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Performance variability in basketball players with intellectual impairment: Ankara World Championships 2013 analysis

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PERFORMANCE VARIABILITY IN BASKETBALL PLAYERS WITH INTELLECTUAL IMPAIRMENT: ANKARA WORLD CHAMPIONSHIPS 2013 ANALYSIS

KEY WORDS: Eligibility systems, Paralympic Sport, Classification

ABSTRACT: The aim of the present study was to identify performance variability in basketball for players with intellectual impairment (II) and to compare it with able-bodied (AB) players. Official game statistics from the 13 games played in the Ankara World II-Basketball Championships (2013) were gathered and descriptive data, variability coefficient (VC), maximum scores and its Z-score were calculated from those players who participated at least 10 minutes per game ($N = 46$; guards = 10, forwards = 21, centers = 15). Results indicated higher performance variability and lower efficiency in shooting percentages and turnovers in II-players comparing with studies in AB-players. Differences found between game positions indicated similar roles of guards, forwards and centers in II and AB-players. These findings are relevant to understand how II impact on basketball performance, which is a necessary step to develop specific eligibility systems in II-basketball according to the guidelines of the International Paralympic Committee.

According to the Paralympic Classification Code (IPC, 2007), all sports for players with an impairment striving for inclusion in the Paralympic program have to develop reliable eligibility systems to guarantee "fair play" during competitions. At this moment in time, there is a clear interest from the International Federation for Para-athletes with Intellectual Impairment (INAS) to reinsert sports competitions in the Paralympics for the athletes they represent (Tweedy and Vanlandewijck, 2011; Van Biesen, Mactavish, Pattyn and Vanlandewijck, 2012). Basketball is one of the most popular sports practiced by players with Intellectual Impairment (II-players in advance) worldwide (Pérez-Tejero, Pinilla and Vanlandewijck, 2014). In a first step developing a specific eligibility system in basketball for II-players, it is necessary to understand how elite II-players play the game of basketball. Basketball is a complex team sport in which performance is strongly related with technique, tactics and strategy (Refoyo, 2001). These aspects, as it is mentioned in the literature, can be influenced, amongst others, by anthropometric characteristics (Lorenzo, 2000), physical fitness (Montgomery, Pyne and Minahan, 2010; Refoyo, Sampedro and Sillero, 2009), training (Feu, Ibáñez and Gozalo, 2010; Ibañez, 2004), experience (Castejón, 2010) and decision making (Refoyo, 2001; Stella, Peacock and Chuan, 2012).

According to the literature, II can negatively impact on decision making (Hickson and Khemka, 1999), learning (Romero and Lavigne, 2006), movement skill development (Sugden and Keogh, 1990), overall intellectual functioning and adaptive behaviour (AAIDD, 2002). Consequently, it is expected that II will have a significant negative impact on basketball performance. Given these processes influenced by scientific evidences, it seems appropriate to develop sport eligibility systems according to these evidences.

Most studies on II-basketball have been conducted during the last decade. These studies focussed on skill acquisition (Stanišić, Berić, Bojić, Nurkić and Kocić, 2012), skill assessment (Franciosi, Gallotta, Baldari, Emerenziani and Guidetti, 2012; Guidetti, Franciosi, Emerenziani, Gallotta and Baldari, 2007), training improvements (Tsimaras et al., 2009) or social and psychological benefits of the basketball practice (Gençöz, 1997). These contributions are important to understand the effects of basketball in II-players; however, a first step to understand how II-players perform basketball, elite competition performance analyses are needed (Lorenzo, 2000; Nadori, 1993). Conventional basketball played by able-bodied players (AB-players in advance) has a large history of competition performance research. Game statistics analyses has been developed to describe game performance (Sampaio and Janeira, 2003; Oliver, 2004; Sampaio, Godoy and Feu, 2004; García, Ibañez, Feu, Parejo and Cañadas, 2009), to detect factors that contribute to success (Trninic, Dizdar and Luksic, 2002; Ibáñez, Sampaio, Sáenz-López, Giménez and Janeira, 2003; Gómez and Lorenzo, 2005; Gómez, Lorenzo, Sampaio and Ibáñez, 2006) and to define differences between players' game position (Sampaio, Janeira, Ibáñez and Lorenzo, 2006; Gómez and Lorenzo, 2007; Sampaio, Ibáñez, Gómez, Lorenzo and Ortega, 2008).

