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Does physical fitness influence the technical-tactical performance indicators in a professional female basketball team?

¿Influye la condición física en los indicadores de rendimiento técnico-táctico en un equipo profesional de baloncesto femenino?

David Mancha-Triguero, María Reina, Javier García-Rubio & Sergio J. Ibáñez
Grupo de Optimización del Entrenamiento y Rendimiento Deportivo (GOERD).
Universidad de Extremadura, Spain

Abstract

The final result of a competition is conditioned by different factors (e.g., age, experience, competitive level) that affect the athlete's performance. This performance may changes throughout the season depending on different variables related to training. The objectives of this research were to know the physical performance profiles of the players in different physical fitness tests grouped by their game position and to analyse the relationships between the results of the physical tests and the technical-tactical performance indicators obtained in competition. To do this, an elite female team was analysed and performed a centripetal force test, an anaerobic capacity test and two lower body strength tests. The results have shown that in women's basketball the players have physical fitness profiles adapted to the demands of the game. In addition, Technical-tactical performance in women's basketball is related to the physical fitness profile of the players. The 2-Point Shots Annotated (p=0.35) negatively correlated with the Explosive Distance of the anaerobic test. The 3-Point Shots Annotated correlate with the Explosive Distance of the anaerobic test (p=.007) and the Right Arch test (p=.015). Total Rebounds correlate with the Explosive Distance of the anaerobic test (p=.001) and MultiJump test Impulse (p=.036) and the Free Throws Scored with Time of the Left Arch test (p=.023). Therefore, the physical level obtained by the players in the physical fitness tests affects both the performance indicators and the final result of the competition that they obtain individually.

Keywords: competition; inertial devices; specific test; women; load monitoring.

Resumen

El resultado final de una competición está condicionado por diferentes factores (por ejemplo, edad, experiencia, nivel competitivo) que afectan el rendimiento del atleta. Este rendimiento puede experimentar cambios a lo largo de la temporada dependiendo de diferentes variables relacionadas con el entrenamiento. Los objetivos de esta investigación fueron conocer los perfiles de rendimiento físico de los jugadores en diferentes pruebas de condición física agrupadas por su posición de juego y analizar las relaciones entre los resultados de las pruebas físicas y los indicadores de rendimiento técnico-táctico obtenidos en competición. Para ello, se analizó un equipo femenino de élite que realizó una prueba de fuerza centrípeta, una prueba de capacidad anaeróbica y dos pruebas de fuerza de tren inferior. Los resultados han demostrado que en el baloncesto femenino las jugadoras tienen perfiles físicos de acondicionamiento físico adaptados a las demandas del juego. Además, el rendimiento técnico-táctico en el baloncesto femenino está relacionado con el perfil de aptitud física de las jugadoras. Los Lanzamientos Anotados de 2 puntos (p=0.35) correlaciona negativamente con la Distancia Explosiva del test anaeróbico. Los Lanzamientos Anotados de 3 puntos correlaciona con la Distancia Explosiva del test anaeróbico (p=.007) y del test del Arco Derecha (p=.015). Los Rebotes Totales correlacionan con la Distancia Explosiva del test anaeróbico (p=.001) e Impulso test MultiJump (p=.036) y los Tiros Libres Anotados con Tiempo del test del Arco Izquierda (p=.023). Por lo tanto, el nivel físico obtenido por los jugadores en las pruebas de condición física afecta tanto a los indicadores de rendimiento como al resultado final de la competición que obtienen individualmente.

Palabras clave: competición; dispositivos Inerciales; test específicos; mujeres; monitorización de carga.

Correspondencia/correspondence: David Mancha-Triguero
Universidad de Extremadura. Spain
Email: davidmancha@unex.es

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Introduction

Basketball is a sport that requires a wide range of physical demands, which include the ability to perform repeated sprints and jumps (Delextrat et al., 2015). The performance in this team sport may be influenced as in the rest of invasion sports, by technical-tactical, psychological and physiological aspects (including physical fitness) (Ziv, & Lindor, 2009). Specifically, basketball is an aerobic-based sport (Korkmaz & Karahan, 2012) in which high intensity anaerobic actions are performed (Meckel, Gottlieb, & Eliakim, 2009). In recent years, the competition has undergone an evolution related to high intensity actions. These actions occur on a greater, higher and longer occasions than a few years ago (Padulo, Attene, Migliaccio, Cuzzolin, Vando, & Ardigò, 2015). This evolution that invasion sports such as basketball are undergoing may be due to the modification of their rules (Ibáñez, Mazo, Nascimento, & García-Rubio, 2018) with the aim of improving the level of competition and, therefore, the show itself.

The evolution of basketball is largely due to the improvement of the physical fitness of the practitioners. For this, one of the most effective strategies to know the physical fitness of the players is to test the players in order to get information about their physical condition and to check if the training process is achieving the planned adaptation (Bangsbo, 2008). Although there is controversy about the results obtained, different investigations have aimed to analyse the players' physical fitness and its influence on the competition (McGill, Andersen, & Horne, 2012; Fort-Vanmeerhaeghe, Montalvo, Latinjak, & Unnithan, 2016). In invasion sports, there is research that found a relationship between technical-tactical games indicators (TTGI) with aerobic capacity (Green, Pivarnik, Carrier, & Womack, 2006), strength, power and the capacity for repeated sprinting (Burr, Jamnik, Baker, Macpherson, Gledhill, & McGuire, 2008; Peyer, Pivarnik, Eisenmann, & Vorkapich, 2011; Carbonell, Aparicio, & Delgado, 2009). Specifically, in basketball, McGill et al., (2009) found a relationship between technical-tactical performance with agility and horizontal jumps. In addition, Zarić, Dopsaj and Marković (2018) confirmed that there was a relationship between TTGI with a 20-metre speed and aerobic endurance test. Therefore, the athlete's physical fitness can be an indirect measure to know of performance they could have in competition.

