

## Analysis of shooting effectiveness in elite basketball according to match status

Miguel A. Gómez \*, Francisco Alarcón \*\* and Enrique Ortega \*\*\*

### ANALYSIS OF SHOOTING EFFECTIVENESS IN ELITE BASKETBALL ACCORDING TO MATCH STATUS

KEY WORDS: Situational variables, Performance analysis, Binomial regression, Performance indicators.

ABSTRACT: The aim of the present study was to identify the importance of performance indicators to predict shooting effectiveness in basketball according to match status. The sample was composed by 510 shots corresponding to n=10 games randomly selected from the FIBA Basketball World Cup (Turkey, 2010). The effects of the predictor variables on successful shots according to match status were analysed using Binomial Logistic Regressions. Results from balanced match status context allowed identifying significant interactions with shooting zone and previous action zones. On the other hand, results from unbalanced match status context allowed identifying interactions with passes used, shooting zone, and possession duration. The results showed no interaction with game period situational variable. The present findings allow improving coaches' plan and tasks that involve game constraints of the identified game scenarios.

Performance analysis in basketball has been focused on performance indicators and their influence on the game outcome. In particular, the importance of shooting effectiveness (i.e., the 2- and 3-point field-goals) in basketball has been widely related to winning a game (Malarranha, Figueira, Leite and Sampaio, 2013; Sampaio and Janeira, 2003). However, the available literature is scarce when describing the importance of technical, tactical and strategic behaviours that involve the shooting skills in basketball (Gómez, Lorenzo, Ibáñez and Sampaio, 2013). From a tactical modelling perspective, the shot in basketball is a skill that depends on environmental related-variables. Thus, this methodological approach allow describing the game behaviours from a complex perspective where team members try to facilitate the movement of the ball and to score points (Garganta, 2009). Skinner (2012) tried to identify the problem of shot selection analysing the NBA league. The author found that the time duration (i.e., seconds remaining for shooting) and the passes developed by the team before shooting were the variables that most affected the shooting effectiveness. More recently, Erčulj and Štrumbelj (2015) have showed the importance of technical (i.e., shooting type) and contextual factors (i.e., shooting location or type of attack) that affect the shooting frequency and their effectiveness. According to this rationale, the environmental related-variables have an important effect on shooting effectiveness and consequently on team-tactical behaviours. Particularly, Garganta (2009) argued the importance of tactical performance indicators such as time (i.e., game quarter or possession duration), space (i.e., distance or shooting zones) and task variables (i.e., defensive pressure, passes used or the previous

action for a shot). Therefore, the aim of the present study was to identify the predictors of shooting effectiveness related to time, space and tasks related-variables. We hypothesized that tactical behaviours during basketball shots are dependent on time, space and task performance indicators that lead to determine the success.

### Method

The sample was composed of 510 shots (from set plays situations) corresponding to 10 games randomly selected from the FIBA Basketball World Cup (Turkey, 2010), with mean differences in score of  $9.1 \pm 1.9$ . The 10 games were analysed through systematic observation by two expert technicians trained for this observational analysis.

### Dependent variable

The shooting effectiveness was transformed in a dichotomous variable: the successful shots (when the offensive team scored a 2 or a 3-point field-goal, and when the offensive team received a foul, including foul shot or a foul received), and the unsuccessful shots (when the offensive team missed a 2 or 3-point field-goal, received a block shot, committed a foul, made a turnover or made any other rule violation).

### Independent variables

The independent variables were related to time, space and task dimensions. The space was studied by the shooting distance where the shot was taken (paint, outside the paint, and 3-point

.Miguel-Ángel Gómez-Ruano, Faculty of Physical Activity and Sport Sciences, Polytechnic University of Madrid, C/ Martín Fierro s/n; 28040, Madrid. Spain. E-mail: miguelangel.gomez.ruano@upm.es

\* Facultad de Ciencias de la Actividad Física y el Deporte. Universidad Politécnica de Madrid.

\*\* Facultad de Ciencias de la Actividad Física y el Deporte. Universidad Católica San Antonio.

\*\*\* Campus de Excelencia Internacional Regional "Campus Mare Nostrum". Universidad de Murcia.

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shots zone). Also, the shooting zones were registered according to the specific court zones when eight different basketball court zones were established from the offensive half court: A, B, C, D, E, F and G zones (see Figure 1).