As INAS would like to get basketball for II-players on the Paralympic program, the impact of II on basketball performance has to be demonstrated. A first step in this process is to understand

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how II-players play basketball. In this sense, the aim of this study is to analyze II-basketball performance variability through game statistics according to players´ game position (guard, forward or center) and to compare it with reference values in AB-players.

Methods

Participants

Official statistics from the World II-Basketball Championships (Ankara, October 2013) organized by INAS were used to carry out this research. Six male national teams (Portugal, France, Australia, Greece, Poland and Turkey) participated in the world championship with a total of 63 male players. Official statistics recorded the following variables per player per game (FIBA, 2005): Team, name, number, starting five, minutes played, two points shots attempted, two points shots scored, two points percentage, three points shots attempted, three points shots scored, three points percentage, free throws attempted, free throws scored, free throws percentage, offensive and defensive rebounds, total rebounds, assists, steals, turnovers, blocks, fouls made and total points scored.

From all players, data analysis was conducet with those players who played more than 10 minutes per game ($N = 46$) for being considered those who significant contributes to the competition outcome (Gómez and Lorenzo, 2007). Players were classified by plying position into guard ($n = 10$), forward ($n = 21$) and center ($n = 15$). All statistical variables were normalized to a game time of 40 minutes (Vanlandewijck et al., 2004) to reduce data contamination generated from differences in time played per player.

Statistical analysis

To analyse performance variability, descriptive data (mean, standard deviation, kurtosis and asymmetry) and variability coefficient (VC = SD/Mean * 100) were calculated. In addition, *Z-scores* were calculated for the best record found in each game variable in each position. *Shapiro Wilk's test* indicated non-normal data distribution in data per playing position; therefore non-parametric statistics were applied. *U Mann Whitney* test was used to evaluate possible differences between two different playing positions. To perform statistical analyses a specific statistical package was used (Excel 2010 and SPSS v.18.0) and level of significance was set at $p \leq .05$.

Results

For each variable, means, standard deviations, variability coefficient (VC), asymmetry, kurtosis, best records and its *Z-scores* are presented in Table 1. The significant variability for many of the basketball outcome variables in elite II-players is confirmed calculating the variability coefficients per variable. Total mean *VC* for all variables and all game positions was 74.9%, ranging between minimal 41.1% in fouls and maximal 140.0% for blocks. Variables as 3p percentage and 3p attempted also exceeded 100% *VC* in the overall analysis.

Variables distribution was right-skewed and leptokurtic for the variables 2p attempted, 3p shots percentage, 3p attempted, free throws attempted, defensive rebounds, assists, steals, blocks and total points scored. It represents that in these variables, although data is concentrated around the mean, some data distribution diverge to the right tail. Best record obtained in each variable diverged from the mean more than 1.96 Z ($p \leq 0.05$) in the variables offensive rebounds and 2p percentage; and more than 2.58 Z ($p \leq 0.01$) in free throws attempted, defensive rebounds, assists, steals, blocks and points scored. Means, standard deviations, *VC´s*, best records, *Z-scores* and significant differences according to game position are presented in Table 2.

These results let us analyse performance variability removing the influence of specific position. However, variability kept high and average *VC´s* was 67.8% for guards, 80.2% for forwards and

VARIABLE	*Mean (SD)*	*VC (%)*	*Asymmetry*	*Kurtosis*	*Best Record*	*Z Score*
2p shots %	28.9 (12.8)	44.3	-.14	.25	58.7	2.32*
2p attempted	11.6 (5.9)	51.1	.73	.37	17.5	1.01
3p shots %	17.4 (19.2)	110.4	2.31	8.26	54.6	1.94
3p attempted	2.9 (3.2)	110.4	1.64	2.70	3.1	.04
Free throws %	47.1 (19.8)	42.1	-0,42	-.85	83.3	1.83
Free throws attempted	3.8 (2.3)	59.1	.83	1.56	11.4	3.37**
Offensive rebounds	3.2 (2.4)	76.3	.77	-.35	8.3	2.10*
Defensive rebounds	5.6 (3.2)	57.8	.88	.77	14.6	2.80**
Assists	2.1 (1.8)	84.6	1.37	1.71	7.5	2.96**
Steals	2.4 (1.4)	56.9	.78	1.21	7.0	3.29**
Turnovers	4.5 (2.6)	58.7	.38	- .73	.5	- 1.52
Fouls	3.8 (1.6)	41.1	.2	- .4	.6	- 1.36
Blocks	.7 (1.0)	140.0	1.79	3.25	4.5	3.70**
Total Points Scored	9.8 (6.5)	66.0	1.0	2.19	33.3	3.61**