To the best of our knowledge, there are few investigations linking physical fitness and sports performance in female basketball players. For all these reasons, the approach of this research was to find out if there is a relationship between the physical fitness of elite basketball players and the TTGI that they obtain during the season. To this end, the objectives of this research were to describe the physical fitness of the players through specific tests based on the game position (Guards, Forwards and Centres) and to analyse the relationships between the physical fitness variables and the TTGI.

Method

Participants

The sample of this research consisted of 10 players belonging to a professional female basketball team which competed in Women´s Spanish League 1 (Liga Día) and EuroLeague Women the (age: 24±3 years-old; height: 195±1 cm; body mass: 93±16 kg; professional playing experience: 5±2 years). All the players and coaches were informed about the research protocol that was developed based on the ethical provisions of the Declaration of Helsinki (2013), approved by the Bioethics Committee of the University (233/2019). The data sample on the TTGI was obtained from the official website of the competition (www.feb.es). The data

sample consisted of the 26 matches played by the team (*n*=210 cases) during the season belonging to the national Basketball League.

Variables

The Specific Position variable (Guard, Forward and Centre) was considered as the independent variable. Furthermore, the rest of the variables were grouped according to the origin from which they came (physical fitness test through inertial devices) or TTGI (competition).

Regarding the variables belonging to the physical fitness tests (Figure 1), seven variables were analysed: i) Technical-tactical efficacy; ii) % Maximum Heart Rate (%HR_{Max}); iii) Distance travelled (m); iv) Distance travelled at high intensity (m); v) Jump time (ms); vi) Jump height (cm); vii) Impulse in G-Force. The selected variables have been defined and used in different investigations that share theme with the object of study of this research (Mancha-Triguero, García-Rubio, Antúnez, & Ibáñez, 2020; Reina, Garcia-Rubio, Feu, & Ibañez, 2019; Reina, García-Rubio, Pino-Ortega, & Ibáñez, 2019).

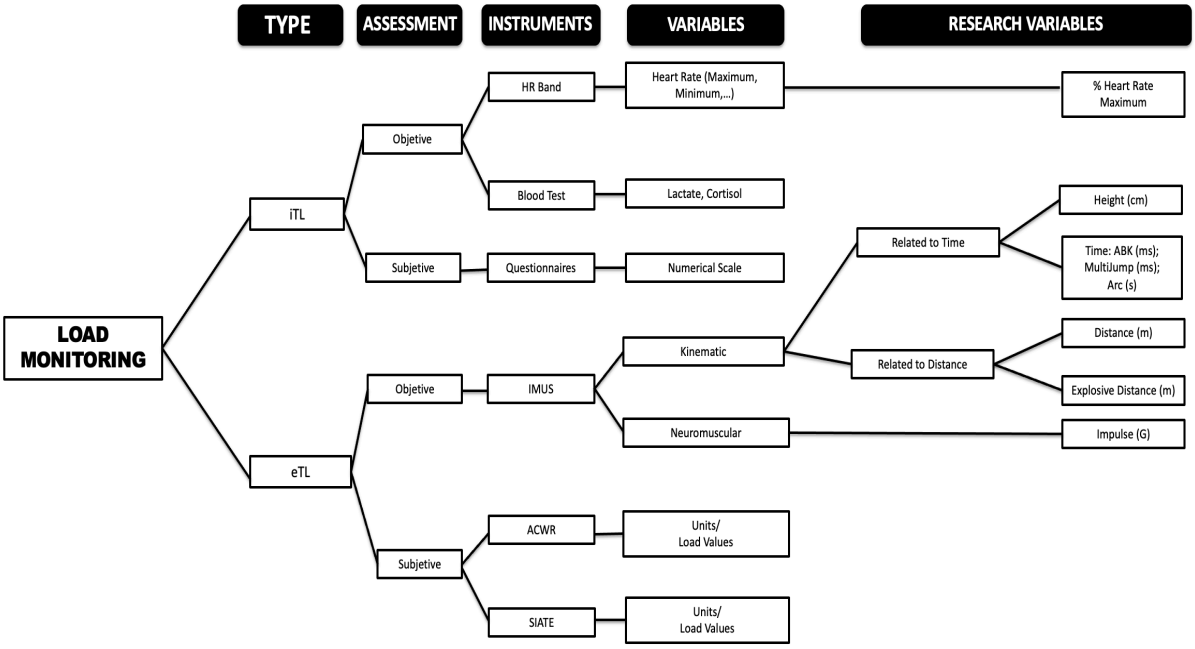


Figure 1. Graphic representation of the variables analysed in the physical fitness tests.

As for the variables belonging to the TTGI, a total of 18 TTGI of the competition were analysed (Figure 2). The variables related to the result in competition are: i) Minutes; ii) Points; iii) 2-Point Shots Annotated; iv) 2-Point Shots Thrown Out; v) 3-Point Shots Annotated; vi) 3-Point Shots Thrown Out; vii) Free Throws Annotated; viii) Free Throws Thrown Out; ix) Defensive Rebounds; x) Offensive Rebounds; xi) Total Rebounds; xii) Assists; xiii) Steals; xiv) Turnovers; xv) Favour Blocks; xvi) Unfavour Blocks; xvii) Fouls Committed; xviii) Fouls Received. The Game Indicators provided by the official competitions are used to carry out this research. These Game Indicators are what have made it possible to identify Technical-Tactical Performance Indicators (TTPI) for different competitions. These Game Indicators have been used because they allow us to complete these results with those provided in other investigations (Ibáñez, González-Espinosa, Feu, & García-Rubio, 2017; Ibañez, García-Rubio, Gómez-Ruano, & Gonzalez-Espinosa, 2018). TTGI are used because many of the indicators obtained in the competition have no impact on the result of the competition. For this reason, we speak of TTGI and not TTPI (they have an impact on the result of the competition).

