

# Did the three point line change influence the female youth basketball? Analysis of the predictive factors from winning teams (U-16 and U-20)

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*DID THE THREE POINT LINE CHANGE INFLUENCE THE FEMALE YOUTH BASKETBALL? ANALYSIS OF THE PREDICTIVE FACTORS FROM WINNING TEAMS (U-16 AND U-20)*

KEYWORDS: Youth basketball, Performance, Game-statistics, Predictor factors.

ABSTRACT: The main purpose of this study was to analyze the behavior of winning teams in youth basketball, considering in particular the increasing distance from the three point line, among other changes introduced by FIBA (International Amateur Basketball Federation). More precisely identify which and how the game-related statistics indicators present in the equation of "4 Factors - ROBOSCOU" discriminate the winning teams, considered in function of category/season. Data referred to 485 matches of the European Championships in 2010 and 2011 (S16-2010,  $n = 140$ , S20-2010,  $n = 104$ , S16-2011,  $n = 131$ , S20-2011,  $n = 110$ ) was analyzed, focusing on the following variables: final score, offensive rebounds, opponent defensive rebounds, turnovers, field goal attempt; 2 and 3-point field-goals and free-through (attempted, failed and made). Although at first view, the main differences appear to be related to the age factor, namely the effectiveness of the field-goals and turnovers per possession, the results obtained using analysis of variance (MANOVA) shows that since 2010 to 2011 seasons the game becomes more homogeneous between S16 and S20 categories, disappearing values statistically significant as the 3-points made and 2-points attempted. Curiously, in U20 category the values given in the 3-point field-goals, considering the significant difference for the attempted and the observed virtually identical percentages, it suggested a better selection of shot in 2011 compared to 2010 season. Despite the consciousness that an understanding of performance in youth basketball need a multivariate perspective, it is expected that these results may help in future research and female basketball coaches in the development of training programs and planning competitions.

Technological advancements have allowed a more accurate register of tactical and technical actions, essential information for training and team managing in the high level competition (Jaime Sampaio, Lago and Drinkwater, 2010). The investigation of teams tactical behavior during the competition, revealing how and which technical indicators are determinant for victory, constitutes an important contribute for the basketball agents.

Studies that analyze basketball game may be divided in the ones that focus at the game-related statistics and others that are centered in the tactical actions developed during the match (Ortega and García, 2009). Although the integration of these perspectives seems to be crucial, through the global analysis of all information and the technological resources (internet, video, software), this study only focuses on the first group mentioned, favoring a wider sample range.

This field has revealed numerous publications that relate different game-related statistics information, analyzing the indicators that better discriminate the performance, according to several factors such as winning/losing, home/away teams, starters/nonstarters; gender/age; etc. (Gómez, Lorenzo, Ortega, Sampaio and Ibáñez, 2009; Gómez, Lorenzo, Sampaio and Ibáñez, 2006; Ibáñez, García, Feu, Lorenzo and Sampaio, 2009; Sampaio, Godoy and Feu, 2004).

Besides these studies contributes, curiously, when the teams statistical leaders are examined, sometimes the winning teams do

not show a better ranking for a certain technical indicator. The defensive rebound, many times referred as a discriminant variable of the winning teams, is an example for this evidence. By logic, it may suggest that a champion team does not accumulate many defensive rebounds, denying shots opportunities through turnovers, achieving success but not evidence in this indicator specifically.

A different approach was carried out by applying the "4-Factors-Roboscout" (4-F) equation proposed by Oliver (2006), which combines the following factors: Effective Field Goal (EFG) 10; Turnovers per Ball Possessions (TO/BP) 5/6; Offensive rebounding percentage (%OR) 4/5; Getting to the foul line (GFL) 2/3 (the number indicates weight of each one to winning a game). In this way, the focus on actions directly related to the initiatives of the winning teams as well as in shooting situations, allowed the satisfaction of basic conditions defined in our analysis.

The main purpose of this study was to analyze the behavior of the winning teams in youth competition, considering particularly the increase distance of the three point line (3PL), among others official rules modifications. More specifically, the identification of which and how technical indicators of the game-related statistic presents at the 4-F equation, discriminate the winning teams in function of the category-season.

