Determinant variables related to performance of professional bullfighters: A narrative review

Variables determinantes relacionadas con el rendimiento de los toreros profesionales: Una revisión narrativa

Authors

Luis Teba-del Pino [1]
Julio Calleja-González [2]
Juan Mielgo-Ayuso [3]
Eduardo Sáez de Villarreal Sáez [1]

[1] Pablo de Olavide University (Spain)
[2] University of the Basque Country (Spain)
[3] University of Burgos (Spain)

Corresponding author:
Luis Teba-del Pino
coach.luisteba@gmail.com

How to cite in APA

Teba-del Pino, L., Calleja-González, J., Mielgo-Ayuso, J., & Sáez de Villarreal, E. (2025). Determinant variables related to performance of professional bullfighters: A narrative review. *Retos*, *65*, 1107–1119. https://doi.org/10.47197/retos.v65.111786

Abstract

Although bullfighting is not considered a sport, bullfighters require an optimal level of physical preparation to be able to face the difficult activity of fighting a brave bull. The usual approaches to the physical preparation of professional bullfighters are based on decontextualized training methods, or on the practice of sports modalities with positive transfer to bullfighting. However, the lack of analysis of the context of bullfighting, as well as the existence of few investigations that have analyzed the psychophysiological variables and the movement time of professional bullfighters during the fight, causes the urgent need to generate a line of research that can solve these deficiencies.
Objective: The main objective of this narrative review is to present the current relevant scientific literature on the variables that determine the performance of bullfighters, and thereby, begin to lay the foundations for a more scientific analysis of bullfighting.
Method: A bibliographic search was carried out in accordance with the PRISMA guidelines and the PICO framework.
Result: The results of this narrative review show the determining variables in the performance of professional bullfighters studied by the scientific community.
Conclusion: knowledge of these variables will allow a more effective application of the principles of training, particularly the principle of specificity, often neglected in the training of this art associated with physical activity.

Keywords

Bull; bullfighter; heart rate; performance; variability.

Resumen

Aunque el toreo no está considerado como un deporte, los toreros requieren de un óptimo nivel de preparación física para poder afrontar la difícil actividad que supone torear un toro bravo. Los planteamientos habituales de la preparación física de los toreros profesionales están basados en métodos de entrenamiento descontextualizados, o en la práctica de modalidades deportivas con transferencia positiva a la actividad de torear. Sin embargo, la falta de análisis del contexto taurino, así como la existencia de pocas investigaciones que hayan analizado las variables psicofisiológicas y el tiempo de movimiento de los toreros profesionales durante la lidia, provocan la urgente necesidad de generar una línea de investigación que pueda solucionar estas deficiencias.
Objetivo: El principal objetivo de esta revisión narrativa es presentar la literatura científica relevante y actual sobre las variables que determinan el rendimiento de los toreros, y con ello, comenzar a sentar las bases para un análisis más científico del toreo.
Método: Se realizó una búsqueda bibliográfica de acuerdo con las directrices PRISMA y el marco PICO.
Resultado: Los resultados de esta revisión narrativa muestran las variables determinantes en el rendimiento de los toreros profesionales estudiadas por la comunidad científica.
Conclusión: el conocimiento de estas variables permitirá una aplicación más efectiva de los principios del entrenamiento, particularmente el principio de especificidad, muchas veces descuidado en el entrenamiento de este arte asociado a la actividad física.

Palabras clave

Toro; torero; frecuencia cardiaca; rendimiento; variabilidad.

Introduction

Bullfighting has been considered an intangible cultural heritage in Spain since 2013. It is an artistic activity of a traditional, social, and cultural nature practiced in Spain, Portugal, southern France, and some Latin American countries (Cozcolluela-Cabrejas et al., 2019; Reguera-Teba et al., 2021; Navas-Mosqueda et al., 2022). Although bullfighting is not considered a sport, the requirements for optimal physical and psychological preparation and mastery of the technical requirements of the activity are similar to those of any sport (Reyes, 2004; Teba-del Pino et al., 2024a; Teba-del Pino, 2024), with the added character of the vital risk that its practice implies (Reyes, 2004; De Miguel, 2019; Teba-del Pino et al., 2024b). Therefore, analyzing the determining variables on performance of this complex activity is vital to improve the performance of the bullfighters in the bullring during bullfights.

In the sports context, the emergence of technology has allowed coaches, physical trainers and researchers to improve the understanding of the competitive context through the study of the determining variables on performance of each sport (Cummins et al., 2013; Dellaserra et al., 2014; Düking et al., 2023). Among them, the use of global positioning systems (GPS), heart rate (HR) monitoring devices (Dellaserra et al., 2014; Imbach et al., 2019; Medina Villanueva et al., 2022), accelerometers (Kawamori et al., 2013; Harper et al., 2019) and video analysis, have made it possible to apply the principle of specificity to training based on the similarity between the stimulus provided in training to that obtained during competition, thus improving sports performance (Cummins et al., 2013; Ade et al., 2014; Harper et al., 2019; Petway et al., 2020; Koyama et al., 2022; Velásquez-González et al., 2023). However, the bullfighting has not undergone the same evolutionary process of optimizing the physical preparation and performance of the bullfighters in their activity, by understanding the sporting context, that most sporting modalities have suffered. This decontextualized process in the activity of bullfighting implies that bullfighters are applying training methods that are completely unspecific to the activity of bullfighting itself (Reyes, 2004; De Miguel, 2019; Teba-del Pino, 2024; Teba-del Pino et al., 2024a).

In particular, the contextualization of a sport modality begins with the analysis and description of the activity itself. From the perspective of physical activity, bullfighting on foot is considered a complex, non-systematic, irregular, and intermittent physical activity (Reyes, 2004; Negro Peral et al., 2006; Navas-Mosqueda et al., 2022; Teba-del Pino et al., 2024a), where the bullfighters must fight at different intensities during the three parts (thirds or phases) that the bullfight lasts (Reyes, 2004; Del Moral, 2011), adapting to the unpredictable behavior of the bull (Del Moral, 2011; Teba-del Pino et al., 2024b). During the fight, the appropriate behavior of the fighting bull favors the artistic creation of the bullfighter (Purroy, 2023). However, this the bull's behavior is unpredictable (Teba-del Pino, 2024). Bearing in mind that bullfighting involves the intelligent exploitation of all the unforeseen and spontaneous reactions of the bull (Del Moral, 2011; Teba-del Pino et al., 2024b), the unpredictable behavior of the bull can be considered the uncertainty principle in bullfighting, directly influencing the performance of the bullfighters (Teba-del Pino et al.,2024b). Adapting the bull's behavior towards artistic creation imposes significant physical, physiological, and psychological demands on the bullfighter. This process involves the cardiovascular, respiratory, endocrine, and nervous systems, as well as the recruitment of motor units from the body's main muscle groups (Reyes 2004; Teba-del Pino et al., 2024a). Achieving an optimal mental state before the fight is essential, ensuring that these systems work in unison to provide the bullfighter with the necessary psycho-physical condition to face the bull effectively.