* $Z \geq 1.96$ ($p \leq .05$) ** $Z \geq 2.58$ ($p \leq .01$)

Table 1. Descriptive results from the game statistics in the Ankara 2013 World Championships. Data normalized to 40 minutes played.

	Descriptive Data			*VC*			Best Records (G)		Best Records (F)		Best Records (C)		Significant Differences		
VARIABLE	Guard (G)	Forward (F)	Center (C)	*G*	*F*	*C*	Value	*Z*	Value	*Z*	Value	*Z*	*G vs F*	*G vs C*	*F vs C*
2p shots %	33.3 (8.6)	25.7 (14.9)	30.6 (11.5)	25.7	57.9	37.7	53.9	2.40*	58.7	2.23*	51.7	1.82			
2p attempted	12.7 (7.7)	10.6 (5.8)	12.1 (4.7)	60.8	54.9	39.0	7.5	-.67	17.5	1.18	16.5	.93			
3p shots %	21.2 (9.6)	18.5 (24.2)	11.7 (13.3)	45.3	131.0	114.5	40	1.97	54.6	1.49	33.3	1.62			
3p attempted	4.6 (4.2)	3.7 (3.1)	.8 (1.0)	91.5	84.6	125.2	1.3	-.78	3.1	-.20	1.3	.50		→	→
Free throws %	52.1 (10.7)	47.5 (22.8)	42.9 (20.6)	20.5	48.1	47.9	67.9	1.48	83.3	1.57	81.8	1.89			
Free throws attempted	4.6 (2.1)	3.5 (2.5)	3.7 (2.0)	46.5	70.4	53.8	7.3	1.28	11.4	3.15**	6.1	1.25			
Offensive rebounds	1.8 (1.6)	2.6 (2.3)	4.9 (2.2)	89.8	87.1	45.8	6.1	2.62**	8.3	2.46*	8.3	1.53		←	←
Defensive rebounds	5.2 (3.6)	4.4 (2.8)	7.5 (2.7)	69.3	64.5	36.0	14.6	2.65**	10.3	2.08*	14.5	2.56*		←	←
Assists	3.6 (2.7)	2.0 (1.4)	1.3 (.9)	74.3	66.4	67.6	7.5	1.42	4.5	1.80	3.1	2.19*		→	
Steals	2.8 (1.4)	2.7 (1.6)	1.8 (.8)	48	60.3	42.5	4.6	1.34	7.0	2.64**	3.5	2.22*			
Turnovers	6.6 (2.4)	3.7 (1.9)	4.2 (3.0)	36.5	51.6	71.9	2.5	-1,7	.7	-1,56	.5	-1,22	→		
Fouls	3.6 (1.6)	3.5 (1.3)	4.3 (1.8)	44.4	37.7	41.9	1.0	-1,61	1.5	-1,48	.6	-2,06*			
Blocks	.4 (.9)	.4 (.7)	1.3 (1.3)	204	155.4	95.2	2.6	2.52*	2.5	2.99**	4.5	2.51*			←
Total Points Scored	11.8 (4.4)	9.5 (7.7)	9.1 (5.8)	37.6	81.9	63.9	18.3	1.45	33.3	3.08**	19.3	1.78			

→ Significant difference ($p \leq .05$) and direction of the difference.

* $Z \geq 1.96$ ($p \leq .05$) ** $Z \geq 2.58$ ($p \leq .01$);

Table 2. Performance variability analysis according to game position (Guard, Forward and Center). Data normalized to 40 minutes played.