**Method**

**Sample**

All the 485 matches of the Women European Championships, Divisions A and B, were analyzed (U16-2010,  $n = 140$ ; U20-2010,  $n = 104$ ; U16-2011,  $n = 131$ ; U20-2011,  $n = 110$ ). Data was selected from the box-scores provided by the official site (FIBA), focusing the following variables: points (PTS); offensive rebounds (OR) and opponent defensive rebounds (ODR); turnovers (TO); field-goal attempt; 2-points, 3-points and free-throws distinguishing attempt, failed and made (2PA; 2PF; 2PM; 3FA; 3PF; 3PM); FTA; and FTM). To apply the 4-F equation, ball possessions (BP) was estimated from the formula  $BP = FGA - OR + TO + 0.4 * FTA$  (Oliver, 2006), and derivative variables were calculated:  $EFG = (LCC + 0.5 * L3C) / LCT$ ;  $TO/PB$ ;  $\%RO = RO / (RO + RDA)$ ; and  $GFL = FTM / FGA$ .

**Statistical analysis**

An explorative analysis of the data was performed and no missing-cases or several outliers were detected. The 4-F equation was applied for all games, to test its suitability for the overall sample, as each championship separately, verifying a percentage of agreement exceeding 95% when compared the final results to the correct prediction of the winning team.

Highlighted the importance given to indicators from the 4-F equation, several treatments was ran using the multivariate analysis of variance (MANOVA). It was analyzed the differences between the winning teams from the groups considered, in function of the dependent variables, grouped according to this equation: (i) EFG, TO/BP, %OR, GFL, (ii) 2PM, 3PM, 3PA, 3PM (iii) TO, BP, (iv) OR, ODR, 2PF, 3PF (v) FTM, FGA.

Although the normality of distribution was not confirmed for all variables, the analysis proceeded considering the size of the

sample that indicate the impact is minimal due groups have approximately the same size (largest/smallest < 1.5). Furthermore, the exploratory analyzes may indicate that this fact result from the asymmetries observed and not from the presence of several outliers. (Hair, Anderson and Tatham, 1998).

The homogeneity of variance and covariance matrices was checked by Levene's test and Box's test ( $\alpha = .05$ ). After verifying the assumptions of MANOVA, outputs of multivariate tests were considered, selecting the Pillai's trace, considering its recognized robustness, because the sample groups do not have identical sizes (Tabachnick and Fidell, 2007) and especially just the assumption of normality was violated (Marôco, 2011). Following, ANOVAs was carried out by tests of between-subjects effects. For these tests the observed power acceptable should be greater than 0.80. Finally, the post-hoc Tukey HSD test was performed for multiple comparisons of means ( $p \leq .00$ ). The treatments were executed using SPSS (v.20, SPSS, Chicago, IL).

**Results**

The first approach examined the behavior of the groups (U16-2010; U20-2010; U16-2011; U20-2011) in function of the indices related to the 4-F equation. The EFG and TO/BP showed statistically significant differences between U16 and U20 categories (see Table 1), highlighting the following means comparisons: EFG - U16-2010 ( $3.32 \pm .06$ ) and U20-2010 ( $3.68 \pm .07$ ); U16-2011 ( $3.34 \pm .07$ ) and U20-2011 ( $3.61 \pm .07$ ); TO/BP - U16-2010 ( $1.48 \pm .03$ ) and U20-2010 ( $1.29 \pm .04$ ); U16-2011 ( $1.51 \pm .04$ ) and U20-2011 ( $1.31 \pm .04$ ). There are statistically significant differences for %OR of U16-2011 to both U20-2010 and U20-2011, highlighting: U16-2011 ( $2.72 \pm .03$ ) and U20-2011 ( $2.8 \pm .03$ ). (see Table 1).