Considering that the action of bullfighting carries an implicit life risk (Reyes, 2004; Teba-del Pino et al., 2024a; 2024b), bullfighters face alterations in their anxiety levels before the competition (bullfight). In fact, pre-competitive anxiety (PCA) is an immediate emotional state manifested by a subjective feeling of perceived threat, accompanied by an increase in the physiological response before a competitive event (Andrade et al., 2007; Salom Martorell et al., 2020). In that sense, high levels of cognitive anxiety (CA) negatively influence the concentration and decision-making capacity of athletes (Paul & Garg, 2012). This fact also influences bullfighters, given that high levels of AC could influence decision-making during the bull's fight, even putting its life at risk (Teba-del Pino et al., 2024b). The somatic anxiety (SA) expressed in an increase in the bullfighters' HR in the moments before the bullfight could influence the bullfighter's performance in the bullring (Reyes, 2004; Zafrillas et al., 2015; Teba-del Pino et al., 2024a). The HR represents the variable most analyzed due to the scarce existing scientific literature on the per-

formance of bullfighters in the bullring. Studies show the high intensities that HR reaches during bullfighting activity (Reyes, 2004; Zafrillas et al., 2015; Teba-del Pino et al., 2024a; 2024b), where the Bullfighters accumulate high internal training loads (ITL) both among the bulls fought within the same bullfight and in periods of accumulation of bullfighting celebrations (Teba-del Pino et al., 2024a).

During the action of bullfighting, not only is the behavior of each bull different, but the way each bullfighter responds to these stimuli is also different, with temper being one of the characteristics that most evidence this variability in the bullfighter's response. The temper is based on accommodating the speed of the deception to the speed of the bull's attack (Del Moral, 2011; Teba-del Pino et al., 2024b), which is essential for success in the fight. Not only the technical-artistic actions (technique) such as tempering integrate the motor aspects of the activity of bullfighting, but also the movements made by the bullfighters, where 72% of the total time of the fight (TT) the bullfighters maintain the posture or perform short and lateral movements with the aim of positioning themselves for the next action (Reyes, 2004; De Miguel, 2019; Teba-del Pino et al., 2024a).

For this reason and given the fact of the scarcity of scientific literature referring to the study of the determining variables on performance of professional bullfighters, as well as the physical preparation and optimization of their performance in the bullring for the bets of the author's knowledge. The main purpose of this narrative review is to present all the information to date on the determining variables in performance, establishing the necessary theoretical basis for establishing a more specific physical preparation for the activity of bullfighting.

Method

Information sources

The review was conducted in accordance with PRISMA guidelines (Liberati *et al.,* 2009) following the 27 checklist items. Additionally, the PICO (Patient/Problem, Intervention, Comparison, Outcome) framework was also implemented throughout the study to gain a better and deeper understanding of the topic being evaluated (Eriksen & Frandsen, 2018). A computer-based literature search from 1 January 1950 to 30 May 2024 was completed using the following information sources: Medline (PubMed), Web of Science, and Scopus. The search strategy was modified for the PubMed database, specifically by using medical subject headings (MeSH) and free text words for key concepts related to Bullfight, bullfighter, performance, and bull, along with Boolean operators such as "&" or "or." We use the following search equation: ("bullfighter" [all fields] OR "bullfighter" [MeSH terms]) AND "performance" [all fields] OR "performance" [MeSH terms] AND ("bullfight" [all fields] OR "bullfight" [MeSH terms] AND "heartrate" [all fields] OR "global Positioning System" [all fields] OR "anxiety" [all fields] OR "variability" [all fields] OR "bull" [all fields] OR "bull" [MeSH terms]. In addition, the reference sections of all relevant articles were also examined by applying the snowball strategy (Linder *et al.,* 2015) by 2 different authors.

Study Inclusion Criteria

The titles and summaries of all the publications found in the information sources used were obtained. All titles and abstracts from the search were cross-checked to identify duplicates and possible missed studies. Titles and abstracts were selected for further full-text review. The search for published studies was conducted independently by two different authors, and disagreements were resolved through discussions between them. The relevance of the publication for inclusion was determined. The availability of the full text was established as one of the inclusion criteria. At the same time, the reference sections of the selected articles were searched to identify other relevant articles. Finally, for the present review only the studies focused on the description of the bullfighting activity, the physical preparation of the bullfighters (training), physiological variables (HR), displacement variables (distance traveled, speed and accelerations), and psychological variables (pre- competitive anxiety)..

Study Exclusion Criteria

Duplicate articles and those related to veterinary medicine and the study of bulls, and articles dedicated to surgery caused by a bull horn wound were excluded. On the other hand, abstracts and articles not peer-reviewed and not written in English or Spanish were excluded.

Study Selection

Two authors identified articles through database searches and then duplicates were removed. The authors then reviewed the titles and abstracts of the remaining publications to determine eligibility for full-text review. All studies that met the inclusion criteria were retrieved and reviewed in their entirety, and any disagreements were resolved by a third reviewer.

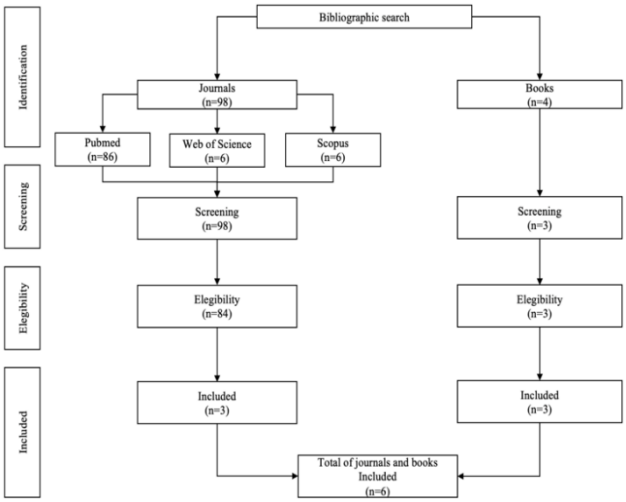
Data Extraction

Once the inclusion/exclusion criteria were applied to each study, the following data were extracted: (1) source of the study (author(s) and year of publication); (2) type of event studied (*tentadero* [real simulation training method] or bullfight); (3) sample population, indicating the number of participants, and type of bullfighter (novillero without *picadores* [apprendice bullfighter], novillero with *picadores* [apprentice semi-professional bullfighter], assistant bullfighter and bullfighter); (4) place where the registration took place (bullfight and *tentadero*); (5) methods and devices used for load monitoring, for geolocation and analysis of pre-competitive anxiety; (6) variables identified for each method and device; and (7) results reported for each dependent variable. In publications in which the variables to be extracted were not shown, information was requested from the corresponding author via email. Two authors independently extracted the results of the interventions using a spreadsheet (Microsoft Excel® 2019, version 23, Microsoft Inc®., Seattle, WA, USA). Subsequently, disagreements were resolved through discussion until a consensus or third-party adjudication was reached.