64.1% for centers. *VC's* for guards ranged from 20.5% (free throws percentage) to 204% (blocks); for forwards from 37.7% (fouls) to 155.4% (blocks); and for centers from 36.0% (defensive rebounds) to 125.2% (3p attempted). No significant differences were found in *VC* per variable between game positions (Table 2). Best values recorded in guards in 2p percentage and blocks obtained *Z-scores* over 1.96 and both offensive and defensive rebounds obtained *Z-scores* over 2.58. In forwards, best value in 2p percentage, offensive rebounds and defensive rebounds showed *Z-scores* over 1.96. Number of free throws attempted, steals, blocks and total points showed *Z-scores* over 2.58. This position was the position in which more variables exceeded *Z-scores* over 1.96. In data relative to centers, offensive rebounds, assists, steals, fouls and blocks were the variables in which the best record was *Z-score* over 1.96.

Regarding significant differences between players´ position (Table 2), forwards and guards were only differentiated by higher number of turnovers in guards. However, centers presented more differences respect to the others positions. Centers attempted less 3p shots than guards and forwards and made less assists than guards. Also, centers got more offensive and defensive rebounds than guards and forwards and made more blocks than forwards. According to these results, performance variation related to players´ position is confirmed in the Ankara World Championships for II-players.

Discussion

The purpose of the present study was to analyze II-basketball performance variability through game statistics according to players´ game position (guard, forward or center) and to compare these results with reference values in AB-players. To the authors' knowledge, basketball performance of elite II-players has not been studied before. The analysis of how II-players play basketball at the highest level of competition is the first step in the understanding of the impairment – sport performance relationship and the development of an evidence-based eligibility system as requested by the IPC Classification Code (IPC, 2007). Although previous investigations studied the effect of basketball training on basketball skills (Franciosi, 2007), perceived competence (Shapiro and Dummer, 1998), maladaptive behaviour (Gençöz, 1997) and physical fitness (Tsimaras et al., 2009); the present study analyses for the first time basketball performance directly from the competition as suggested by Nadori (1993).

Performance variability described in the Ankara World Championships seems to be high in the overall data (*VC* = 74.9%) and data distribution analysis indicated that this variability can be due to a better performance of some players compared with the mean in the variables: 2p attempted, 3p shots percentage, 3p attempted, free throws attempted, defensive rebounds, assists, steals, blocks and total points scored. Although in our knowledge variability performance has not been addressed directly in basketball AB-players, *VCs* could be calculated from the overall team results showed by García et al. (2009); in which *VCs* ranged from 19.5% (2p attempted) to 46.7% (3p made) in the Senior world basketball championships and from 19.7% (2p attempted) to 55.0% (free throws made) in the Junior World Championships. This data suggests that overall data variability is higher in II than AB-competitions (Table 1).

The presence of *Z-scores* higher than 1.96 such as 2p shots percentage, offensive rebounds, free throws attempted, defensive rebounds, assists, steals, blocks and total points represents that there are players who perform much better than the mean in II basketball. These results can partially explain the high variability found in performance. In addition, some of these variables like free throws made, 2p made, defensive rebounds, assists, steals, blocks and points can discriminate between winning and losing teams in AB basketball, (Gomez, Lorenzo, Sampaio, Ibanez and Ortega, 2008; Lorenzo et al., 2010; Trninic et al., 2002) so, a good individual performance in these variables can contribute a teams to win.

This performance variability presented by II-players, could also be explained by differences in practical experience, basketball training, physical fitness, anthropometry, team quality and also coaches' contribution to make players improve (Alarcon et al., 2009; López, Vélez, León, Ortín and López, 2010). However, as it is well known, decision making skills contribute to success in basketball performance (Castejón, 2010; Jiménez and Ortega, 2009) so, it is suggested to analyse also how differences in cognitive capacities can affect on performance variability in II-players (Van Biesen, Mactavish and Vanlandewijck, 2014). Although differences in performance depending on player position could explain performance variability (Escalante, Saavedra and García-Hermoso, 2010; Sampaio et al., 2008), the inexistence of significant differences ($p \leq 0.05$) between position *VC´s* discard this fact as possible reason. Also, high performance variability was seen in each position through *VC´s* and *Z-scores* analysis.