The time related variable studied was the ball possession duration (more than 10 second to shot, between 10 and 5 second to shot, and less than 5 seconds to shot). The task related variables included (i) the number of passes used by each team during the ball possession (0, 1-2 passes, 3-4 passes, and 5 or more passes used); ii) the defensive systems used by the defensive team (man-to-man or zone); iii) the previous action before to shot: individual action (the player with the ball did not interact with the team mates or receives any screen on or off the ball), screen on (when the screener sets a screen to the offensive player that handles the ball), screen off (when the screener sets a screen to an offensive player without the ball), and open player (one player is far from the defender without any defensive pressure); and iv) defensive pressure when the player shots (HIGH: the defensive player is close to the offensive player with an intense defensive pressure; MODERATE defensive pressure: the defensive player keeps a reduced distance trying to avoid any shooting trajectory; LOW defensive pressure: the offensive player is free of any defensive player when making a shot; or NO defensive pressure when the offensive player makes a shot without defender).

**Covariate**

In order to control for the situational variables effects, the game period (first, second, third and fourth game quarters) was introduced in the model as a covariate. The sample was stratified in order to build separate models for two game contexts according to match status. This situational variable was obtained using the accumulative differences between points scored and allowed in each ball possession and then converted into “balanced match status” (differences between 0 to 9 points) and “unbalanced match status” (differences above 10 points) using the game criticality criteria (Ferreira, Volossovitch and Sampaio, 2014).

**Statistical analysis**

Binomial Logistic Regression were used to estimate

regression weights and odds ratios (Landau and Everitt, 2004) of the relation between performance indicators and covariates according to ball possessions effectiveness (Gómez et al., 2013) for each game context (balanced and unbalanced match status). In a first stage, the performance indicators were tested individually and, in a second stage, the adjusted model was performed with all variables, which in isolation showed some shooting effectiveness relation (Landau and Everitt, 2004). Odds ratios (OR) and their 95% confidence intervals (CI) were calculated and adjusted for ball possession effectiveness. The statistical analyses were performed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago IL), and statistical significance was set at  $P < 0.05$ .

**Results**

The distribution of relative frequencies from the studied variables across the two game contexts for basketball teams are showed in Table 1.

The Binomial Logistic Regression models were computed with one variable at each step, the adjusted model fitted the two game contexts, balanced match status:  $LRT = 91.9, P < .0001$ ; and unbalanced match status:  $LRT = 81.2, P < .0001$ . Basketball teams showed a relation between shooting effectiveness and shooting distance ( $LRT = 75.2, P = .001$ ), and shooting zone during balanced match status ( $LRT = 70.2, P = 0.013$ ), and with shooting distance ( $LRT = 104.7, P = .001$ ), the number of passes used ( $LRT = 87.3, P < .004$ ) and possession duration ( $LRT = 88.4, P = .026$ ) during the unbalanced match status.

During the balanced match status context, results obtained (Table 2) showed that the teams obtained higher shooting effectiveness when they shot into the paint and when they used the shooting zones were A, B, C, D, E, and F. On the other hand, during the unbalanced match status context the teams reduced the shooting effectiveness when they used 0 passes or between 1 and 2 passes, and they increased the ball possession effectiveness when they shot into the paint, when they used between or 3 to 4 passes and when they used possession durations of more than 10 seconds to shot.

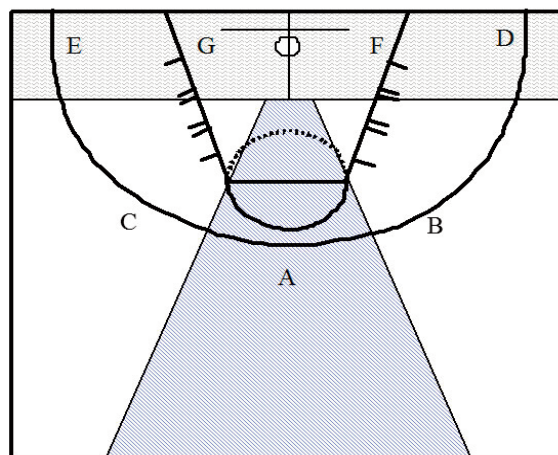


Figure 1. Zones.

## Shooting effectiveness in basketball

Performance indicators	Balanced Match status (n = 269) (%)	Unbalanced Match status (n = 241) (%)
Efficacy		
Successful	52.8	44.8
Unsuccessful	47.2	55.2
Space		
Shooting distance		
Paint	44.2	39.4
Outside paint	12.3	17.0
3-pt zone	43.5	43.6
Shooting distance		
A	33.1	34.4
B	25.3	19.1
C	17.5	23.2
D	9.7	13.7
E	9.3	9.5
F	1.1	0.0
G	2.2	0.0
H	1.9	0.0
Time		
Duration (s)		
More than 10 s	54.6	53.5
10-5 s	28.3	32.8
Less than 5 s	17.1	13.7
Task		
Passes used (n)		
0	78.1	56.8
1-2 passes	17.1	30.7
3-4 passes	4.8	10.4
5 or more passes	0.0	2.1
Defensive pressure		
No	29.0	25.3
Moderate	15.6	16.2
Intermediate	20.4	18.7
High	34.9	39.8
Previous action		
Individual	64.3	72.6
Screen on	21.2	15.8
Screen off	4.8	7.5
Open player	9.7	4.1
Defensive system		
Man-to-man	88.8	91.3
Zone	11.2	8.7