Results

The initial literature search detected a total of 98 articles and 4 books on the performance of bullfighters; However, 95 articles and 1 book were discarded because they did not refer to the determining variables in the bullfighters' performance nor did they meet the inclusion criteria established in the present review (Figure 1).

Figure 1. Flow diagram of study selection



Variability in the performance of professional bullfighters. Influence of bull behavior

The summary of the interventions and the results of the study about variability on performance of bullfighters can be observed in Table 1 and Table 2. Only one study examined the variability in the performance of professional bullfighters (Teba-del Pino *et al.,* 2024b). In this study, the differences and the coefficient of variation (CV) in the performance variables of three bullfighters were analyzed between the fight of the six bulls of a bullfight.

Table 1. Study of the variability in the HR response associated with the behavior of the bull.

Reference	n	Bullfighter	Place	Tecnology meansure	HRmax	%HRmax	HR_{mean}	>70 %HRmax	>80 %HRmax	>90 %HRmax	TRIMPs

Teba-del Pino et al., (2024b)	6	Bullfighter (n=3)	Bullfight	Polar Team 2	P < 0.001 | CV = 53.55%	P < 0.001 | CV = 7.76%	P < 0.001 | CV = 4.24%	P =0.005 | CV = 50.20%	P = 0.004 | CV = 48.78%	P < 0.001 | CV = 69.14%	P < 0.001 | CV = 53.55%

n = number of bulls fought; Bullfighter = number of bullfighter number who participated; Place = place where the fight takes place; HRmax= Heart-rate maximum; %HRmax= Percentage of maximum heart rate; HRmean= Average heart rate; 70% = time that the bullfighter was above 70% HRmax; 80% = time that the bullfighter was above 80% HRmax; 90% = time that the bullfighter was above 90% HRmax; TRIMPS = Training Impulse.

Table 2. Study of the variability in the movements of bullfighters associated with the behavior of the bull.

Reference	n	Bullfighter	Place	Tecnology meansure	DT	Zone 1 (0-6 km/h-1)	Zone 2 (6.1-14 km/h-1)	Zone 3 (>14.1 km/h-1)	Smax	Smean	Acceleration Zone 1	Acceleration Zone 2	Acceleration Zone 3
Teba-del Pino et al., (2024b)	6	3	Bullfight	GPS	P = 0.001 | CV = 12.20%	P < 0.001 | CV = 26.45%	P < 0.017 | CV = 70.03%	P = 0.141 | CV = 140.21%	P < 0.001 | CV = 23.39%	P < 0.001 | CV = 19.36%	P = 0.001 | CV = 52.73%	P = 0.006 | CV = 37.50%	P = 0.028 | CV = 79.80%

n = number of bulls fought; Bullfighter = number of bullfighter number who participated; Place = place where the fight takes place; TD = total distance traveled (m); Smax = maximum speed; Smean = average speed; Zone 1 = Accelerations carried out between 0.5-1 m/s-2; Zone 2 = Accelerations carried out between 1-2 m/s-2; Zone 3 = accelerations greater than 2 m/s-2.

Pre-competitive anxiety

The summary of the interventions and the results of the study about PCA or pre-bullfight anxiety in the case of bullfighters, can be observed in Table 3. Only one study has analyzed PCA in bullfighters (Teba-del Pino et al., 2024a). This study compared the levels of PCA before fighting in a bullfight and in a tentadero.

Table 3. Pre-competitive anxiety in the activity of bullfighting.

Reference	n	Category	Place	Questionnaire	AC	AS	SC	Result
Teba-del Pino et al., (2024a)	3	Bullfighter (n=1)	Bullfight	CSAI-2R (spanish version)	10	10	19	Significant differences (P≤0.05) in SC (P = 0.037). Not in AS (P = 0.079) and AC (P = 0.09).
			Tentadero (bulls)		14	9	18	
		Assistans Bullfighter (n=2)	Bullfight		10.5 ± 1.4	12.5 ± 0.7	12.5 ± 0.7	Significant differences (P≤0.05) in SC (P = 0.019) and AS (P = 0.054). Not in AC (P = 0.194).
			Tentadero (bulls)		10	8	19	

n= number of bullfighters; Category = types of bullfighters; Place = place where the fight takes place; AC = Anxiety cognitive; AS = Anxiety somatic; SC = Self-confidence.

The HR response

The summary of the interventions and the results of the study related to HR and ITL response of the bullfighting activity are described in Table 4. Four studies analyzed the HR response of bullfighters during the bullfighting activity (Reyes, 2004; Zafrillas et al., 2015; Teba-del Pino et al., 2024a; 2024b). While the four studies analyzed HRmax and HRmean in professional bullfighters during a bullfight. Reyes, (2004) analyzed four bullfighters during the fight of a bull, Zafrillas et al., (2015) analyzed a bullfighter during the fight of eight bulls, Teba-del Pino et al., (2024a) analyzed a bullfighter during a bullfight (two bulls fought), and the bullfighter's assistant's bullfighter Teba-del Pino et al., (2024b) analyzed the six fights of a bullfight carried out by three professional bullfighters.

Only two studies grouped HR into different zones according to the time the bullfighters spent at a certain intensity (Teba-del Pino *et al.,* 2024a; 2024b). Both studies grouped the time (mm:ss) and the percentage (%) of the TT that the bullfighter and his assistants were in three intensity zones (>70, >80 and > 90% HRmax) during a bullfight.

Table 4. Variables related to the HR response analyzed in bullfighting.