According to players´ position performance, centers highlighted by a greater number of offensive and defensive rebounds and less 3p shots attempted than guards and forwards. Also, centers made more blocks than forwards. Similar differences in centers´ performance was seen in number of rebounds (Gómez and Lorenzo, 2007; Sampaio et al., 2008; Sampaio et al., 2009) and in less number of 3p shots attempted (Sampaio et al., 2006) in AB-basketball competitions. However, Gómez and Lorenzo (2007) also indicated a greater number of 2p shoots scored by centers as differenced variable for AB-centers. Although success in 2p shots seems more distributed by all players in basketball for II-players than for AB-players, number of rebounds seems to indicate that center position is clearly defined in both basketball modalities, probably influenced by anthropometric characteristics and game location next to the basket (Sampaio et al., 2006; Sampaio et al., 2009). Turnovers and assists pointed out guards as players who distribute the ball during the game in the line of AB-players (Gómez and Lorenzo, 2007; Sampaio et al., 2006). However, non significant differences between guards and forwards in 3p shots and assists seem to indicate that responsibilities working around the 3p line are shared by guards and forwards instead of only guards as in AB-basketball (Sampaio et al., 2006). In the AB-players´ literature, forwards played as an intermediate position between guards and centers (Sampaio et al., 2008), but also in some competitions appeared as 3p shooters (Sampaio et al., 2006).

Although II and AB basketball performance data should be matched to identify significant differences (by now we can only compare studies), a first comparison (Table 3) highlights higher shooting percentages and total points made by AB-players and higher number of turnovers, rebounds and shots attempted by II-players in all players´ position. Although comparisons in performance between II-players and AB-players should be made according the training volume, authors only found players´ position performance analysis in high competitions of AB-players in which,

probably, training volume is higher than in II-basketball (Gómez and Lorenzo, 2007; Sampaio et al., 2006; Sampaio et al., 2008).

Instead of individual performance analyses, team performance analyses was made on Junior World Championships (García, Ibáñez, Feu, Parejo and Cañadas, 2009) and U-16 Championships (Lorenzo, Gómez, Ortega, Ibáñez and Sampaio, 2010) for AB-basketball. Probably, these competitions are closer in training volume to II-Basketball, however, from these studies, only shooting percentages are comparable with data presented in this study (Table 4). Also comparing with these competitions, shooting percentages stay lower in II-competitions than in AB-competitions. Behind shooting percentage there is not only a technical explanation, but tactical to get the best shooting condition (Refoyo, 2001). In this sense, decision making skills play an important role in performance (Jiménez and Ortega, 2009). As it was seen, cognitive capacity can also influence on decision making, adaptive behaviour and learning capacity that involves basketball performance (Araujo, 2013), so probably, II impact might explain these differences in shooting percentage.

Regarding at these first differences with AB-players and according to the performance variability found in the present study, eligibility systems in II-basketball should not encourage participation of those with better cognitive capacities but those who have a real impairment in cognitive capacities involved in sport performance (Tweedy and Vanlandewijck, 2011; Van Biesen et al., 2010), in this case, in basketball.

Conclusions

The results of this study are new insights to the understanding of basketball game in high level competitions of II-players. This analysis indicated a high variability in performance in II-basketball and differences in game statistics according to game-position. The obtained results in this study let us compare for the first time basketball specific performance in II and AB-players, indicating that II might impact on basketball performance variability and on performance indicators related with game statistics although game position´s roles seemed similar in AB and II-players. Although further studies are needed to demonstrate the impact of II on basketball performance, these findings are first evidence II impact that let us orientate future studies in this line.