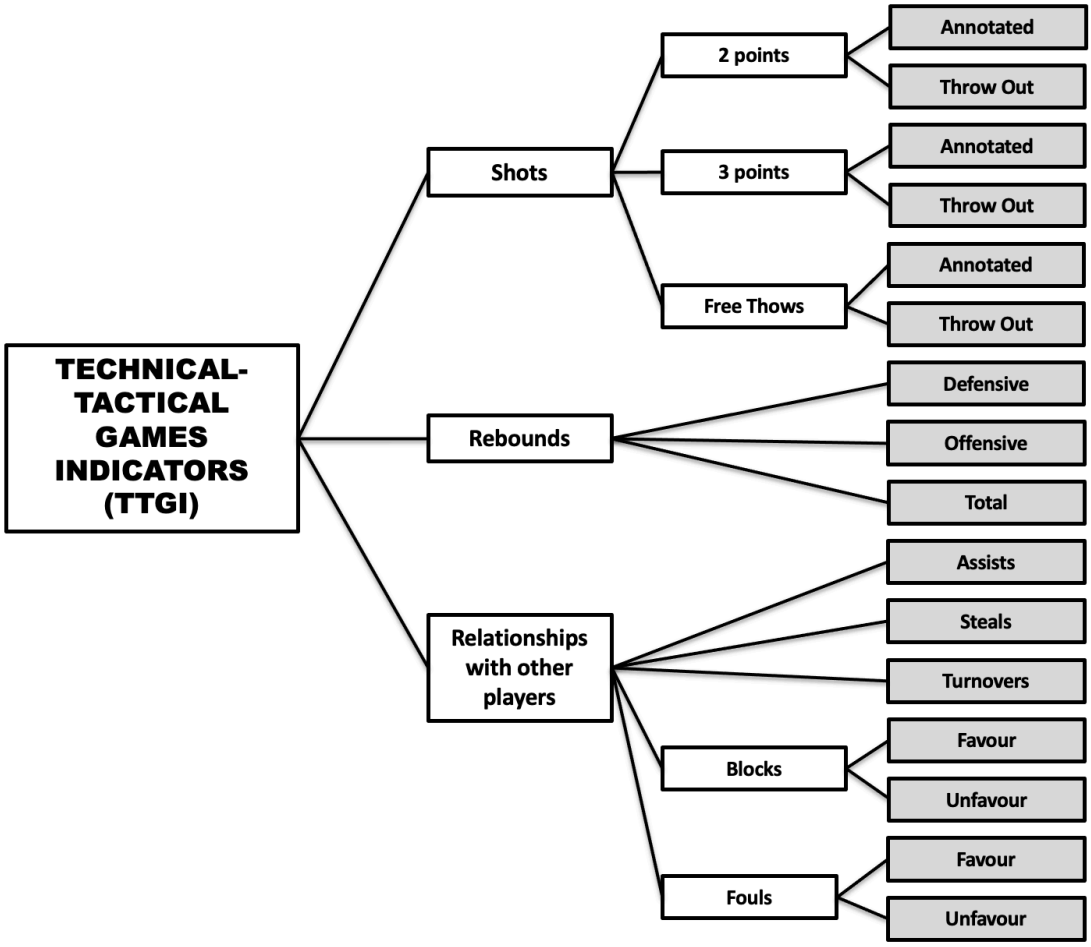
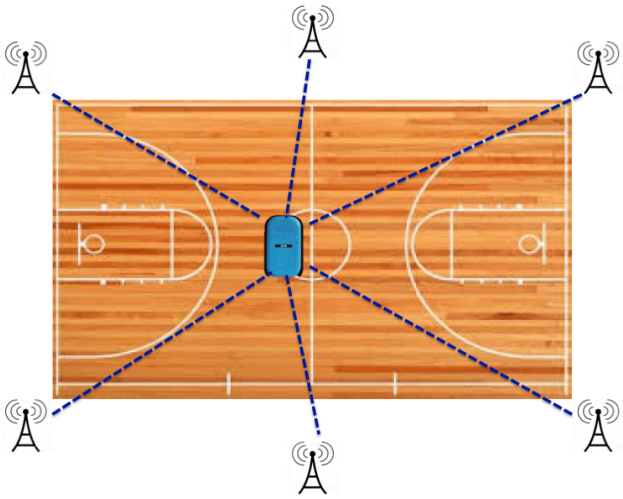


Figure 2. Graphic representation of the variables analysed of the TTGI

Instruments

The players were equipped with a GARMIN® heart rate band (Olathe, KS, USA) to analyse the internal load variables. For the external load variables, each player carried a WIMU PRO™ inertial device (RealTrack Systems, Almería, Spain) that was placed on the upper back in a vest adjusted to the athlete (Figure 3A). In addition, a system of six antennas was placed using Ultra Wide-Band technology (UWB) (Bastida-Castillo et al., 2019) with the aim of creating a Local Positioning System (LPS) and having an optimal quality of information obtained in the physical fitness tests (Figure 3B).

