©Journal of Sports Science and Medicine (2009) **8,** 278-283
http://www.jssm.org

Research article

Game related statistics discriminating between starters and nonstarters players in Women's National Basketball Association League (WNBA)

Miguel. A Gómez [1]✉, Alberto Lorenzo [2], Enrique Ortega [3], Jaime Sampaio[4] and Sergio. J Ibáñez [5]
[1] Faculty of Education, Complutense University of Madrid, Spain, [2] Faculty of Physical Activity and Sport Sciences, Technical University of Madrid, Spain,[3] Faculty of Health, Physical Activity and Sport Sciences, Catholic University Saint Anthony of Murcia, Spain, [4] Research Center in Sport Sciences, Health and Human Development, Portugal, [5] Faculty of Sport Sciences, University of Extremadura, Spain.

Abstract
The aim of the present study was to identify the game-related statistics that allow discriminating between starters and nonstarter players in women's basketball when related to winning or losing games and best or worst teams. The sample comprised all 216 regular season games from the 2005 Women's National Basketball Association League (WNBA). The game-related statistics included were 2- and 3-point field-goals (both successful and unsuccessful), free-throws (both successful and unsuccessful), defensive and offensive rebounds, assists, blocks, fouls, steals, turnovers and minutes played. Results from multivariate analysis showed that when best teams won, the discriminant game-related statistics were successful 2-point field-goals (SC = 0.47), successful free-throws (SC = 0.44), fouls (SC = -0.41), assists (SC = 0.37), and defensive rebounds (SC = 0.37). When the worst teams won, the discriminant game-related statistics were successful 2-point field-goals (SC = 0.37), successful free-throws (SC = 0.45), assists (SC = 0.58), and steals (SC = 0.35). The results showed that the successful 2-point field-goals, successful free-throws and the assists were the most powerful variables discriminating between starters and nonstarters. These specific characteristics helped to point out the importance of starters' players shooting and passing ability during competitions.

Key words: Performance, game-statistics, starters, nonstarters, women's basketball.

Introduction

Nowadays, basketball coaches and performance analysts have used game-related statistics to study team's and player's performance in different game contexts (Hughes and Franks, 2004). In this particular topic, published research has been focussed specifically on men's teams (Ibáñez et al., 2003; Trninić et al., 2002). However, available research on women's basketball (Gómez et al., 2006) and also in comparing both genders' performances (Sampaio et al., 2004) is very limited. This fact reflects that women's basketball analysis through game-related statistics would seem to be an important area of research, because the teams' and players' performance differ as a function of the gender. According to Sampaio et al. (2004) the anthropometric, technical and tactical characteristics in both genders configure different game tactics and strategies. Therefore, it seems reasonable that the gender of the sample studied can have an impact upon players' game-related statistical profile.

On the other hand, an important topic studied in basketball is the players' performance analysis during games and competitions (Sampaio et al., 2006b), specifically, studying the five players who will start the game and their performance when compared with those players who are not selected for the starting five of the team. One particular study (Sampaio et al., 2006a) analyzed the 2002-2003 regular season from the Portuguese Professional League, and found that when the best teams lost, nonstarters' performance was worse than the starters', whereas when the worst teams lost, the starters' performance was worse than the nonstarters'. According to these authors, the differences between starters and nonstarters are probably influenced by game outcome and team quality, which seem to affect players' game-related statistical profile, and consequently configure different game styles. In fact, as some authors argued (Sampaio et al., 2004; 2006b) coaches prepare and select players according to different factors (e.g., team status, player's position or gender) that are strongly influenced by their knowledge and perceptions. This fact suggests a need to improve the knowledge about women's basketball, which is very limited and generally based on men's norms, in particular to know women's player performance and their contributions to team performance according to their player status. Thus, the aim of the present study was to examine the differences in game-related statistics between basketball starters and nonstarters players when related to game outcome and team quality in Women's National Basketball Association League (WNBA).