Reference	n	Level	Place	Tecnology meansure	HRmax	%HRmax	HRmean	>70 %HRmax	>80 %HRmax	>90 %HRmax	TRIMPs
Reyes (2004)	12	Bullfighter (n=4)	Bullfight	Polar T31	188 bpm	.	160 bpm	.	.	.	.
		Apprendice bullfighter (n=4)			200 bpm	.	182 bpm	.	.	.	.
		Apprentice semi-professional bullfighter (n=4)			199 bpm	.	181 bpm	.	.	.	.
Zafrillas et al., (2015)	8	Bullfighter (n=1)	Tentadero (brave cows)	Polar Team 2	164 bpm	.	121 bpm	.	.	.	.
	8	Bullfighter (n=1)	Tentadero (bulls)		177 bpm	.	157 bpm	.	.	.	.
	8	Bullfighter (n=1)	Bullfight		182 bpm	.	164 bpm	.	.	.	.
Teba-del Pino et al., (2024a)	2	Bullfighter (n=1)	Bullfight	Polar Team 2	186 bpm	96.40%	159 bpm	37:41 | 77.38%	30:54 | 63.82%	13:00 | 26.85%	180
	2	Bullfighter (n=1)	Tentadero (bulls)		160 bpm	82.90%	125 bpm	19:13 | 53.38%	1:54 | 5.28%	00:00 | 0%	79
	2	Assistans Bullfighter (n=2)	Bullfight		172 ± 7 bpm	95.30% ± 7 bpm	129 ± 6 bpm	22:24 ± 6:53 | 46.68% ± 14.36	15:03 ± 3:08 | 31.37% ± 6.56	7:48 ± 0:06 | 16.25% ± 0.19	125.5 ± 25.8
	2	Assistans Bullfighter (n=2)	Tentadero (bulls)		156 ± 13 bpm	86.63% ± 4.39 bpm	116 ± 29.70 bpm	10:03 ± 13:13 | 27.64% ± 36.3	5:24 ± 7:38 | 15% ± 21.2	0:47 ± 1:05 | 2.66% ± 3	61.25 ± 69.7
Teba-del Pino et al., (2024b)	6	Bullfighter (n=3)	Bullfight	Polar Team 2	184.83 ± 10.55 bpm	97.4 ± 4.11 bpm	156.33 ± 12.13 bpm	20:22 ± 10:13 | 83.51% ± 8.6	16:34 ± 8:04 | 68.46% ± 12.56	6:42 ± 4:37 | 31.98% ± 23.21	91.83 ± 49.18

n= number of bulls fought; Apprendice bullfighter = novilleros without picadors; Apprentice semi-professional bullfighter = novilleros with picadors; HRmax= Heart-rate maximum; %HRmax= Percentage of maximum heart rate; HRmean= Average heart rate; 70% = time that the bullfighter was above 70% HRmax; 80% = time that the bullfighter was above 80% HRmax; 90% = time that the bullfighter was above 90% HRmax; TRIMPS = Training Impulse.

Internal load

Only two studies analyzed the ITL of professional bullfighters during a bullfight (Teba-del Pino *et al.,* 2024a; 2024b). Teba-del Pino *et al.,* (2024a) analyzed a bullfighter and his assistant's during a bullfight and tentadero (two bulls fought in each place). Teba-del Pino *et al.,* (2024b) examined the six fights of a bullfight carried out by three professional bullfighters (see Table 4).

Variables of movement time in the activity of bullfighting

The summary of the interventions and the results of the study about displacement variables of the bullfighting activity can be seen in Table 5. Only two studies analyzed the variables associated with the displacement of the bullfighters during the fight of a bull (Teba-del Pino *et al.,* 2024a; 2024b). Teba-del Pino *et al.,* (2024a) grouped the results obtained during two fights carried out by a bullfighter and his assistants, presenting them as a summary of the travel variables associated with the activity of bullfighting during a bullfight. Teba-del Pino *et al.,* (2024b) examined the displacement variables of three professional bullfighters during the fight of six bulls in a bullfight.

Table 5. Movement time variables analyzed in bullfighting.

Reference	n	Level	Place	Tecnology meansure	DT	Zone 1 (0-6 km/h-1)	Zone 2 (6.1-14 km/h-1)	Zone 3 (>14.1 km/h-1)	Zone 4 (>18 km/h-1)	Smax	Smean	Acceleration Zone 1	Acceleration Zone 2	Acceleration Zone 3
Teba-del Pino *et al.,* (2024a)	2	Bullfighter (n=1)	Bullfight	GPS	1814.8	1305.7 | 71.95%	441 | 24.3%	68.1 | 3.75%	9.5 | 0.52%	20 km/h	2.2 km/h	97	21	18
	2	Bullfighter (n=1)	Tentadero (bulls)		1069.5	712.2 | 66.59%	357.2 | 33.39%	0 | 0%	0 | 0%	13.95 km/h	1.8 km/h	56	36	34
	2	Assistans Bullfighter (n=2)	Bullfight		1332.7 ± 6.65	887.8 ± 7.92 | 66.62% ± 0.93	416.85 ± 12.80 | 31.27% ± 0.80	24.60 ± 12.80 | 1.85% ± 0.24	0 ± 0 | 0% ± 0	16.95 km/h ± 0.64	1.63 km/h ± 0.18	72.5 ± 11	32.5 ± 2	17.5 ± 5
	2	Assistans Bullfighter (n=2)	Tentadero (bulls)		490.15 ± 113.63	309.8 ± 15.41 | 63.6 ± 13.15	116.2 ± 100.83 | 32.41% ± 13.07	11.6 ± 6.22 | 2.58% ± 1.87	0 ± 0 | 0% ± 0	15.4 km/h ± 0.57	0.83 km/h ± 0.59	20.5 ± 5	12.5 ± 6	14 ± 10
Teba-del Pino *et al.,* (2024b)	6	Bullfighter (n=3)	Bullfight	GPS	628.01 ± 229.84	491.63 ± 130.06 | 80.57 ± 8.10	125.03 ± 87.55 | 18.18 ± 6.45	13 ± 18.23 | 1.8% ± 1.74	.	15.65 km/h ± 3.61	1.91 km/h ± 0.15	29.67 ± 15.64	13.67 ± 5.12	4.67 ± 3.72

n= number of bulls fought; TD = total distance traveled (m); Smax = maximum speed; Smean = average speed; Zone 1 = Accelerations carried out between 0.5-1 m/s-2; Zone 2 = Accelerations carried out between 1-2 m/s-2; Zone 3 = accelerations greater than 2 m/s-2.

Discussion

To understand the context of the activity of bullfighting and considering the concerns of the bullfighters about their performance in the bullring, the present narrative review tries to provide a complete vision about the activity of bullfighting from the perspective of performance, through the analysis of the determining variables on performance of the bullfighter during a bullfight. The high variability in the behavior of the bull directly influences the intensity of the fight, as well as the importance of monitoring and quantifying variables such as HR, time of motion and PCA of the bullfighters to improve their performance in the bullring, are some of the main findings presented in this narrative review.