Variables	U16 -2010	U20 -2010	U16 -2011	U20 -2011
EFG * # ‡ +	3.32 ± .06	3.68 ± .07	3.35 ± .06	3.61 ± .07
TO/BP * # ‡ +	1.48 ± .03	1.28 ± .04	1.51 ± .04	1.31 ± .04
%OR # +	2.75 ± .03	2.85 ± .04	2.73 ± .04	2.85 ± .03
GFL	.52 ± .03	.57 ± .03	.61 ± .03	.55 ± .03
2PM	19.26 ± .42	19.89 ± .49	20.31 ± .44	19.80 ± .48
3PM * +	4.55 ± .22	5.80 ± .25	4.26 ± .22	5.03 ± .24
2PA * +	47.29 ± .75	43.97 ± .87	48.13 ± .78	46.19 ± .85
3PA † +	17.04 ± .51	18.51 ± .59	16.09 ± .52	16.09 ± .57
TO * # ‡ +	20.08 ± .47	17.62 ± .55	19.87 ± .49	17.01 ± .53
BP # ‡	76.11 ± .55	74.32 ± .64	75.98 ± .57	72.54 ± .62
OR * # ‡ +	16.66 ± .46	13.86 ± .53	16.64 ± .47	14.61 ± .52
ODR * +	26.83 ± .45	23.57 ± .52	25.89 ± .47	25.36 ± .51
2PF * +	28.03 ± .57	24.08 ± .66	27.82 ± .59	26.39 ± .64
3PF †	12.49 ± .39	12.71 ± .45	11.75 ± .40	11.06 ± .44
FTM	12.81 ± .47	14.19 ± .54	13.45 ± .48	13.26 ± .52
FGA	64.33 ± .73	62.48 ± .85	64.14 ± .76	62.28 ± .83

Statistically Significant Difference ( $p \leq .05$ ): † U20-2010 e U20-2011; \* U16-2010 e U20-2010; # U16-2011 e U20-2011; ‡ U16-2010 e U20-2011; + U16-2011 e U20-2010.

Table 1. Mean and standard deviation of the observed values for each dependent variable as in function on the category-season.

Specifically the indicators related to the ECL showed statistically significant differences for the 3PM and 2PA of U16-2010 and U16-2011 to U20-2010; as well as for the 3PA of U20-2010 to S16-2011 and S20-2011; highlighting the following means comparisons: 3PM - U16-2010 ( $4.55 \pm .22$ ) and U20-2010 ( $5.80 \pm .25$ ); 2PA - U16-2010 ( $47.29 \pm .75$ ) and U20-2010 ( $43.97 \pm .87$ ); LTT: U20-2010 ( $18.51 \pm .59$ ) and U20-2011 ( $16.09 \pm .04$ ).

For indicators related to %OR, was detected statistically significant differences for OR between the U16 and U20 categories, regardless of the year; for ODR and 2PF of U16-2010 and U16-2011-2010 to the U20-2010, and for 3PF between U20-2010 and U20-2011, highlighting the following means comparisons: RO - S16-2010 ( $16.66 \pm 0.46$ ) and S20-2010 ( $13.86 \pm .53$ ), S16-2011 ( $16.64 \pm .47$ ) and S20-2011 ( $14.61 \pm .52$ ), RDA - S16-2010 ( $26.83 \pm .45$ ) and S20-2010 ( $23.57 \pm .52$ ); LDF - S16-2010 ( $28.03 \pm .57$ ) and S20-2010 ( $24.08 \pm .66$ ), LTF - S20-2010 ( $12.71 \pm .45$ ) and S20-2011 ( $11.06 \pm .44$ ).

## Discussion

Due to the few papers found in the literature regarding the female youth competition, it becomes necessary to enlarge the discussion related articles referring also to the senior category and/or involving the men's basketball. The purpose of this study was to identify which and how the technical indicators from game-related statistics present at the 4-F equation, discriminate the winning teams, in function of category-season. Through these indices, higher values for EFG and TO/BP were found for U20 compared to U16 category, regardless the season, which suggests at first sight, this difference is associated with age, with no influence by the 3PL change (see Figure 1). Ibáñez, Feu and Dorado (2003) findings corroborate this trend, indicating that with increasing age, the teams play with less ball possessions and the offensive efficacy increases. The authors claim that even in the elite basketball, does not develop equally, explaining the differences by age and inexperience of the younger players. Sampaio et al. (2004) confirmed the advantage achieved with age, noting that the junior compared to senior, occur more turnovers and less care, reflecting a poorer selection of shooting opportunities and reducing the offensive efficacy (see Figure 1).