Methods

Sample and variables

Archival data were obtained from the 2005 regular season official box scores (n = 216 games) of the WNBA (Women's National Basketball Association). The game-related statistics gathered included: 2- and 3-point field-goals (both successful and unsuccessful), free-throws (both successful and unsuccessful), defensive and offensive rebounds, assists, blocks, fouls, steals, turnovers and minutes played. All data were collected by experts from the League.

Women's players were classified as starters (n = 2134) or nonstarters (n = 1643) as they were selected or not for the starting five of the team. All records were later analysed according to team quality (best teams, classified

Received: 11 February 2009 / Accepted: 07 April 2009 / Published (online): 01 June 2009

Table 1. Descriptive results and univariate differences between starter and nonstarter players according to the team quality (best and worst teams) in winning and losing games.

Variables	Winning Games				Losing Games			
	Starters		Nonstarters		Starters		Nonstarters	
	M	SD	M	SD	M	SD	M	SD
Best Teams								
Successful 2-pt field-goals *†	.13	.07	.10	.09	.11	.06	.09	.08
Unsuccessful 2-pt field-goals *†	.16	.07	.14	.11	.18	.08	.16	.11
Successful 3-pt field-goals	.01	.03	.01	.03	.01	.02	.01	.03
Unsuccessful 3-pt field-goals †	.03	.04	.02	.05	.04	.05	.03	.05
Successful free-throws *†	.08	.07	.05	.08	.06	.07	.04	.08
Unsuccessful free-throws	.02	.04	.02	.06	.02	.03	.02	.05
Offensive rebounds *	.04	.05	.04	.07	.04	.04	.04	.06
Defensive rebounds *†	.11	.08	.09	.09	.10	.07	.08	.08
Assists *†	.08	.06	.06	.07	.06	.06	.05	.07
Fouls *†	.08	.06	.11	.10	.10	.07	.13	.11
Steals †	.03	.04	.03	.05	.03	.03	.02	.04
Turnovers *	.06	.05	.07	.08	.07	.05	.07	.08
Blocks *†	.02	.03	.01	.03	.01	.03	.01	.03
Worst Teams								
Successful 2-pt field-goals *†	.13	.07	.10	.08	.11	.06	.09	.09
Unsuccessful 2-pt field-goals *†	.15	.08	.13	.10	.17	.08	.16	.12
Successful 3-pt field-goals	.02	.04	.02	.05	.01	.02	.01	.04
Unsuccessful 3-pt field-goals	.03	.04	.03	.06	.04	.04	.04	.07
Successful free-throws *†	.07	.07	.05	.08	.06	.07	.04	.08
Unsuccessful free-throws	.02	.03	.02	.05	.02	.03	.01	.04
Offensive rebounds *†	.04	.04	.05	.07	.04	.04	.04	.06
Defensive rebounds *	.11	.07	.09	.10	.09	.07	.09	.09
Assists *†	.08	.06	.05	.08	.07	.06	.05	.07
Fouls †	.09	.06	.10	.09	.10	.07	.12	.11
Steals *	.04	.03	.02	.04	.03	.03	.03	.05
Turnovers †	.06	.05	.06	.07	.08	.05	.06	.07
Blocks	.02	.04	.02	.04	.01	.03	.01	.03

* Univariate statistically significant differences between starters and nonstarters on winning games ($p \leq .05$).
† Univariate statistically significant differences between starters and nonstarters on losing games ($p \leq .05$).

for the playoffs, and worst teams, teams who miss playoffs) and game outcomes (winning and losing). According to the available studies (Sampaio et al., 2006a, 2006b, 2008) the players whose participation in any game was less than five minutes duration were excluded from the analysis (starters, $n = 29$; nonstarters, $n = 417$).

Statistical analyses

In order to compare the game-related statistics collected between starters and nonstarters, each player's results were divided by that player's time on court, resulting in derived rate variables. Four descriptive discriminant analyses were performed according to team quality (best teams and worst teams) and game outcomes (winning and losing). The interpretation of the discriminant functions was based on examination of the structure coefficients which were higher than |0.30| (Tabachnick and Fidell, 2007). This validation of discriminant models was conducted using the leave-one-out method of cross-validation (Norušis, 1998). Cross-validation analysis takes subsets of data for training and testing and is needed in order to understand the usefulness of discriminant functions when classifying new data. This method involves generating the discriminant function in all but one of the participants (n-1) and then testing for group membership on that participant. The process is repeated for each participant (n times) and the percentage of correct classifications generated through averaging for the n trials. The statistical analyses were performed using SPSS software release 13.0 and significance was set at $p \leq 0.05$.