Uncertainty principle of the activity of bullfighting. The behavior of the bull

The only study that analyzed the variability in the variables related to HR and the movements made by the bullfighters was the study carried out by Teba-del Pino *et al.,* (2024b). In this study, all the HR and movement time variables analyzed presented significant differences in each of the bulls (see Table 1 and Table 2), which shows that the response of the HR and the movements made could be conditioned to the reactions and responses of the bull to the fight proposed by the bullfighter, as well as to the unpredictable behavioral characteristics of the bull itself. Variables related to high intensity such as HRmax and >90%HRmax show a CV of 53.55% and 69.14% respectively, which shows that the maximum HR intensities reached by bullfighters are different, unpredictable and dependent on unpredictable bulls' reactions, as well as the way the bullfighter deals with it (Teba-del Pino *et al.,* 2024a; 2024b). Future studies with a greater number of bullfights and bullfighters analyzed are necessary to reinforce this hypothesis.

Teba-del Pino *et al.,* (2024a) compared the ITL between the two bulls fought by the bullfighter both in the bullring and in the *tentadero*. The results show significant differences between these bulls fought both in the *tentadero* and during the bullfight, thus showing that the ITL is different in each bull. In another study, Teba-del Pino *et al.,* (2024b) showed significant differences in the ITL among the six bulls

fought with a CV of 53.66%, which shows that the ITL accumulated in each fight is different due to the unpredictable behavior of the bull, conditioning the bullfighter's reactions and way of conducting the fight, thus influencing the ITL accumulated in each fight. A similar fact to what occurs in sports context, Oliva Lozano *et al.,* (2022) shows that the performance and training load of professional soccer players is different depending on the level and characteristics of the opponent. However, Petway *et al.,* (2020) published that the variability in the ITL could be subject not only to the characteristics of the opponent, but also to variables such as experience and skill level, all of which influence the variability in the quantification of the ITL. Future studies that analyze the influence of these variables on the variability of the ITL in professional bullfighters would be necessary.

Other findings of Teba-del Pino *et al.,* (2024b) were that as the speed of movement increases and the intensity of acceleration increases, the variability among fights increases. This shows that the movements and accelerations carried out at high speed by the bullfighters could be subject to the unpredictable behavior of the bull, given that the greater the CV, the greater the difficulties in predicting performance and the more dependent they are on the context. This fact occurs similarly in some sports modalities. Rampinini *et al.,* (2007) and Casterllano & Blanco-Villaseñor (2015) stated that as the movement speed of soccer players increases, the variability is greater, showing a greater CV. Taking into account that 72% of the bullfighter's TT is maintaining the posture or making movements with speeds of less than 6.1 km/h (Teba-del Pino *et al.,* 2024a), and that the technical-artistic actions are carried out maintaining mainly the posture, it could be said that the movements made by the bullfighters at a speed greater than 6.1 km/h would be subject to the variable behavior of the bull (Teba-del Pino *et al.,* 2024a; 2024b).

Anxiety prior to the activity of bullfighting

Anxiety levels are related to the magnitude of the challenge and the levels of uncertainty associated with the activity (Mateo *et al.,* 2012), which could explain why the levels of PCA in bullfighting are high due to the high rate of uncertainty that fighting a bull has (Teba-del Pino *et al.,* 2024a). Only one study in scientific literature analyzed precompetitive anxiety in professional bullfighters (Teba-del Pino *et al.,* 2024a). Considering self-confidence (SC) as the degree of self-confidence that the athlete has and his belief about success in the given task (Castillo-Rodríguez *et al.,* 2022; Mercader-Rubio *et al.,* 2023), Teba-del Pino *et al.,* (2024a) observed that SC levels in both the bullfighter and his assistants were higher before fighting in a *tentadero* than before fighting in a bullfight. Results that are in accordance with Reyes (2004), who stated that the setting, responsibility, expectations of success and the public could influence the levels of AC prior to fighting a bull, with the levels of SC being higher in controlled environments such as the *tentadero* (real simulation training) than in a bullfight (competition) where the stress factors generated could have a greater rate of influence on the psychological state of the bullfighters prior to fighting. But no previous evidence has been found to date related to this topic.

The CA manifested through a negative self-evaluation of the athlete (Castillo-Rodriguez *et al.,* 2022; García-Ceberino *et al.,* 2022; Mercader-Rubio *et al.,* 2023), could have a determining impact on the bullfighter's ability to concentrate, pay attention and make decisions in a context where the activity practiced has an associated vital risk (Teba-del Pino *et al.,* 2024). The study by Teba-del Pino *et al.,* (2024a) observed that there were no significant differences between the CA levels of the bullfighter before fighting a bullfight and a *tentadero*, but there were significant differences in the CA levels of the attendees of the assistant's bullfighter being older before the bullfight than the *tentadero*. Based on the premise that the bullfighter analyzed was considered a "figure" (highest level bullfighter), the control of CA levels before bullfighting could be greater than in his lower-level assistant bullfighter. Morales *et al.,* (2013) showed that international judo athletes have lower levels of CA than national and regional judo athletes. Therefore, the level of experience and performance of the bullfighter could influence precompetitive CA levels in professional bullfighters. Future studies that assess these hypotheses are necessary.

The SA represented by the physiological response to the thoughts and sensations of the athlete in the moments before the competition (Souza et al., 2019; García-Ceberino *et al.,* 2022; Mercader- Rubio *et al.,* 2023), is considered one of the greatest generators of stress in professional bullfighters (Reyes, 2004; Teba-del Pino *et al.,* (2024a). Although there were no statistically significant differences in the study carried out by Teba-del Pino *et al.,* (2024a), higher levels of SA were observed before the *tentadero* than before the bullfight. The authors explained this fact by stating that the *tentadero* used to measure PCA was on the eve to one of the most important bullfights of the season, which could influence the

bullfighter's AS levels. This fact reinforces the hypotheses of Reyes (2004) who stated that the type of bullring (stage) could affect PCA levels, showing increased sweating rate, activation and increases in HR in the moments prior to the start of the bullfight. The HR response in the moments before the bullfight could be associated with SA (Reyes, 2004, Zafrilla *et al.,* 2015; Teba-del Pino *et al.,* 2024a). The results of Reyes (2004) affirm that bullfighters reach between 80-160 ppm in the moments prior to the bullfight. Therefore, future studies that analyze the HR response in situations prior to a bullfight, as well as its relationship with the bullfighter's PCA levels, will allow us to know the possible influence of AS on the bullfighter's performance.

Although it is true that due to the small size of the study population (one professional bullfighter and two assistant's bullfighter) of the study by Teba-del Pino *et al.,* (2024a), these findings generate interest in physical trainers and bullfighting psychologists due to the impact of anxiety on the performance of bullfighters. Future studies that analyze the influence of anxiety on performance of professional bullfighters would allow us to control the factors that generate acute stress in the moments before the bullfight, alleviating the effects of anxiety on the bullfighter's performance in the bullring.

