In 2011, the first ever physical analysis of the FIFA Women's World Cup™ was conducted using a semi-automatic camera system. However, the report[21] used speed thresholds and definitions which had not previously been used, making comparison to the available research difficult. The main findings from the 2011 World Cup analysis reported that outfield players covered an average TD of 10.2 km during games, with 2.3 km of moderate running (12.1 to 18 km/h), 395 m of high-speed running (18.2 to 21 km/h), 235 m of optimum sprinting (21.1 to 25 km/h) and 55 m of maximum sprinting (25 km/h). The analysis also showed that, on average, players from the top six ranked teams in the tournament covered 10.6 km per game, compared to 9.9 km 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% in 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. Physical analysis of the FIFA Women's World Cup™ was conducted again in 2015[22], and outfield players covered 10.9 km on average, which was slightly higher than in 2011. Figure 1 shows the average distance covered in each speed threshold (the 2011 data was re-analysed using the same thresholds as the 2015 analysis) for 2011 and 2015 FIFA Women's World Cup™.

There was very little difference between any of the speed thresholds and the average distance completed, suggesting the physical game demands were very similar. For the 2015 FIFA Women's World Cup™, the tournament increased from 16 to 24 participating teams and required greater travel distances across multiple time zones in Canada, compared to less challenging travel in Germany in 2011. Such factors could have an impact on the results observed and, generally, the higher placed teams, in terms of final tournament ranking, covered more distance in the higher intensity thresholds. During the 2015 FIFA Women's World Cup™, HSR (>16 km/h) accounted for 12% of the TD, while Rampinini et al[23] reported that high-speed activity accounts for approximately 8% of the total distance covered during match-play in men's football. Research in women's football has found that high-speed running activities account for between 12.5% for domestic Scandinavian league players[7] and as much as 24.7% for Australian international players[24]. These values suggest that female players are completing a comparable, if not higher, proportion of HSR as male players. As such, preparation is key to ensure the players have the capacity

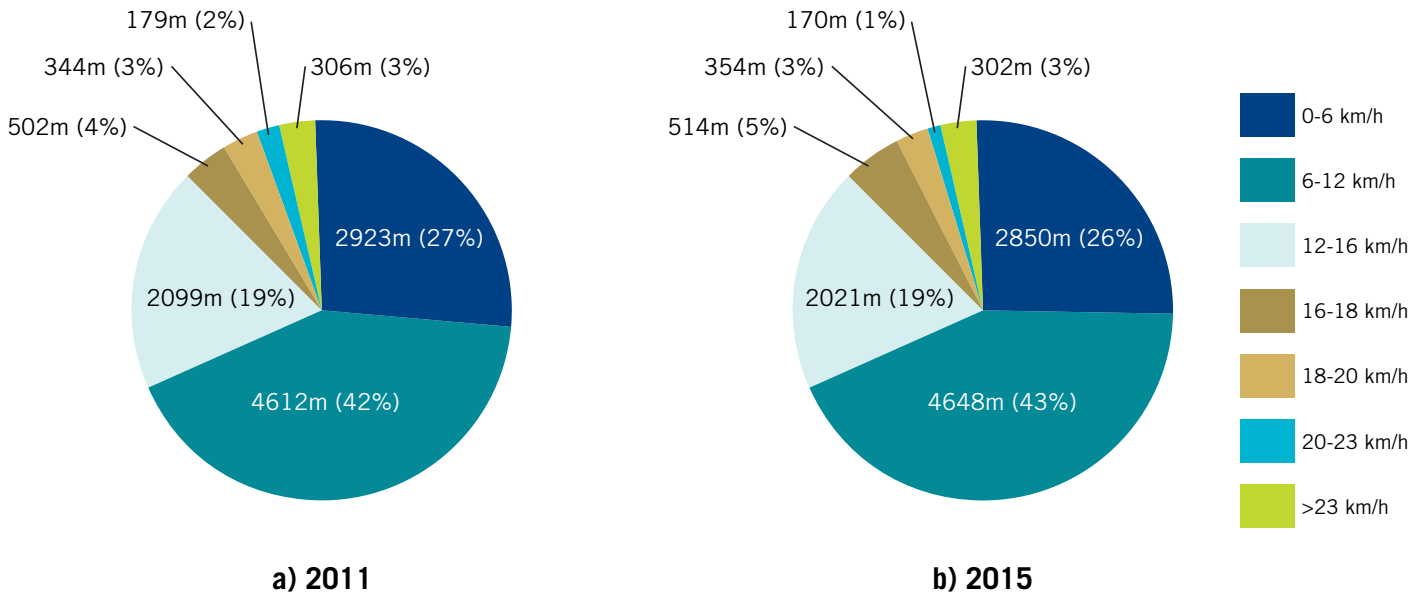

Figure 1: Analysis of the average distances covered per outfield player per match for the FIFA Women's World Cup Germany 2011™ and the FIFA Women's World Cup Canada 2015™.

to complete these loads. 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[25] found that high-speed activity completed by players during match play is highly variable between matches and is affected by factors such as playing position and ball possession, which are in turn affected by the tactical and technical requirements of each 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 match requirements.