Results

The means and standard deviations for each group of women's basketball players for the game-related statistics are presented in Table 1.

The obtained discriminant functions were all statistical significant ($p \leq 0.05$). Results showed (see Table 2) that when best teams won games starters were discriminated from nonstarters by their higher values in successful 2-point field-goals (SC = 0.47), successful free-throws (SC = 0.44), fouls (SC = -0.41), assists (SC = 0.37), and defensive rebounds (SC = 0.37). When best teams lost games, results were very similar and described differences between both groups on successful 2-point field-goals (SC = 0.39), defensive rebounds (SC = 0.34), successful free-throws (SC = 0.32), assists (SC = 0.31), fouls (SC = -0.46), and unsuccessful 2-point field-goals (SC = 0.39).

When worst teams won games, starters were discriminated from nonstarters by their higher values in successful 2-point field-goals (SC = 0.37), successful free-throws (SC = 0.45), assists (SC = 0.58), and steals (SC = 0.35). Conversely, when these teams lost games, results described differences between both groups on successful 2-point field-goals (SC = 0.30), successful free-throws (SC =0.43), assists (SC = 0.36), fouls (SC = -0.36), and turnovers (SC = 0.33).

Table 2. Discriminant function structure coefficients, residual discrimination and tests of significance.

	Best Teams		Worst Teams	
Variable	**Winning**	**Losing**	**Winning**	**Losing**
Successful 2-pt field goals * † # ‡	.47	.39	.37	.30
Successful free-throws * † # ‡	.44	.32	.45	.43
Fouls * † ‡	-.41	-.46	-.21	-.36
Defensive rebounds * †	.37	.34	.24	.07
Assists * † # ‡	.37	.31	.58	.36
Blocks	.26	.26	.04	.07
Unsuccessful 2-pt field goals †	.25	.39	.25	.21
Successful 3-pt field goals	.16	.19	.02	.00
Turnovers ‡	-.15	.00	.10	.33
Unsuccessful 3-pt field goals	.13	.27	-.02	-.14
Offensive rebounds	-.07	.06	-.24	-.22
Steals #	.04	.29	.35	.03
Unsuccessful free-throws	-.02	-.04	.09	.14
Eigenvalue	.13	.08	.14	.09
Canonical correlation	.34	.27	.36	.30
Chi-squared	170.4	75.6	68.6	90.1
Wilks Lambda	.88	.92	.87	.91
p	<.001	<.001	<.001	<.001

* SC discriminant value ≥|0.30| for starters and nonstarters in games won by best teams;
† SC discriminant value ≥|0.30| for starters and nonstarters in games lost by best teams;
# SC discriminant value ≥|0.30| for starters and nonstarters in games won by worst teams;
‡ SC discriminant value ≥|0.30| for starters and nonstarters in games lost by worst teams.

The leave-one-out test summarizes the ability of the discriminant functions to correctly classify the players (see Table 3). This analysis provided an overall percentage of successful classification of 64.6% for the best teams winning games and 66.7% for losing games. The worst teams obtained an overall percentage of successful classification of 61.4% on winning games and 63.7% on losing games.

Discussion

The aim of the present study was to examine the differences in game-related statistics between basketball starters and nonstarters players when related to game outcome and team quality in women's basketball. It was argued that the gender of the players and their physical differences would configure different game-related statistical profile.

There are rule differences between the sample studied (WNBA) and the European basketball. In particular, Reimer (2005) compared FIBA and North-American rules, and found the following differences for WNBA 2005 season: i) two time periods of 20 minutes instead of four periods of 10 minutes; ii) thirty seconds in each ball possession instead of twenty four seconds; iii) six fouls per player instead of five personal fouls; and iv) seven team fouls to go to the free-throw line instead of five team fouls. Therefore, despite the present results are characterizing the highest level of women's competition; extrapolation to other contexts should consider differences in rules.