Adds Lorenzo, Gómez, Ortega, Ibáñez and Sampaio (2010) that these results may indicate that the U16 players make errors due to the difficulty of keeping the ball possession, increasing the fast-break occurs and the game pace. This study also points out that the winning teams, especially in balanced games, show better values in assists and turnovers. However, it seems not correct to infer that a reduction in the game pace, probably reducing the possessions and the risk of errors, ensure better rates to U16 category. Paradoxically, (Ortega, Palao, Gómez, Lorenzo and Cárdenas, 2007) reporting to this age level, note that the winning teams frequently plays fast-break, using shorter time on offense.

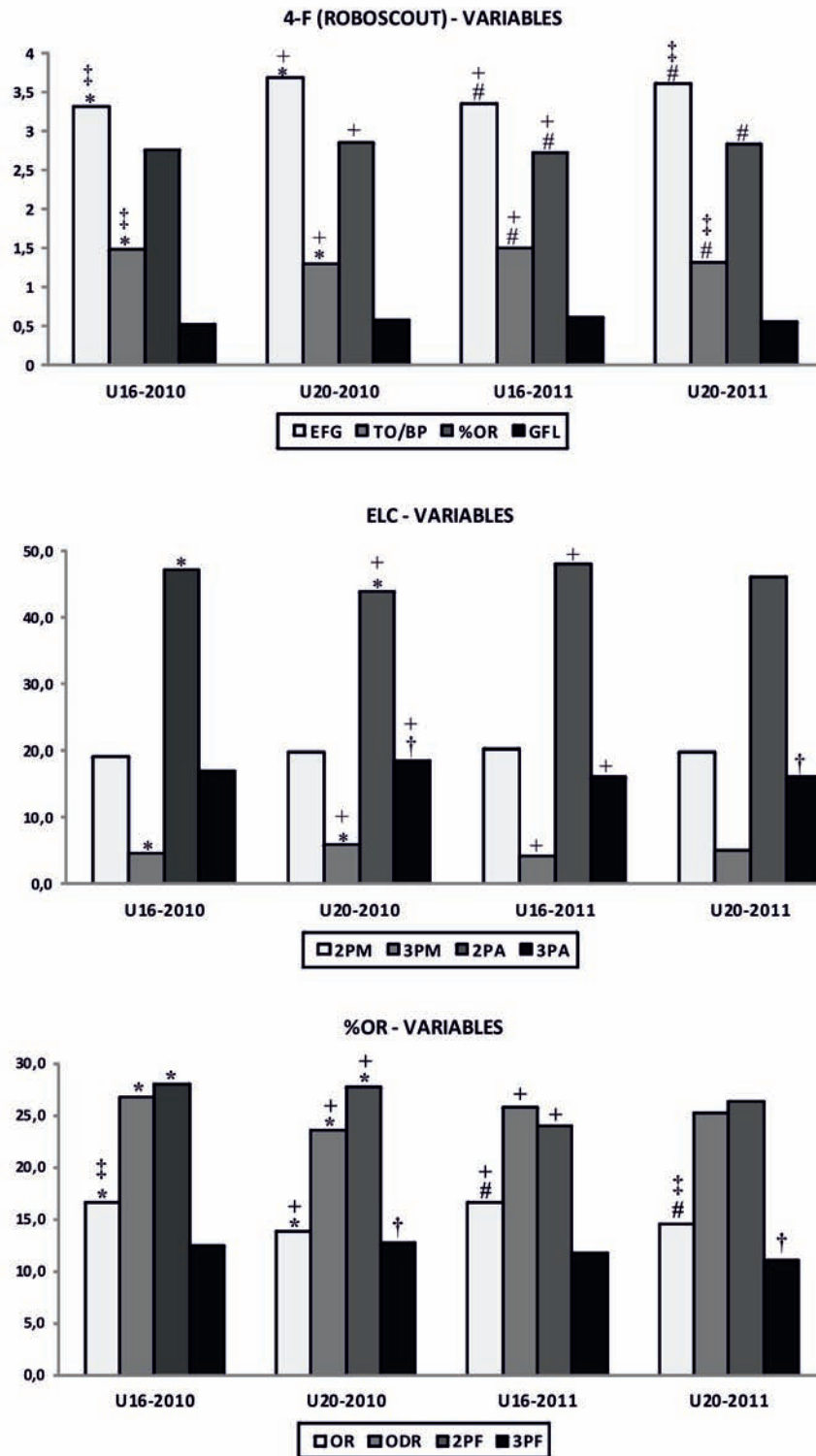
By observing the %OR, it appears that the difference between U16 and U20 category, always advantageous to the older, only becomes significant in 2011. To analyze this factor, and better interpret the EFG, this study distinguished 2 from 3points (marked, failed and attempt), thus revealing differences likely influenced directly by the 3PL change. It should be noted, without misprize the GFL, especially at final in balanced games, that this factor is not discussed, since not show significant differences, neither seems to be directly associated with the 3PL change.