A. Basketball player wearing the inertial device.

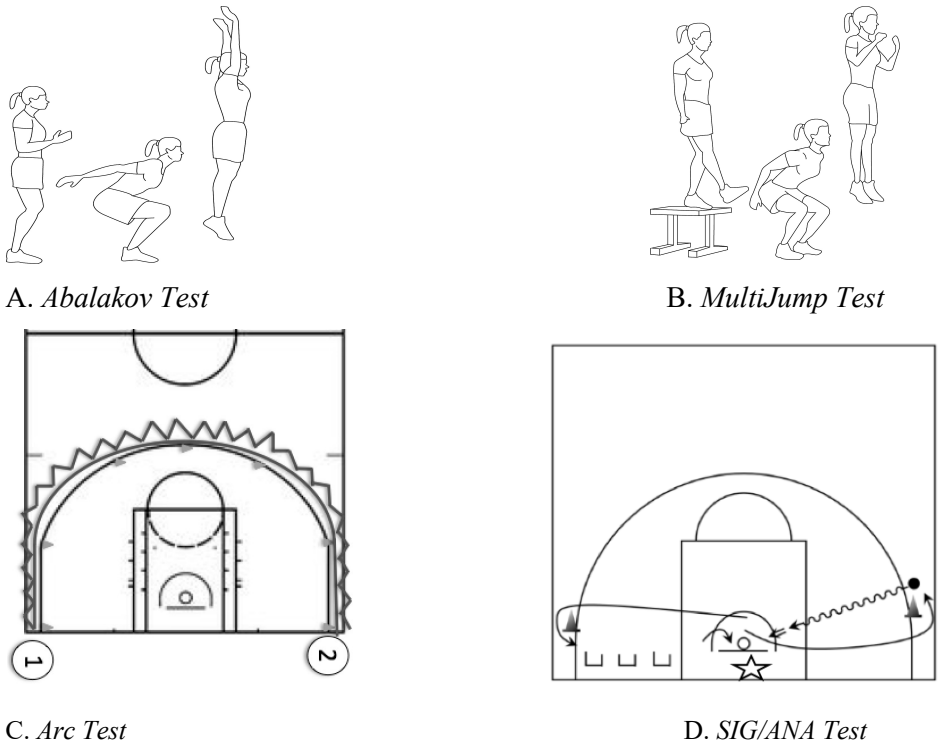


B. *Ultra Wide Band System on the basketball court*

Figure 3. Instruments used for data collection

The tests selected by the research team to assess the physical fitness of the athletes are part of the SBAFIT Battery (Mancha-Triguero, García-Rubio, & Ibáñez, 2019). The following tests were carried: i) Abalakov test (Bosco, 1994), ii) MultiJump test (Mancha-Triguero et al., 2019); iii) Arc Test (Mancha-Triguero et al., 2019); iv) SIG / ANA Anaerobic Test (Ibáñez, Sáenz-López, & Gutiérrez, 1995);

The Abalakov Test (Bosco, 1994) evaluated the maximum lower body strength (Figure 4A). To assess reactive strength, the players performed a MultiJump Test (Mancha-Triguero et al., 2019) in which they started from a height of 50 cm and chained 5 maximum jumps (Figure 4B). The Arc Test (Mancha-Triguero et al., 2019) was performed to evaluate the centripetal force of the athletes. In this test, the player walked the perimeter of the line that delimited the three points (Figure 4C). To evaluate the anaerobic capacity, the SIG / ANA Anaerobic Test (Ibáñez et al., 1995) was performed. It is an interval test that lasts ten minutes (one minute of activity, one minute of passive recovery). The purpose was to complete as many laps as possible that started and ended under the basket ring (star symbol in the figure) (Ibáñez, Reina, Mancha-Triguero, & García-Rubio, 2019) (Figure 4D).



A. *Abalakov Test* B. *MultiJump Test*

C. *Arc Test* D. *SIG/ANA Test*

Figure 4. Graphic representation of the physical assessment tests.

Procedure

The organization of the physical tests was planned according to the physical demands used by the athlete to carry them out. First, the tests that generate less fatigue (Abalakov Test and MultiJump Test) were carried out and recovery was faster. The last test was the one that required the most fatigue and recovery time (SIG/ANA Test) (Ibáñez, Sáenz-López, Gutiérrez, 1995). To perform the different tests, the players warmed-up as they usually do in match days, since in both situations, the level of demands is maximum (Zarić et al., 2018; Mancha-Triguero et al., 2019). Each player carried out a training session with the material to be used to familiarize themselves with the material and the protocol. After the warm-up period, each player observed a practical demonstration of the tests to become familiar with them. To obtain the results of the physical fitness tests, the proposal described by Rico-González, Los Arcos, Rojas-Valverde, Clemente, Pino-Ortega (2020) in the use of Inertial Devices was partially followed. For the TTGI of the competition, all the matches of the league competition (26 matches) were analysed. The evaluation of the physical fitness tests was carried out during the first week of the competitive period (prior to the first match day of the season). This timing was chosen because all the players had undergone a preseason period and were in good physical condition. The results of the TTGI were obtained at the end of the championship through the digital platform of the organizer of the competition.