HR response during bullfighting activity

The HRmax reached during a physical activity allows us to know the intensity of the activity, making it possible to prescribe more specific training in terms of intensity, equalizing the intensity reached during training to the intensity reached during competition (bullfight) (Halson, 2014; Nevado-Garrosa & Suárez-Arrones, 2014; Bourdon et al., 2017). The data provided in the present narrative review show that the activity of bullfighting reaches maximum values of relative HR of the bullfighters. Reyes (2004) establishes the HRmax achieved by professional bullfighters between 180-200 bpm during 47.7% of the total time of the fight. Zafrillas et al., (2015) recorded the HR of a professional bullfighter during a tentadero with eight brave cows (164 bpm, 74.41%HRmax), eight bulls (177 bpm, 85.43%HRmax) and eight bulls fought in bullfights (182 bpm, 89.6%HRmax). Teba-del Pino et al., (2024a) analyzed the HRmax achieved by a professional bullfighter during a bullfight (183 bpm, 96.4%HRmax), and a tentadero (160 bpm, 82.9%HRmax). The same authors recorded the HRmax of the bullfighters' assistant's bullfighter during the same bullfight (172 bpm, 95.3%HRmax), and the tentadero (156 bpm, 86.6%HRmax). This same study showed significant differences in the HRmax achieved between the two bulls fought by both the bullfighter and his assistants in the tentadero and in the bullring. Another study carried out by Teba-del Pino et al., (2024b), recorded HRmax data of 185 bpm equivalent to 97.4%HRmax. The literature analyzed shows the high requirements of the cardiovascular system in the activity of bullfighting, reaching maximum intensities of HR.

Another elementary variable analyzed in scientific HR literature, and which shows the high requirements of the cardiovascular system, is HRmean. The HRmean establishes the average intensity of the HR maintained by the bullfighters during the bullfighting activity. Reyes (2004) establishes the HRmean of bullfighters and bullfighters at 175 bpm. Zafrillas et al., (2015) conclude in their study that the average HR of the bullfighter is established between 85-89% HRmax. Teba-del Pino et al., (2024a) established that the HRmean achieved by a professional bullfighter was 159 bpm, and 129 bpm by his assistant during a bullfight. During a tentadero the average HR for the bullfighters was 125 bpm and 116 bpm for the assistant's bullfighter. The results of the study by Teba-del Pino et al., (2024b) showed significant differences between the HRmean (156 bpm) achieved by three professional bullfighters during the fight of the six bulls fought during a bullfight, with a CV of 4.24 %. The findings of this study show that the HRmean achieved during the fight is due to the unforeseen reactions of the bull, but due to the reduced CV, the HRmean achieved by the bullfighters during the fight of a bull could be integrated within the confidence interval (CI) [144 – 169 bpm] obtained in the study. At the same time, the HRmean results from the studies by Zafrillas et al., (2015) and Teba-del Pino et al., (2024a) are included within the CI proposed by the study by Teba-del Pino et al., (2024b). This fact, together with the reduced CV (4.24%) presented by Teba-del Pino et al., (2024b) could help establish that the HRmean of professional bullfighters could be represented within the CI established by the authors.

Buchheit & Laursen (2013) establish that the use of HR zones is an effective method for improving performance during prolonged exercise. Reyes (2006) establishes that bullfighters maintain heart rates higher than 180 bpm 51% of the total time of fighting a bull. Teba-del Pino et al., (2024a) establishes that, during a bullfight, the bullfighter spends 13 minutes at an intensity greater than 90%HRmax, which represents 26.85% of the TT of exposure with the bull. Teba-del Pino et al., (2024a) establish that

31.98% of the TT bullfighters are at intensities greater than 90% HRmax. Which shows the high intensity that the activity of bullfighting implies for bullfighters. These data could provide some information about the intensity at which bullfighters should train to induce cardiorespiratory adaptations, which could improve their performance during a real bullfight. And, considering that bullfighting is an intermittent physical activity, interval methods could be established as a specific tool to improve the cardiovascular performance of bullfighters.

Internal training load

Quantifying the time that bullfighters spend at different intensities of HR during the fight of a bull allows the ITL to be quantified (Teba-del Pino et al., 2024a; 2024b). There were only two studies in the scientific literature that analyzed ITL in professional bullfighters. Teba-del Pino et al., (2024a) compared the ITL accumulated during a tentadero and during a bullfight through Training Impulse (TRIMPs) using the Edwards method. The results showed that there were no significant differences in the ITL between the tentadero and the bullfight, which would establish simulated competition training (tentadero) as a training method that could equal the ITL of the bullfight. However, this comparison was made only between a tentadero and a bullfight, so readers of this narrative review are asked to be cautious in considering the tentadero as a training method that equals the ITL of bullfighting. Future studies with a larger comparative sample size would make it possible to give greater solidity to the results of the study.

Variables of movement time in the activity of bullfighting

The scientific literature referring to the analysis of the variables related to the movement of bullfighters during the fight of a bull is very scarce. Only two studies analyzed the travel variables of professional bullfighters with GPS technology. Teba-del Pino et al., (2024a) show through the sum of the displacement variables of a bullfighter of the two bulls fought in a bullfight and during a tentadero, that the tentadero could be a specific tool for training the bullfighters' displacement variables because there were no significant differences in the statistical comparison between the competitive context (bullfight) and the real simulation training (tentadero). This same study compared both bullfights both in tentadero and in the bullfight. The results show that there were only significant differences between the two bulls fought in the bullfight in the distance traveled in Zone 1 (0-6 km/h), and in the Smax during the tentadero. However, a subsequent study carried out by Teba-del Pino et al., (2024b) shows significant differences between the fights of the six bulls that make up a bullfight in the variables DT, distance traveled in Zone 1 (0 – 6 km /h), Zone 2 (6.1 – 14 km/h), Smax, Smean and the accelerations carried out in zone 1 (0.5-1 m/s-2), zone 2 (1-2 m/s-2) and zone 3 (>2 m/s-2). The difference between both results could be since Teba-del Pino et al., (2024a) analyzed the bullfights carried out by the same bullfighter, and Teba-del Pino et al., (2024b) analyzed three different bullfighters. Therefore, experience and the way of bullfighting could influence the displacement variables of the bullfighters during the fight against a bull.

De Miguel (2019) stated that bullfighters must have the ability to accelerate and decelerate in a short period of time, with the aim of adapting to the bull's unforeseen reactions. Only two studies analyzed the accelerations performed by bullfighters during the fight with a bull. Teba-del Pino et al., (2024a) compared the number of accelerations performed by the bullfighter and the assistant's bullfighter in a bullfight and a tentadero. The results showed that the bullfighter and the subordinates perform the same accelerations in both contexts, establishing the authors' conclusion that the tentadero could be a specific tool for training the accelerative capacity of the bullfighters. Future studies should be conducted with a larger size of comparisons to provide robustness to the study findings. However, another study carried out by Teba-del Pino et al., (2024b) showed significant differences in the number of accelerations performed by the bullfighters during the six fights that make up a bullfight. This difference in results between both studies could be due to the study design, where the number of bullfighters and bulls were different in both studies.