*Table 1. Distribution of relative frequencies from the studied variables across the two match status.*

Success in shots	Balanced match status OR (95% CI)		Unbalanced match status OR (95% CI)
Shooting distance Paint	4.48 (1.98 - 10.2)*	Shooting distance Paint	4.84 (2.15 - .42)**
Shooting zone		Passes (n)	
A	2.56 (0.36 - 3.88)**	0 passes	.49 (.26 - .98)**
B	5.06 (4.72 - 5.43)**	1-2 passes	.48 (.21 - .87)**
C	4.79 (4.56 - 5.03)**	3-4 passes	1.15 (1.09 - 2.18)*
D	6.28 (6.27 - 6.29)**	Possession duration (s)	
E	4.57 (4.48 - 4.66)***	More than 10 s	2.77 (1.11 - 6.89)*
F	1.50 (1.37 - 1.61)**		

\*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ ; OR, odds ratios; CI, confidence intervals

Table 2. Binomial logistic regression: shooting effectiveness as a function of technical and tactical indicators used by basketball teams (reference category: success in shots).

## Discussion

The main results allowed identifying interactions with shooting zone and previous action zones during balanced match status context. Conversely, the results from unbalanced match status context identifying interactions with passes used, shooting zone, and possession duration. The results showed no interaction with game period situational variable. These results allow supporting the hypothesis that group-tactical behaviours during shots in basketball are dependent on time, space and task related indicators.

On the one hand, during balanced game contexts the shooting effectiveness was higher when the shot was performed inside the paint and in zones D and B. This fact may reflect that during a close match status the defensive team increases the defensive pressure to steal the ball and then the offensive team has to improve the best field-goal situation near the basket, both in time and space (Erčulj and Štrumbelj, 2015; Malarranha et al., 2013). Specifically, the balanced situations represents the highest level of performance, which are characterized by slight differences (not clear/ large differences) between confronting

teams (Lupo, Condello, Capranica and Tessitore, 2014). Thus, the shooting effectiveness is characterized by a wide range of zones and distances where the players are able to shot without defensive pressure and clear options (Skinner, 2012). On the other hand, during unbalanced game contexts the shooting effectiveness was higher inside the paint, after 3-4 passes, and possession durations longer than 10 seconds. These trends reflect that when the teams have a wide margin in the score they should use long and controlled ball possessions (i.e., to reduce the game pace) where teamwork plays an important role. Particularly, the group-tactical decisions that enable to create optimal space-time field-goal opportunities inside the paint (Gómez et al., 2013). In addition, these strategies are useful when increasing/ reducing the differences in the score because avoid the use of precipitating actions or risky options that involve turnovers or bad field-goal positions (Mavridis, Laios, Taxildaris and Tsiskaris, 2003).

Finally, the identified trends provide important information for modelling high-level shooting performances, then coaches should improve the players' performance according to these specific game constraints.

## ANÁLISIS DEL LANZAMIENTO Y SUS ACCIONES PREVIAS COMO VARIABLES PREDICTORAS DE LA EFICACIA DE LOS EQUIPOS DEL MUNDOBASKET 2010

PALABRAS CLAVES: Variables situacionales, Análisis del rendimiento, Regresión binomial, Indicadores de rendimiento

RESUMEN: El objetivo del presente estudio fue identificar la importancia de los indicadores de rendimiento que permiten predecir la efectividad del lanzamiento en baloncesto en función del marcador parcial de juego. La muestra estaba compuesta por 510 lanzamientos correspondientes a 10 partidos seleccionados de manera aleatoria del Campeonato del Mundo de baloncesto (FIBA, Turquía, 2010). Los efectos de las variables predictoras en el éxito del lanzamiento se analizaron utilizando la regresión logística binomial. Los resultados con marcadores equilibrados identificaron interacciones significativas con la zona de tiro y la zona de juego de la acción previa al lanzamiento. Por otro lado, los resultados de los marcadores desequilibrados mostraron interacciones significativas con los pases utilizados, la zona de tiro y la duración de la posesión. Los resultados no mostraron interacciones significativas con la variable situacional periodo de juego. Los resultados obtenidos permiten mejorar el diseño de tareas de entrenamiento y control de competición mediante la modificación de las variables de juego en base a los resultados obtenidos.

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