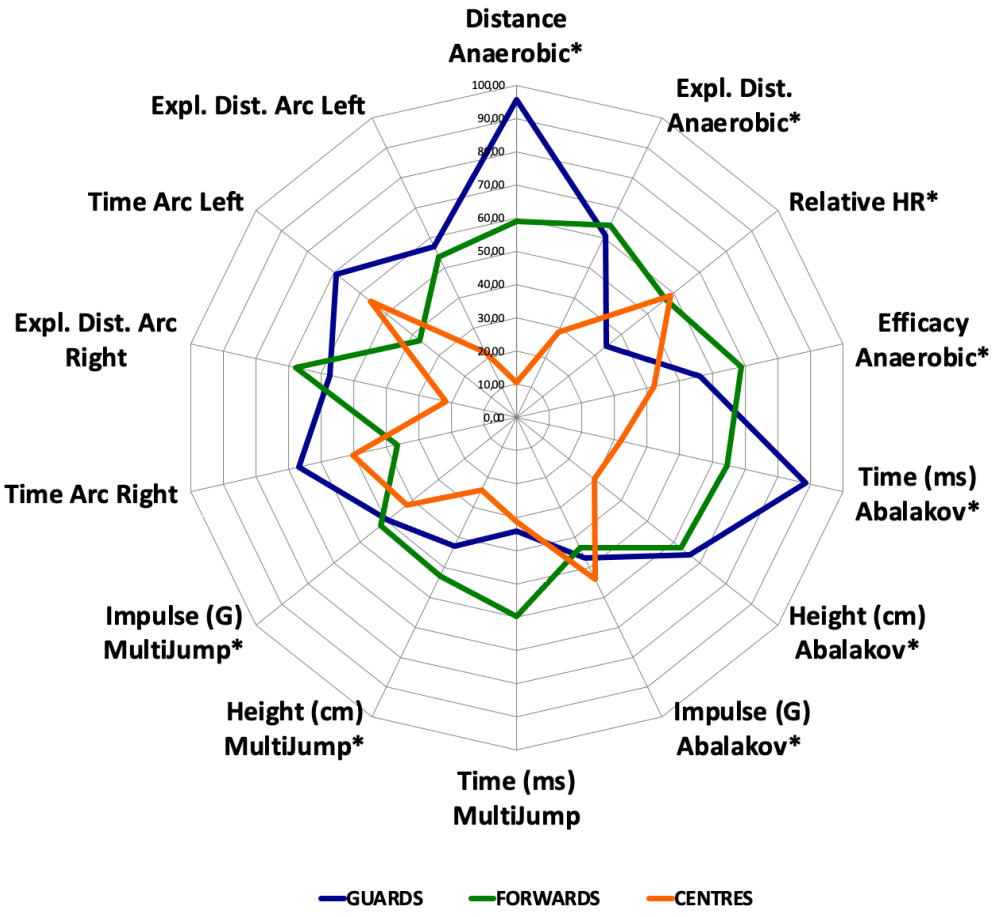
Statistical Analysis

First, a descriptive analysis (mean and standard deviation) was made. Second, criteria assumption tests were carried out (Field, 2009). The results showed a normal distribution of data, so parametric tests were performed to contrast the hypotheses. To identify the differences in the TTGI variables related to the specific position (Guards, Forwards and Centres), a ANOVA test was performed with Bonferroni's Post Hoc (Newell, Aitchison, & Grant, 2014). In addition, bivariate correlations were made between the variables analysed in a general manner (without taking into account the specific position) using the Pearson correlation

coefficient with the purpose of looking for relationships between the physical performance variables and the TTGI variables. Finally, the effect size was calculated in pairs through Cohen's d, classifying the value as low effect (0-.2), small effect (.2-.6), medium effect (.6-1.2), large effect (1.2-2.0) and very large effect (> 2.0) (Hopkins, Marshall, Batterham, & Hanin, 2009). The statistical power was also calculated with partial eta squared (Cárdenas, & Arancibia, 2014) that groups the values into small (> .10), medium (> .25) and large (> .40). The software used was SPSS 24.0 (SPSS Inc., Chicago, IL, USA). Significance was established at p <.05 (Field, 2009). Finally, for physical performance, a normalised profile was made through Z-Score to visually observe the results obtained. The purpose of Z-Score is to standardise the standard deviation that the value is above the mean (O´Donoghue, 2013).

Results

Figure 3 shows the normalised results of the physical fitness tests performed by the players who made up the sample. The figure selects the variables that can provide clearer information on each of the tests performed. The results show significant differences in all the tests carried out according to the specific position. As it can be seen, the Guard and Forward players obtain the best results in all the variables analysed.



(*There are significant differences in the variable depending on the specific position)

Figure 3. Standardised results of physical assessment tests depending on the specific game position.

Table 1 shows the results of the selected tests and the significant differences depending on the specific position. The Guard players show the greatest differences in comparison with the rest of the game positions. Regarding the effect size, the variables that show a large size are related to the centre position (ES G-C and ES F-C). These values confirm that the variables that obtain a large effect size show a significant difference between groups. The rest of the variables show a medium or small effect size. The results obtained in the statistical power test show that the variables Distance, Explosive Distance and Efficacy of the anaerobic test, Impulse of the MultiJump test, and the Explosive Distances of the Arc test to the right and to the left show a high statistical power (< .40). The rest of the variables analysed show a small or medium power.

Table 1. Results of physical assessment tests based on the specific position of the players.

		Guards		Forwards		Centres				*ES*	*ES*	*ES*
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Sig.*	*eta²*	*(G-F)*	*(G-C)*	*(F-C)*
Anaerobic	Distance (m)	749.75	9.60	738.26	22.92	699.28	14.49	.000* ***βΩ***	0.648	0.654	2.106	2.033
	Explosive Dist. (m)	138.85	22.06	136.15	13.11	106.37	19.07	.000* ***βΩ***	0.522	0.149	1.575	1.820
	% HR_{Max}.	85.55	2.19	93.10	5.53	92.37	2.73	.001*Δ***β**	0.271	-1.795	-2.756	0.167
	Efficacy (%)	93.00	4.80	96.80	2.77	92.20	5.09	.023* ***Ω***	0.424	-0.919	-1.844	1.123
ABK	Time (ms)	576.00	8.48	578.50	52.86	465.33	82.65	.000* ***βΩ***	0.225	-0.066	1.884	1.631
	Height (cm)	40.65	1.20	41.30	7.59	27.10	9.16	.000* ***βΩ***	0.215	-0.120	2.074	1.688
	Impulse (G)	2.61	0.10	2.36	0.29	3.42	3.29	.359	0.018	1.153	-0.348	-0.454
MULTI JUMP	Time (ms)	474.00	66.46	558.25	65.74	503.00	0	.016*Δ	0.367	-1.275	-0.617	1.189
	Height (cm)	32.72	1.89	34.78	9.92	29.08	0	.457	0.083	-0.288	2.724	0.813
	Impulse (G)	4.13	0.36	4.24	0.98	3.75	0	.576	0.059	-0.149	1.493	0.707
Arc R	Time (s)	4.68	0.13	4.39	0.27	4.71	6.47	.003*Δ***Ω**	0.383	1.369	-0.007	-0.070
	Explosive Dist. (m)	7.75	0.82	8.04	0.66	0.22	1.03	.000*Δ***Ω**	0.519	-0.390	0.889	0.940
Arc L	Time (s)	4.82	0.21	4.44	0.28	4.71	0.29	.008*Δ ***Ω***	0.333	1.535	0.434	-0.947
	Explosive Dist. (m)	9.28	0.08	9.23	0.96	8.08	0.55	.001*Δ***Ω**	0.44	0.073	2.053	1.470