	II Basketball at Ankara World Championships				AB Basketball at Euroleague 2004/05 (Gómez and Lorenzo, 2007)			
VARIABLE	Guard	Forward	Center	Sig. Dif.	Guard	Forward	Center	Sig. Dif.
2p shots %	33.3 (8.6)	25.7 (14.9)	30.6 (11.5)		50%	52.2%	57.7%	
2p attempted	12.7 (7.7)	10.6 (5.8)	12.1 (4.7)		6.4 (2.0)	9.2 (6)	10.4 (6)	C > G, F
3p shots %	21.2 (9.6)	18.5 (24.2)	11.7 (13.3)		33.3%	33.3%	50%	
3p attempted	4.6 (4.2)	3.7 (3.1)	0.8 (1.0)	G, F > C	6.0 (2.0)	3.2 (4)	0.4 (1.2)	G > F, C
Free throws %	52.1 (10.7)	47.5 (22.8)	42.9 (20.6)		83.3%	72.7%	73.3%	
Free throws attempted	4.6 (2.1)	3.5 (2.5)	3.7 (2.0)		4.8 (4.8)	4.4 (4.8)	6 (5.6)	C > G, F
Offensive rebounds	1.8 (1.6)	2.6 (2.3)	4.9 (2.2)	C > G, F	0.4 (0.8)	2.4 (2)	2.8 (2.4)	C > G, F
Defensive rebounds	5.2 (3.6)	4.4 (2.8)	7.5 (2.7)	C > G, F	2.8 (2.0)	4.8 (2.8)	6 (3.2)	C > G, F
Assists	3.6 (2.7)	2.0 (1.4)	1.3 (0.9)	G > C	3.6 (2.8)	2 (2)	2 (2.4)	G > F
Steals	2.8 (1.4)	2.7 (1.6)	1.8 (0.8)		1.6 (1.6)	1.6 (1.6)	1.6 (2)	
Turnovers	6.6 (2.4)	3.7 (1.9)	4.2 (3.0)	G > F	2.4 (1.6)	2.4 (2)	2.8 (2.4)	
Fouls	3.6 (1.6)	3.5 (1.3)	4.3 (1.8)		3.2 (2.0)	4.4 (2.8)	1.2 (1.6)	
Blocks	0.4 (0.9)	0.4 (0.7)	1.3 (1.3)	C > F	0.4 (0.4)	0.4 (0.8)	1.2 (1.6)	C > G, F
Total Points Scored	11.8 (4.4)	9.5 (7.7)	9.1 (5.8)		17.6 (8.4)	16.8 (8.4)	17.2 (8.4)	

Table 3. Comparison of players´ position performance between II Basketball and AB basketball Championships.

VARIABLE	II Ankara World Championship (2013)	World Junior Championship (2006)	U-16 European Championship (2004-05)
2p %	28.90%	43.10%	49.70%
3p %	17.40%	29.80%	30.90%
Free throw %	47.10%	64.50%	62.10%

Table 4. Comparison of shooting percentage in II-players, AB-junior male players (García et al., 2009) and AB-under 16 male players (Lorenzo et al. 2010)

ANÁLISIS DE LA VARIABILIDAD DEL RENDIMIENTO EN JUGADORES DE BALONCESTO CON DISCAPACIDAD INTELECTUAL. CAMPEONATO DEL MUNDO ANKARA 2013

PALABRAS CLAVE: Sistemas de elegibilidad, Deporte Paralímpico, Clasificación.

ABSTRACT: El objetivo del presente estudio fue identificar la variabilidad en el rendimiento en baloncesto para personas con discapacidad intelectual (DI) y compararlo con jugadores sin DI. Las estadísticas oficiales de juego de los 13 partidos disputados en los Campeonatos del Mundo de Baloncesto para personas con DI de Ankara (2013) fueron recogidas y se analizaron las variables descriptivas, los coeficientes de variabilidad (CV), indicadores máximos y su correspondiente valor-Z en aquellos jugadores que participaron al menos 10 minutos por partido (*N*= 46; bases = 10, aleros = 21 y pívots = 15). Los resultados indicaron una mayor variabilidad en el rendimiento y una menor eficacia en el porcentaje de tiro y en las pérdidas de balón en jugadores con DI comparado con estudios en jugadores sin DI. Las diferencias encontradas entre las posiciones de juego indicaron roles similares de los bases, aleros y pívots en jugadores con y sin DI. Estos descubrimientos son relevantes para entender el impacto de la DI sobre el rendimiento en baloncesto, lo cual es un paso necesario para el desarrollo de sistemas específicos de elegibilidad en baloncesto para personas con DI de acuerdo a las directrices del Comité Paralímpico Internacional.

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