The results identified several differences from those obtained in men's players' available research (see Sampaio et al., 2006a). Results from the discriminant analysis showed the power of successful 2-point field-goal, successful free-throws and assists discriminating between starters and nonstarters players in all four analyses. These variables are offence-related, and reflect the importance of field-goal selection after good passes, or getting to the free-throws line as often as possible with better decision-making and game situations that allow receiving an opponent's personal foul with free-throws.

In women's basketball the importance of successful 2-point field-goals and assists are strongly associated with winning teams (Gómez et al., 2006) and are the basis of offensive efficiency reflecting that best teams are tactically disciplined with clearly assigned responsibilities. Specifically, Oliver (2004) argued that in the WNBA the game pace has been getting slower, and efficiency has been getting better, this may be explained because

Table 3. Classification matrix.

Actual Membership		**n**	**Predicted Group Membership**			
			Starter		**Nonstarter**	
			n	**%**	**n**	**%**
Best Teams						
Winning	Starter	775	506	65.3	269	34.7
	Nonstarter	574	208	36.2	366	63.8
Losing	Starter	531	326	61.4	205	38.6
	Nonstarter	427	165	38.6	262	61.4
Worst Teams						
Winning	Starter	294	196	66.7	98	33.3
	Nonstarter	210	70	33.3	140	66.7
Losing	Starter	534	349	65.4	185	34.6
	Nonstarter	432	266	38.4	166	61.6

coaches prepare games and competitions with more emphasis on better field-goals selection and better ball-handling skills. The fact that starters made more 2-point field-goals and assists suggests, on the one hand, that starters exhibit better psychological responses such as greater role efficiency and desire for affiliation that allow them to get better team coordination and, consequently, field-goals opportunities (Bray, 2002; Gruber and Gray, 1982). And, on the other hand, women's players are much more likely than men's players to be disturbed by negative comments or crowd support (Pendleton, 2001) then it is not surprising that the nonstarters missed more 2-point field-goals and failed more passes. This could reflect that nonstarters are less task conscious and less confident with their own performance than starters (Gruber and Gray, 1982), as a consequence of that they get poorer offensive performances.

The importance of successful-free-throws has been found in men's teams discriminating team success (Ibáñez et al., 2003; Kozar et al., 1994), whereas in women's teams did not discriminate winning and losing teams (Gómez et al., 2006). This game-related statistic discriminated starters and nonstarters, and may represent the importance of penetrating the opponents defence, because it increases high field-goals percentages and personal fouls received (Trninić et al., 2002). The differences in free-throws performance between starters and nonstarters may be associated to: i) technical performances and psychological aspects (i.e., concentration, motivation, confidence or task consciousness) that affect the free-throws execution; and ii) the offensive production, where starters generate better field-goal situations and get to draw fouls.

In both groups (best and worst teams) the remaining variables that best discriminated between starters and nonstarters were defence-related. In best teams, both groups were discriminated by defensive rebounds and fouls, these variables were found in men's teams as the most powerful variables discriminating starters and nonstarters (Sampaio et al., 2006a). This reflects that starters have better defensive performances in defensive rebounds associated with better jumping ability (Sampaio et al., 2006a). On the other hand, the lower fouls committed also reflect better defensive play maintaining 5 or 6 steps from one to offensive players, and this allow to successful defensive helping and reduces fouls committed (Trninić et al., 2002). One last factor seems to have influenced these results which is that nonstarters players are less worried with the 6-fouls limit that exists in the WNBA (rule 12.B. Personal foul), probably because they play less time. Thus, they could play focusing their attention on high defense pressure based on irregular hand use and physical contacts, because they are not affected by their exclusion (Sampaio et al., 2006a). Comparing the starters' and nonstarters' performance when they won or lost (Table 1), the descriptive results reflect that the best teams lost their games because starters' and nonstarters' performance was worse.