Anaerobic*: Anaerobic Test;* ***ABK****: Abalakov Test;* ***MultiJump****: MultiJump Test;* ***Arc R****: Arc (right);* ***Arco L****: Arc (left);* ***Explosive Dist.****: Explosive Distance;* ***Sig****: p;* *******: **p**<.05;* Δ*: Significant differences between Guards and Forwards;* ***β****: Significant differences between Guards and Centres;* ***Ω****: Significant differences between Forwards and Centres;* ***ES (G-F)****: Effect Size (Guards-Forwards);* ***ES (G-C)****: Effect Size (Guards-Centres);* ***ES (F-C****): Effect Size (Forwards-Centres).*

Table 2 shows the results obtained in the analysis of the relationships between the physical fitness tests and the TTGI. The results of the study reveal the existence of relationships between the results of the physical fitness assessment tests and the TTGI. The anaerobic capacity test is related to the two and three points shots, rebounds and free throws. The lower body strength tests (Abalakov test and MultiJump test) correlate with blocks and with free throws and rebounds. Lastly, in the centripetal force test, in the test with the direction of rotation to the right, the results correlate with the 3-point shots, free throws and rebounds, while, in the direction of the rotation to the left, the results show only correlation with the free throws annotated variable.

Table 2. Results of the Pearson's bivariate correlations of the physical fitness variables and the TTGI of the competition.

			Min	Points	2 P.S. Annot	2 P.S. ThrOut	3 P.S Annot	3 P.S ThrOut	F.T. Annot	F.T. ThrOut	Def. Reb.	Of. Reb.	Tot. Reb.	As	Steals	TurnO.	Fav. Blocks	UnFav. Blocks	Fouls C.	Fouls R.
Anaerobic	Distance	*Pearson*	.375	-.017	-.581	-.552	**.896***	**.850***	-.629	**-.730***	**-.770***	**-.846***	**-.821***	.51	.192	.087	**-.696***	-.527	-.123	.255
		Sig.	.32	.965	.101	.123	**.001**	**.004**	.07	**.026**	**.015**	**.004**	**.007**	.161	.621	.823	**.037**	.145	.752	.507
	Expl.Dist	*Pearson*	.034	-,255	**-.703***	**-.704***	**.819***	**.849***	**-.721***	**-.914***	**-.877***	**-.831***	**-.902***	.141	.484	-.263	-.486	-.326	-.091	.117
		Sig.	.93	.508	**.035**	**.034**	**.007**	**.004**	**.029**	**.001**	**.002**	**.005**	**.001**	.718	.186	.494	.185	.391	.815	.764
	Efficacy	*Pearson*	.245	.345	.056	.127	.334	.17	-.287	0.034	-0.286	-.183	-.272	.308	.239	-.053	-.312	.518	.534	.061
		Sig.	.525	.363	.886	.745	.379	.662	.454	0.931	0.456	.637	.479	.42	.536	.893	.414	.153	.139	.876
	% HR_{Max}	*Pearson*	-.44	-.347	-.113	-.019	-.184	-.049	-.47	-.212	-.176	-.069	-.156	-.659	-.386	**-.747***	.239	.14	.144	-.562
		Sig.	.236	.361	.772	.961	.635	.9	.201	.584	.651	.86	.689	.054	.305	**.021**	.536	.72	.712	.115
Abalakov	Time	*Pearson*	.431	.196	-.156	-.136	.496	.316	-.393	-.127	-.488	-.351	-.474	.291	-.066	-.021	**-.900***	**-.899***	-.464	-.232
		Sig.	.247	.613	.689	.726	.175	.407	.295	.745	.182	.354	.198	.447	.866	.957	**.001**	**.001**	.208	.548
	Height	*Pearson*	.374	.144	-.215	-.186	.53	.366	-.468	-.182	-.541	-.404	-.529	.269	-.08	-.065	**-.876***	**-.892***	-.411	-.24
		Sig.	.322	.712	.578	.632	.142	.333	.204	0.64	.133	.281	.143	.484	.837	.868	**.002**	**.001**	.272	.534
	Impulse (G)	*Pearson*	-.593	-.599	-.499	-.476	.075	.333	-.299	-.467	-.225	-.331	-.261	-.163	.206	-.321	.629	.61	.62	.264
		Sig.	.092	.089	.171	.195	.848	.381	.435	.205	.56	.384	.497	.676	.596	.40	.07	.081	.075	.493
MultiJump	Time (Avg)	*Pearson*	.06	-.021	.363	.229	-.665	-.711	.656	.732	.123	.727	.358	-.08	,231	-.236	-.154	.16	-.483	-.417
		Sig.	.898	.965	.423	.622	.103	.073	.109	.061	.794	.064	.43	.865	.618	.61	.741	.731	.272	.352
	Height (Avg)	*Pearson*	.079	.008	.397	.267	-.677	-.734	.666	**.757***	.13	.747	.372	-,077	,225	-,24	-.161	.157	-.468	-.43
		Sig.	.865	.987	.378	.562	,095	.06	.102	**.049**	.781	.053	.412	,869	,628	,604	.731	,737	.289	.336
	Impulse (Avg)	*Pearson*	-.454	-.602	-.522	-.482	-.017	.137	-.587	-.172	**-.908***	-.241	**-.786***	-.442	**-.761***	-.65	-.274	-.399	-.459	-.735
		Sig.	.306	.152	.23	.273	.971	.77	.166	.712	**.005**	.603	**.036**	.321	**.047**	.114	.553	.375	.30	.06
Arc Right	Time	*Pearson*	-.347	-.489	-.15	-.135	-.337	-.231	-.016	.414	.279	.114	.249	-.077	-.629	-.082	.14	-,124	-.223	-.142
		Sig.	.361	.181	.701	.729	.375	.549	.967	.268	.467	.771	.518	.844	.07	.834	.719	,751	.564	.715
	Expl.Dist.	*Pearson*	.148	-.122	-.56	-.514	**.736***	**.773***	-.594	**-.711***	**-.852***	**-.744***	**-.860***	.388	.266	-.159	-.409	-.213	.269	.149
		Sig.	.704	.755	.116	.157	**.024**	**.015**	.092	**.032**	**.004**	**.022**	**.003**	.302	.489	.684	.274	.581	.485	.702
Arc Left	Time	*Pearson*	.393	.166	.342	.253	-.388	-.39	**.739***	.527	.598	.393	.571	.374	-.154	.553	-.008	.182	-.468	.292
		Sig.	.295	.669	.367	.511	.302	.30	**.023**	.145	.089	.295	.109	.321	.693	.123	.984	.64	.204	.446
	Expl.Dist.	*Pearson*	.574	.299	-.186	-.188	.648	.505	-.326	-.379	-.409	-.537	-.458	.515	.586	.089	-.634	-.585	.023	.389
		Sig.	.106	.434	.632	.628	.059	.166	.392	.314	.275	.136	.215	.156	.097	.82	.067	.098	.954	.301