Datson et al[16] published the largest study to date on women's football, when they conducted an analysis of the physical demands of different playing positions during competitive female international match play. A total of 107 outfield players were observed across two seasons, encompassing 148 match observations, with a median of 2 matches per player (range=1 to 4). A computerised semi-automatic multi-camera system was used. Playing position was characterised as central defender (CD), wide defender (WD), central midfield (CM), wide midfield (WM) and attacker (ATT). They found that total distance and total high-speed running (THSR – defined as greater than 14.4 km/h) were influenced by playing position. CM completed the highest TD and THSR (10985±706 m and 2882±500 m, respectively), while CD completed the lowest (9489±562 m and 1901±268 m). The researchers also found that there was a reduction in work rate from the first to the second half. This research gives a further insight into the positional demands for female players, as well as the work rate as games progress. The authors used velocity thresholds that have commonly been used in the analysis of male players[26,27], meaning 19.8 km/h was used as the threshold for high speed running and 25.1 km/h was used as the sprint threshold, the authors felt that the speed thresholds proposed for female players[15] were not representative of the physical characteristics of elite female players. Again, this highlights the differing opinions in terms of the velocity thresholds that should be used for female players. A few studies[13,15,28] have more recently tried to standardise such thresholds to better reflect the physical capabilities of female players. However, this warrants further research to determine universal thresholds so that better comparisons can be made between research conducted in women's football. While Datson et al[16] used a large cohort of players, the study focused on international players and used a sophisticated camera system not affordable or accessible to many female teams, so caution should be used when comparing this data to other methods. 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. Additionally, limited data is available on youth players and, specifically, the physical demands at the different age groups.

One other area of research that is especially lacking in female athletes is in relation to the menstrual cycle and how that may affect physical performance and potential injury risk[29]. Bruinvels et al[30] recently reported that 41.7% of exercising women believe their menstrual cycle has

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a negative impact on exercise training and performance. However, largely due to the dearth of sports and exercise research in women, explanations for this are lacking. Heavy menstrual bleeding with unknown or undiagnosed iron deficiency could be a cause, but this is speculative[30]. Research has generally shown that there is a higher incidence of ACL injuries in females – two to six times greater than in males[31] – and that women are potentially more predisposed to non-contact ACL injuries during the pre-ovulatory phase of the menstrual cycle, when oestrogen levels are high[32]. This could have implications for practitioners working with female players and managing those players during training and competition to reduce the risk of injury in relation to the phase of the menstrual cycle. Furthermore, this can also help practitioners in the planning and implementation of conditioning programmes, 'prehab' and injury prevention programmes dependent on the phase of the cycle, in an attempt to optimise performance and minimise the impact of the menstrual cycle on the athlete.

A holistic player monitoring system is important for the development of systematic training models for individual players. Since you cannot manage what you do not monitor[33], it is important that practitioners have a comprehensive approach in their tracking of internal and external load parameters. As the women's game continues to grow and funding is increased, players are better able to train and compete full-time, so there is an increased need to determine the physical game demands for players, required levels of fitness to cope with such demands and optimal programmes that will prepare players for those physical loads. As such, further research is warranted to determine the physical game demands for players at domestic and international level, including contextual considerations such as positional demands, tactical strategy, environment, jet lag, and demands across the different age ranges. The use of a greater number of players and/or games will give a better picture of the actual demands and negate some of the physical match variability[25] previously observed. Additional to this, consensus on suitable speed thresholds to be used for female players is required so that comparisons between data can be made more easily. Finally, there is a clear need to gain better understanding of female physiology and to define the effects of the cyclical variations in hormones, both positive and negative, on athletic performance. Furthermore, it is necessary to evaluate how the fluctuating hormone levels alter the biomechanical and physiological profile of athletes and how that affects training, injury risk and performance.

As female football continues to grow worldwide, more data is needed on the physical match demands and training loads/methods required to optimally prepare players for those loads, while minimising injury risk.

Research should focus on contemporary methods for determining the match demands for female players and researchers should aim to study a greater number of players and/or games and reach consensus on the speed thresholds for female players.

Further research is warranted with regards to how the menstrual cycle may affect physical performance and potential injury risk, and more specifically how practitioners should monitor this and modify training programmes as appropriate.

References available at www.aspetar.com/journal

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