In worst teams, starters and nonstarters were also discriminated by steals in won games with better values for starter players. This fact reinforces the idea of better defensive preparation in comparison with nonstarters. Trninić et al, (2002) argued that steals are a result of aggressive defensive play that decreases the offensive player's abilities allowing to recover the ball. Thus, it is not surprising that starters are more confident and task conscious with their own performance (Gruber and Gray, 1982) and their defensive readiness is better than nonstarters resulting in an increasing number of steals. Conversely, in lost games starters were also discriminated from nonstarters by their higher number of turnovers. This result could be explained with the poor controlled style of play that starters showed in lost games, because it would increase risks in resolving game attacks and may generate more turnovers after bad passes or poor dribbling (Trninić et al., 2002).

Comparing the starters' and nonstarters' performance when they won or lost (Table 1), the descriptive results reflect that worst teams lost their games because starters' performance was worse. These results are different from those obtained in best teams, and reflect that best teams need better starters and nonstarters' performances to win games, whereas in worst teams the starters' performance should be better to win games. These facts enhance the importance of team cohesion between both groups, according to Bergeles and Hatziharistos (2003), when starters are attracted to each other to the same competitive goal, the team's performance is enhanced and leads to higher scoring.

The prediction of group membership was similar for starters and nonstarters in all the analyses. These values were moderate, with results between 66% and 61%. These percentages reflect the ability of the discriminant function to correctly classify the players in their respective statuses (starter or nonstarter). Thus, it seems that both players' role is less clear and that on some occasions they could be classified as starters. This fact, as Oliver (2004) suggested, could be associated with the WNBA young life, where players showed similar performances, and only a few group of mature players have better performances than the other players. This individual dominance would configure in the league different game styles and strategies based on best players contribution.

The results found in the present study indicate that men's and women's teams have different playing styles. These differences may reflect that women's teams play with slower game pace (Oliver, 2004), probably women's teams attack more frequently versus zone defenses, which require more emphasis on team and less on individual defense (Gómez et al., 2008). Thus, women's teams need more passes and structured offenses to break the opposite defense as pointed out by the importance of offensive actions (assists and 2-point field-goals). On the other hand, men's teams have higher game pace (Oliver, 2004; Ortega et al., 2007). This suggest better physical parameters that allow to defend with higher intensity, more physical contact and with a game based on defensive rebounds to initiate their ball possessions, and fouls trying to stop the opposite offence.

Conclusion

In practical applications, players' game-related statistical

profiles varied according to team status and across the gender studied. Coaches can use these results to make training programmes more specific and detailed in women's basketball, and to focus their attention on different players' contribution to team performance as well. For example, coaches could pay special attention to their starters' passing and shooting ability, and to their nonstarters' defensive skills in rebounding, anticipation or drawing fouls.

References

Bergeles, N. and Hatziharistos, D. (2003) Interpersonal attraction as a measure of estimation of cohesiveness in elite volleyball teams. *Perceptual and Motor Skills* **96(1),** 81-91.

Bray, S.R. (2002) Efficacy for interdependent role functions. *Small Group Research* **32(3),** 356-373.

Gómez, M.A., Lorenzo, A., Barakat, R., Ortega, E. and Palao, J.M. (2008) Differences in game-related statistics of basketball performance by game location for men's winning and losing teams. *Perceptual and Motor Skills* **106**, 43-50.

Gómez, M.A., Lorenzo, A., Sampaio, J. and Ibáñez, S.J. (2006) Differences in game-related statistics between winning and losing teams in women's basketball. *Journal of Human Movement Studies* **51**, 357-369.

Gruber, J. and Gray, G. (1982) Responses to forces influencing cohesion as a fuction of player status and level of male varsity basketball competition. *Research Quarterly for Exercise and Sport* **53**, 27-36.

Hughes, M. and Franks, I.M. (2004) *Notational analysis of sport. Systems for better coaching and performance in sport.* Routledge. London.

Ibáñez, S.J., Sampaio, J, Sáenz-López, P, Giménez, J. and Janeira, M.A. (2003) Game statistics discriminating the final outcome of junior world basketball championship matches (Portugal 1999). *Journal of Human Movement Studies* **74**, 1-19.