Limitation and strength

The main limitation of the present narrative review is the small number of available studies. Therefore, we incorporated studies of different quality, which could affect the robustness of the findings. However,

and considering the premise of literature regarding the analysis of the determining variables in the performance of professional bullfighters, the present study represents the first narrative review of the scientific literature on the topic studied. Fact that could lay the theoretical foundations regarding the determining variables in the performance of professional bullfighters, thus allowing the professionals in charge of the preparation of bullfighters to optimize the performance of professional bullfighters during the bullfight.

Future research lines

The results provided in this narrative review provide the need to increase the number of scientific publications that analyze the determining variables in the performance of professional bullfighters. Some of the suggestions made after the narrative review are:

- Increase the number of comparisons between the tentaderos and the bullfights analyzed to check whether the tentadero equals the ITL that the bullfighters accumulate in the bullfight. Establishing itself as a specific tool that allows bullfighters to improve their subsequent physical performance in the bullring.
- Compare the psychophysiological response of the bullfighter before fighting in bullrings of different categories.
- Carrying out experimental studies that analyze the influence of training on the performance of bullfighters in the bullring.
- Increase the sample size in the number of fights to study the variability in the performance of bullfighters.

Practical application

To optimize the performance of professional bullfighters, determining variables in performance must be understood through a contextual analysis of the bullfighting activity. A fact that allows physical trainers to program and design more specific and individualized training for professional bullfighters. The analysis of the scientific literature has shown that, during the third bullfight, the bullfighter's HR usually reaches an intensity ≥93% HRmax for several minutes (~13min), which demonstrates the high levels of physiological stress that are supported during a run. Both data show the time (volume) and intensity (%HRmax) that bullfighters should achieve during training to match the stimulus achieved during bullfighting. However, this intensity is not the result of the intensity of the movement made by the bullfighter during the fight. Since the bullfighters spend 70% of the TT walking at an average speed of 2.2 km/h or maintaining the posture. The reasons for this event could be that the high cardiac stress could be due to the sum of psychological parameters and mechanical factors resulting from the handling of the *capote* and *muleta* during the bullfight.

Other relevant data described in this narrative review is the low variability in the HRmean and %HRmax parameters achieved by the bullfighters. This would allow physical trainers to predict the intensity of both variables reached by bullfighters during the fight against a bull. At the same time, studies showed that the performance of professional bullfighters is different on each of the bulls, due to the unpredictable behavior of the bull.

Conclusions

In summary, the present narrative review provides an approximate vision of the activity of bullfighting, providing greater knowledge of the context of bullfighting on foot from the point of view of physical performance. The activity of bullfighting can be considered an activity with high requirements of the cardiovascular system, reaching maximum HR intensities (97.4% of HRmax). The study of variability showed that the unpredictable behavior of the bull directly influences the performance variables of the bullfighters during the fight. However, although the behavior of the bull is unpredictable, variables such

as the HRmean show a reduced CV (4.24%), which would allow us to establish the IC (144 – 169 bpm) as the interval where the HRmean of the bullfighters is located during the fight of a bull.

Author Contributions: Conceptualization, L.T-dP, J.C-G and E.S-dV; methodology, L.T-dP, J.C-G, J.M-A and E.S-dV; investigation, L.T-dP; resources, L.T-dP; data curation, L.T-dP; writing original draft preparation, L.T-dP; writing—review and editing, L.T-dP, J.C-G, J.M-A and E.S-dV; visualization, L.T-dP; supervision, J.M-A, J.C-G and E.S-dV All authors have read and agreed to the published version of the manuscript.

References

Ade, J. D., Harley, J. A., & Bradley, P. S. (2014). Physiological response, time-motion characteristics, and reproducibility of various speed-endurance drills in elite youth soccer players: small-sided games versus generic running. International journal of sports physiology and performance, 9(3), 471–479. https://doi.org/10.1123/ijspp.2013-0390.

Bourdon, P. C., Cardinale, M., Murray, A., Gastin, P., Kellmann, M., Varley, M. C., Gabbett, T. J., Coutts, A. J., Burgess, D. J., Gregson, W., & Cable, N. T. (2017). Monitoring athlete training loads: Consensus statement. International Journal of Sports Physiology and Performance, 12(s2). https://doi.org/10.1123/ijspp.2017-0208

Buchheit, M., & Laursen, P. B. (2013). High-intensity interval training, solutions to the programming puzzle: Part I: cardiopulmonary emphasis. Sports medicine (Auckland, N.Z.), 43(5), 313–338. https://doi.org/10.1007/s40279-013-0029-x

Cozcolluela-Cabrejas, M. R., Sanz-Salanova, L. A., Jerez Oliveros, J. J., Madrid Pérez, J. M., Zalazar, L. R., & Pérez Omeñaca, F. (2019). Injuries to amateur participants in traditional bullfighting festivals. Lesiones producidas en aficionados durante los festejos taurinos populares. Cirugia espanola, 97(1), 34–39. https://doi.org/10.1016/j.ciresp.2018.08.004

Cummins, C., Orr, R., O'Connor, H., & West, C. (2013). Global positioning systems (GPS) and microtechnology sensors in team sports: a systematic review. Sports medicine (Auckland, N.Z.), 43(10), 1025–1042. https://doi.org/10.1007/s40279-013-0069-2

de Cossío, J. M. (2007). Cossío los toros. Espasa Calpe.

de Miguel, R. (2019). Fisioterapia y osteopatía en el mundo de la tauromaquia: Toreros Y Recortadores. Círculo Rojo Editorial.

Del Moral, J. A. (2011). Cómo ver una corrida de toros: Manual de Tauromaquia para Nuevos aficionados. Alianza Editorial.