Some studies (Gómez et al., 2006; Gómez et al., 2009) focus the importance of 2PM in female basketball as a factor associated with the victories and the basis for offensive efficacy, reflecting tactically disciplined teams with defined responsibilities. Although from different perspective, this factor per se did not reveal significant differences between groups, deducing that other variables determine this advantage in EFG to the U20. The reason seems to be at the inversely proportional ratio between the categories, where the U20 made more baskets in fewer attempts compared to S16.

On the other hand, the 3PM and 2PA significant differences between the U16 and U20 categories ceased to exist from 2010 to 2011, a possible effect of 3PL change, making the game more uniform among the ages in this aspect. There is also an expected tendency of increasing the 2PM and 2PA against a decreasing 3PM and 3PA. However, taking in account all variables associates to 3-points shots, there is a significant difference in the attempted shots and practically identical percentages. This may suggest a better selection of shot in 2011 compared to the 2010 season, indicator pointed in many studies as key to victory (Gómez et al., 2006; Koh, John and Mallett, 2011).

Curiously, considering the OR, there is another advantage for U16 category, since U20 category display best values of % RO. This is justified by the simultaneous occurrence of a greater number of failed shots and ODR, reinforcing the importance to avoid treat separately values of the OR. The origin of failed shots allied with the context of the board fight on rebound, as highlighted by (Ribas, Navarro, Tavares and Gómez, 2011), should be considered together in evaluating this factor. Note also that no longer exist significant differences in the ODR and 2PF from 2010 to 2011 between S16 and S20 categories. There is also a significant decrease in 3PF from 2010 to 2011 for the U20 category, reinforcing the idea of improving the three point percentage of even with increasing 3PL distance.

Despite the consciousness that understanding the concept of performance in youth basketball involve a multivariate perspective, we expect the results presented and discussed here contribute in future researches, training programs and planning competitions, providing references for female basketball coaches.



Statistically Significant Difference ( $p \leq .05$ ): † U20-2010 e U20-2011; \* U16-2010 e U20-2010; # U16-2011 e U20-2011; ‡ U16-2010 e U20-2011; + U16-2011 e U20-2010.

Figure 1. Graphics of the observed means values for each dependent variable as in function on the category-season.

*MODIFICACIÓN DE LA LÍNEA DE TRES PUNTOS Y EL BALONCESTO DE FORMACIÓN. ANÁLISIS DE LOS FACTORES PREDICTIVOS DE LA VICTORIA (SUB-16 Y SUB-20 FEMENINOS)*