Kozar, B., Vaughn, R.E, Whitfield, K.E, Lord, R.H, and Dye, B. (1994) Importance of free-throws at various stages of basketball games. *Perceptual and Motor Skills* **78(1),** 243-248.

Norušis, M.J. (1998) *SPSS 8.0: Guide to Data Analysis*. Prentice-Hall. Upper Saddle River.

Oliver, D. (2004) *Baketball on paper. Rules and Tools for Performance Analysis.* Brassey´s, Inc. Washington, D. C.

Ortega, E., Palao, J.M., Gómez, M.A., Lorenzo, A. and Cárdenas, D. (2007) Analysis of the efficacy of possessions in boys' 16 and under basketball teams: differences between winning and losing teams. *Perceptual and Motor Skills* **104**, 961-964.

Pendleton, S. (2001) Motivating female athletes for success in basketball. *Scholastic Coach and Athletic Director* **70**(7), 96-97.

Reimer, A. (2005) FIBA vs North American rules comparison. *FIBA Assist Magazine* **14**, 40-44.

Sampaio, J., Ibáñez, S, Lorenzo, A, Gómez, M, A, and Ortega, E. (2008) Game location influences basketball players' performance across playing positions. *International Journal of Sport Psychology* **39(3),** 205-216.

Sampaio, J., Ibáñez, S., Lorenzo, A. and Gómez, M, A. (2006a) Discriminative game-related statistics between basketball starters and nonstarters when related to team quality and game outcome. *Perceptual and Motor Skills* **103**, 486-494.

Sampaio, J., Janeira, M., Ibáñez, S. and Lorenzo, A. (2006b) Discriminant analysis of game-related statistics between basketball guards, forwards and centres in three professional leagues. *European Journal of Sport Science* **6(3),** 173-178.

Sampaio, J., Ibáñez, S. and Feu, S. (2004) Discriminatory power of basketball game-related statistics by level of competition and sex. *Perceptual and Motor Skills* **99**, 1231-1238.

Tabachnick, B.G. and Fidell, L.S. (2007) *Using Multivariate Statistics.* Harper Collins, New York.

Trninić, S., Dizdar, D. and Luksić, E. (2002) Differences between winning and defeated top quality basketball teams in final tournaments of European club championship. *Collegium Antropologicum* 26(2), 521-531.

Key points

- The players' game-related statistical profile varied according to team status, game outcome and team quality in women's basketball.
- The results of this work help to point out the different player's performance described in women's basketball compared with men's basketball.
- The results obtained enhance the importance of starters and nonstarters contribution to team's performance in different game contexts.
- Results showed the power of successful 2-point field-goals, successful free-throws and assists discriminating between starters and nonstarters in all the analyses.

AUTHORS BIOGRAPHY

Miguel-Ángel GÓMEZ
Employment
Complutense University of Madrid. Faculty of Education.
Degree
PhD
Research interest
Notational Analysis in Team Sports.
E-mail: magor_2@yahoo.es

Alberto LORENZO
Employment
Faculty of Physical Activity and Sport Sciences. Technical University of Madrid.
Degree
PhD
Research interest
Notational Analysis in Team Sports, Expertise and development of Talent.
E-mail: alberto.lorenzo@upm.es

Enrique ORTEGA
Employment
University of San Antonio de Murcia, Spain.
Degree
PhD
Research interest
Notational analysis in Basketball.
E-mail: eortega@pdi.ucam.edu

Jaime SAMPAIO
Employment
Full Professor at the Sport Sciences Department, Research Center for Sport Sciences, Health and Human Development, University of Trás-os-Montes e Alto Douro at Vila Real, Portugal.
Degree
MSc, PhD
Research interests
Monitoring training and competition in team sports.
E-mail: ajaime@utad.pt

Sergio-José IBÁÑEZ
Employment
Associate Professor. Faculty of Sport Science. University of Extremadura.
Degree
PhD
Research interests
Monitoring training and competition in team sports.
E-mail: sibanez@unex.es

✉ **Miguel Ángel Gómez Ruano**
Avenida, Levante, Nº 101, Portal 7, 1ºA, Rivas Vaciamadrid, CP/ 28521, Madrid, Spain.