Sig: <p valour .05**; **2 P.S. Annot**: 2-point Shots Annotated; **2 P.S. ThrOut**: 2-point Shots Thrown Out; **3 P.S. Annot**:3-point Shots Annotated; **3 P.S. ThrOut**: 3-point Shots Thrown Out; **F.T. Annot**: Free Throws Annotated; **F.T. ThrOut**: Free Throws Thrown out; **Def. Reb.**: Defensive Rebounds; **Of. Reb.**:Offensive Rebounds; **Tot. Reb.**: Total Rebounds; **As**: Assists; **Steals**: Steals; **TurnO.**: Turnovers;* **Fouls *C: *Fouls Committed;* Fouls *R:* Fouls *Received;* ***Expl Dist.***: *Explosive Distance (>15km/h);* ***% HR_{Max}***.: *% Maximum Heart Rate;* ***Impulse (G)***: *Impulse measured in G Force.*

Discussion

There is a relationship between performance during the competition and physical fitness tests (Zarić et al., 2018; Fort-Vanmeerhaeghe et al., 2016). It is necessary to have knowledge of the influence of physical fitness on the athlete's technical-tactical performance depending on their specific position. To this end, the objectives of this research were to characterize the physical fitness of the players by means of specific tests based on the specific position and to analyse the existence of relationships between the physical fitness and the TTGI. The results show the existence of different physical profiles depending on the game position (Guards, Forwards and Centres). In addition, the relationships between the results obtained in the physical condition assessment tests and the TTGI obtained during the competition were observed.

Assessment of physical fitness.

The assessment of the physical fitness allows to have a better knowledge about the state in which the athlete is and make individual adaptations depending on the game position (Tee, Lambert, & Coopoo, 2016). Along these lines, Zhang, Lorenzo, Gómez-Ruano, Liu, Gonçalves and Sampaio (2017) explained that perimeter players are the fastest players and that their movements are made at a higher speed that centres. In this line, Puente, Abián-Vicén, Areces, López and Del Coso (2017) added that they tend to be characterized by having a more static game than their peers and by moving at a lower speed due to their play close to the rim. These statements are due to the fact that one of the determining factors to classify the player in a position must be physical performance, which is influenced by anthropometric factors. In addition, focusing on the jumps of the players, Delextrat et al., (2015) confirmed that the Forwards are the players that perform this action more times. This may be due to the fact that Forward players have a direct game towards the basket and sometimes, when they are close to it, they collaborate in the rebound action. The results pertaining to the external load variable of this research reveal that Guard players obtain the best results and their demands for the same effort are lower. This fact affects the players having fewer requirements and therefore, generates less fatigue. Coinciding with the findings, Hulka, Cuberek, and Bělka (2013) stated that the specific position is decisive in the intensity of the athlete. In addition, they confirmed that the athlete's anthropometry has an impact on heart rate. Body size affects the athlete's heart rate and for this reason, these results are confirmed. Finally, the gravitational forces do not show differences depending on the specific position. These results confirm that all the players show similar force values (measured in G Force), the jump being affected by aspects related to the weight of the player. These results confirm the importance of strength training in the lower body, especially in centre players who, due to their characteristics and game, require this ability to a greater extent.

Relationship between physical fitness and TTGI.

Regarding the relationship between the physical variables with the TTGI, the results confirm the relationship between all the variables. These findings show the influence that physical fitness has on competition. The most participatory players in the game are characterized by having a better physical response to the requirements of the competition.

In the SIG/ANA anaerobic capacity test, the players who travel the most distance and explosive distance are the players who obtain more 3-point shots and less Free Throws and Rebounds during the competition. These findings are in line with those that confirm that perimeter players tend to be the ones with the greatest distance and at the fastest speed (Puente et al., 2017), looking for unopposed shooting positions, which would cause free throws. This may be due to the fact that perimeter players make a previous move to gain an advantage in receiving the ball and in game. Regarding the centres, different investigations have shown that, due to their position close to the basket, their game is usually static and with few movements (Reina et al., 2019). The actions performed by these players (Centres) are related to strength, while to a lesser extent they perform explosive actions or those related to speed. The results of this research have shown that the players who obtain a greater number of rebounds do not travel long distances to achieve this technical action (Puente et al., 2017). Defensive rebounds are a TTGI that predicts the best classified teams (Ibáñez et al., 2008). This responsibility, due to their proximity to the place where they are carried out, is in most cases executed by the paint players. As a result of the contact that exists in the inner