**PALABRAS CLAVE:** Baloncesto femenino, Estadísticas de juego, Indicadores predictores, Formación.

**RESUMEN:** El objetivo de este estudio fue analizar el comportamiento de los equipos ganadores en las categorías inferiores, teniendo en cuenta el aumento de la distancia desde la línea de tres puntos, entre otros cambios introducidos por la FIBA (Federación Internacional de Baloncesto Amador). Más precisamente, identificar los indicadores técnicos y cómo las estadísticas de juego presentes en la ecuación de los "4 Factores - ROBOSCOU" discrimina a los equipos ganadores, considerada en función de la categoría / temporada. Se analizaron los datos de 485 partidos del Campeonato Europeo de 2010 y 2011 (S16-2010,  $n = 140$ ; S20-2010,  $n = 104$ ; S16-2011,  $n = 131$ ; S20-2011,  $n = 110$ ), focalizándose las variables: puntuación final, rebotes ofensivos, rebotes defensivos del oponente, pérdidas de balón, tiros de campo; tiros de 2 puntos, 3 puntos y tiros libres (intentados, fallados y anotados). Aunque las principales diferencias parecen estar relacionadas con el factor de la edad, en particular la eficiencia de lanzamiento de campo y las pérdidas de balón, a través de los resultados obtenidos mediante el análisis multivariada de la variancia (MANOVA), verificase que de la temporada de 2010 para 2011, el juego se vuelve más homogéneo entre las categorías de S16 y S20, desapareciendo los valores estadísticamente significativos en los tiros de 3-puntos anotados y en los tiros de 2-puntos intentados. Curiosamente para la categoría de S20 los valores correspondientes a los tiros de tres puntos, teniendo en cuenta la diferencia significativa en los intentos y los porcentajes prácticamente idénticos, sugieren una mejor selección de lanzamiento en 2011 en comparación con la temporada 2010. A pesar de la conciencia de que la comprensión del rendimiento en el baloncesto de formación pasa a través de una perspectiva multivariada, se espera que estos resultados contribuyan a futuras investigaciones, programas de entrenamiento y las planificaciones de la competición.

*A ALTERAÇÃO DA LINHA DE TRÊS PONTOS E O BASQUETEBOL DE FORMAÇÃO ANÁLISE DOS FATORES PREDITIVOS DA VITÓRIA (SUB-16 E SUB-20 FEMININOS)*

**PALAVRAS-CHAVE:** Basquetebol feminino, Estatística de jogo, Indicadores preditores, Formação

**RESUMO:** O propósito deste trabalho foi analisar o comportamento das equipas vencedoras nos escalões de formação, considerando-se em especial o aumento da distância da linha dos três pontos, dentre outras alterações promovidas pela FIBA (Federação Internacional de Basquetebol Amador). Mais precisamente identificar quais e como os indicadores técnicos da estatística de jogo presentes na equação dos "4 Factors - ROBOSCOU" discriminam as equipas vencedoras, consideradas em função do escalão-época. Foram analisados os dados referentes às 485 partidas dos Campeonatos da Europa 2010 e 2011 (S16-2010,  $n = 140$ ; S20-2010,  $n = 104$ ; S16-2011,  $n = 131$ ; S20-2011,  $n = 110$ ), focalizando-se as variáveis: pontuação final; ressaltos ofensivos; ressaltos defensivos do adversário; turnovers; lançamentos de campo; lançamentos de 2-pontos, 3-pontos e Lances-Livres (tentados, falhados e convertidos). Os resultados obtidos com recurso à análise da variância multivariada (MANOVA), embora num primeiro momento as principais diferenças aparentem estar relacionadas ao fator idade, nomeadamente a eficácia de lançamento de campo e os turnovers por posse de bola, ao aprofundar a análise verifica-se que da época de 2010 para 2011 o jogo se torna mais homogéneo entre os escalões S16 e S20, desaparecendo valores estatisticamente significativos como os lançamentos de 3-pontos convertido e os de 2 pontos-tentados. Curiosamente no escalão S20 os valores verificados para os lançamentos de três pontos, tendo em conta a diferença significativa quanto às tentativas e as percentagens quase idênticas, sugerem uma melhor seleção nas finalizações em 2011 em comparação ao ano de 2010. Não obstante a consciência de que o entendimento da performance no basquetebol de formação passa por uma perspectiva multivariada, espera-se que os resultados contribuam para futuras pesquisas, programas de treino e planeamento das competições.

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