zone, many of the actions end in Free Throws. These data coincide with the findings of (Ibáñez, Santos, & García, 2015) that show that the centres are the ones who make the most free throws. Likewise, related to the distance travelled, the players who covered the greatest distance during the anaerobic test obtained the least number of Blocks in Favour in the competition. This may be due to the fact that the players who make a lower number of Blocks during the season have a position further away from the basket (Delextrat et al., 2015). In areas far from the basket, the number of blocks is less than in nearby areas where the defence is contact. Also, the players who travel the greater explosive distance throw fewer 2-point shots, but more 3-point shots. This may be related to the importance of making explosive movements prior to receiving the ball, since this explosiveness can hinder defense and facilitate a 3-point shots. Finally, the players with the lowest % Maximum Heart Rate are the players with the highest number of Turnovers during the season. These results coincide with those mentioned by (Reina et al., 2019) in which they stated that perimeter players show lower heart rates. In addition, these players tend to be characterized by high technical and tactical control during matches (Ibáñez et al., 2018) that make the athlete to sometimes take excessive risks, which may lead to technical errors (turnover, steals, travelling, bad pass).

In the lower body maximum strength test, the results show that the players with the longest fly time and jump height obtained the lowest number of Blocks during the competition. These results may be due to the fact that the players with the greatest leap in the physical assessment test are the perimeter players. In addition, Centre players who have a smaller jump do not require great efforts in this action due to their anthropometric characteristics. This habit gives the athlete a greater knowledge that affects the interpretation of the rival game and gives these players an advantage. For the players whose physical performance in jumping action is low, the coaching staff must provide knowledge about game reading or pre-indicators to counteract their deficit.

Regarding the reactive strength of the lower body, the players with the highest height in the jump obtain a greater number of Free Throws Annotated. During games with a tight score, the winning teams are distinguished from the losers by the free throws annotated (Ibáñez, Sampaio, Sáenz-López, Giménez, & Janeira, 2003). The fight for a rebound, with consecutive jumps, favours the reception of fouls that involve free throws. The results found in the analysed sample may be due to the fact that the test assesses the reactive capacity of the player to chain a set of maximum jumps. In addition, the players with the highest Impulse (G) in the selected test obtain the lowest number of rebounds and stolen balls. These results coincide with those obtained in the anaerobic test. Players with lower physical performance obtain advantages in these variables, which may be related to anthropometric factors or to their position on the pitch. In addition, the players who show a lower physical performance develop other facets of the game to equal the final performance.

Lastly, in the centripetal force test with a right-turning direction, the players with the greatest explosive distance travelled obtained a greater number of 3-point shots, fewer Free Throws Annotated and Rebounds. As in the anaerobic test, the results are repeated and can share reasoning (Abdelkrim, El Fazaa, & El Ati, 2007). Centre players are characterized by being the slowest players on the team; this lack of speed is supplemented by a high level of strength that helps to perform these technical actions during the competition as in the previous moments. In the test with the direction of rotation to the left, the players who spend the most time going through the test are the ones with the highest number of free throws annotated during the competition. Coinciding with the aforementioned, centre players are characterized by moving at a lower speed than their peers (Puente et al., 2017). These results are due to the fact that perimeter players must train the high intensity running with a curved trajectory because in many of their movements or contact with the ball, they do this action as an intrinsic gesture in the game.

Conclusions

The results of this research spread knowledge and have an impact on the evaluation of physical fitness in team sports such as basketball, due to its relationship with TTGI and, therefore, in the achievement of success. The findings show that in women's basketball there are different profiles of physical fitness depending on the game position and the demands of the competition. The results provide objective and specific knowledge about the requirements of the players in the face of the same stimulus. These differences facilitate the physical work of the coach, who can individualize the training depending on the position of the game.

Finally, regarding the relationships between variables, the findings show a relationship between physical performance and the TTGI obtained during the competition. All physical fitness assessment tests show a relationship with some performance indicator. Technical-tactical performance in women's basketball is related to the physical fitness profile of the players and their specific position. Therefore, the importance of the athlete's physical performance in the result of the competition can be confirmed.

The practical applications that can be obtained from this research are the following: i) different profiles are shown depending on the playing position. These results confirm that specific physical work must be planned based on the athlete's game position. ii) It is observed that depending on the game position, the TTGI performed during the competition are different. Each TTGI is related to a skill. Therefore, the players who, due to their game position, execute a certain TTGI to a greater extent must work specifically on the ability that allows them to do so. As well as the coach design training tasks in which this work is optimized to perform it efficiently in the competition. iii) Finally, having observed the relationship between the physical variables of the athletes and the TTGI in competition, the physical state of the athlete can be known based on the results that she obtains in the competition.

Limitations

The research carried out has as a sample a team that competes in both the national league championship and in the top European competition. Despite having a great ecological validity and the data coming from a team taken as an international reference, the results cannot be generalized to the rest of the teams that compete in the national league championship. The main differences found with the Spanish league teams not only affect the quality of the players. It is also important to highlight the high number of games they accumulate during the season. As for the matches analysed, they belong to a national club taken as a reference, where the results of the matches are usually favourable to this team, with results with much difference and always finishing as victories. The physical tests were conducted on one occasion during the season.

For future research, it would be interesting to repeat the protocol with a greater number of teams with different rankings in the classification. In addition, it would be interesting to carry out the physical fitness assessment tests at different times of the season to have a better knowledge of the physical fitness of the athletes and to take into account all the official matches that the team participates in. In addition, the selection of the variables was made collectively by the research team and not taking into account the analysis of main components as mentioned by Rojas-Valverde, Gómez-Carmona, Oliva-Lozano, Ibáñez and Pino-Ortega (2020). This fact may affect the results obtained and the choice of other variables could have shown other results.

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