Dellaserra, C. L., Gao, Y., & Ransdell, L. (2014). Use of integrated technology in team sports: a review of opportunities, challenges, and future directions for athletes. Journal of strength and conditioning research, 28(2), 556–573. https://doi.org/10.1519/JSC.0b013e3182a952fb

Düking, P., Picerno, P., Camomilla, V., Gastaldi, L., & Sperlich, B. (2023). Editorial: Highlights in sports science, technology and engineering 2021/22. Frontiers in Sports and Active Living, 4. https://doi.org/10.3389/fspor.2022.1117803

Eriksen, M. B., & Frandsen, T. F. (2018). The impact of patient, intervention, comparison, outcome (PICO) as a search strategy tool on literature search quality: A systematic review. Journal of the Medical Library Association, 106(4). https://doi.org/10.5195/jmla.2018.345

Espasa-Labrador, J., Fort-Vanmeerhaeghe, A., Montalvo, A. M., Carrasco-Marginet, M., Irurtia, A., & Calleja-González, J. (2023). Monitoring Internal Load in Women's Basketball via Subjective and Device-Based Methods: A Systematic Review. Sensors (Basel, Switzerland), 23(9), 4447. https://doi.org/10.3390/s23094447

Esteve-Lanao, J., Moreno-Pérez, D., Cardona, C. A., Larumbe-Zabala, E., Muñoz, I., Sellés, S., & Cejuela, R. (2017). Is Marathon Training Harder than the Ironman Training? An ECO-method Comparison. Frontiers in physiology, 8, 298. https://doi.org/10.3389/fphys.2017.00298

García-Ceberino, J. M., Fuentes-García, J. P., & Villafaina, S. (2022). Impact of Basketball Match on the Pre-Competitive Anxiety and HRV of Youth Female Players. International journal of environmental research and public health, 19(13), 7894. https://doi.org/10.3390/ijerph19137894

Halson S. L. (2014). Monitoring training load to understand fatigue in athletes. Sports medicine (Auckland, N.Z.), 44 Suppl 2(Suppl 2), S139–S147. https://doi.org/10.1007/s40279-014-0253-z

Harper, D. J., Carling, C., & Kiely, J. (2019). High-intensity acceleration and deceleration demands in Elite Team Sports Competitive Match Play: A systematic review and meta-analysis of observational studies. Sports Medicine, 49(12), 1923–1947. https://doi.org/10.1007/s40279-019-01170-1

Imbach, F., Ragheb, W., Leveau, V., Chailan, R., Candau, R., & Perrey, S. (2022). Using global navigation satellite systems for modeling athletic performances in elite football players. Scientific reports, 12(1), 15229. https://doi.org/10.1038/s41598-022-19484-y

Kawamori, N., Nosaka, K., & Newton, R. U. (2013). Relationships between ground reaction impulse and sprint acceleration performance in team sport athletes. Journal of strength and conditioning research, 27(3), 568–573. https://doi.org/10.1519/JSC.0b013e318257805a

Koyama, T., Rikukawa, A., Nagano, Y., Sasaki, S., Ichikawa, H., & Hirose, N. (2022). Acceleration Profile of High-Intensity Movements in Basketball Games. Journal of strength and conditioning research, 36(6), 1715–1719. https://doi.org/10.1519/JSC.0000000000003699

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS medicine, 6(7), e1000100. https://doi.org/10.1371/journal.pmed.1000100

Linder S.K., Kamath G.R., Pratt G.F., Saraykar S.S., Volk R.J. Citation Searches Are More Sensitive than Keyword Searches to Identify Studies Using Specific Measurement Instruments. Physiol. Behav. 2015;68:412–417. doi: 10.1016/j.jclinepi.2014.10.008

Medina Villanueva, S., Ródenas Cuenca , L. T. ., Vanegas Farfano, M. T. J. ., Bojorquez Castro, L. B. ., & Tristán Rodríguez, J. L. . (2022). Comparación de carga externa en las acciones de alta velocidad en partidos y entrenamientos en un equipo de fútbol base (External load comparison in high-speed actions on matches and workouts on a base soccer team). *Retos, 46*, 1022–1027. https://doi.org/10.47197/retos.v46.93362

Morales, J., García, V., García-Massó, X., Salvá, P., Escobar, R., & Buscà, B. (2013). El uso de la variabilidad de la frecuencia cardíaca en la evaluación del estrés precompetitivo en atletas de judo de alto nivel. Revista internacional de medicina deportiva, 34(2), 144-151. https://doi.org/10.1055/s-0032-1323719

Nevado-Garrosa, F., & Suárez-Arrones, L. (2015). Comparison of physical demands in small sided games and competition in football players under 13. Cultura_Ciencia_Deporte, 10(30), 235–243. https://doi.org/10.12800/ccd.v10i30.592

Navas-Mosqueda, Á., Valera-Calero, J. A., Varol, U., Klich, S., Navarro-Santana, M. J., Fernández-de-Las-Peñas, C., Ríos-León, M., Belón-Pérez, P., Cimadevilla-Fernández-Pola, E., Hervás-Pérez, J. P., & Arias-Buría, J. L. (2022). The Prevalence of Shoulder Disorders among Professional Bullfighters: A Cross-Sectional Ultrasonography Study. Tomography (Ann Arbor, Mich.), 8(4), 1726–1734. https://doi.org/10.3390/tomography8040145

Negro Peral, A., Miñambres Martín, D., & Bartolomé Martín, J. L. (2006). Frequent injuries in pupils of bullfighting school | Lesiones frecuentes en alumnos de escuelas taurinas. Fisioterapia. 28(2), 58–64.

Petway, A. J., Freitas, T. T., Calleja-González, J., Medina Leal, D., & Alcaraz, P. E. (2020). Training load and match-play demands in basketball based on competition level: A systematic review. PloS one, 15(3), e0229212. https://doi.org/10.1371/journal.pone.0229212

Purroy, A. (2023). Comportamiento del Toro de Lidia: En El Campo, en el Ruedo. Universidad Pública de Navarra.

Reguera-Teba, A., Martínez-Casas, I., Torné-Poyatos, P., & Hernández-Cortés, P. (2021). Eight-year analysis of bullfighting injuries in Spain, Portugal and southern France. Scientific reports, 11(1), 16006. https://doi.org/10.1038/s41598-021-94524-7

Reyes, G. (2004). El Corazón del Torero. Consejería de Gobernación. Junta de Andalucía.

Teba-del Pino, L. (2024). Análisis de las variables determinantes en el rendimiento de los toreros profesionales. [Tesis de doctorado, Universidad Pablo de Olavide]. Repositorio institucional – Universidad Pablo de Olavide.

Teba-del Pino, L., Robles Aguilar, J. A., Ramirez-Campillo, R., & Sáez de Villarreal, E. (2024a). Respuestas psicofisiológicas del toreo profesional real y simulado: estudio de un caso (Psychophysiological responses to real and simulated professional bullfighting: a case study). *Retos, 51*, 833–839. https://doi.org/10.47197/retos.v51.101119

Teba-del Pino, L., Robles Aguilar, J. A., & Sáez de Villarreal Sáez, E. (2024b). Diferencias en el rendimiento de los toreros durante una corrida de toros. ¿Tiene el comportamiento del toro influencia directa en las variables que determinan la actuación de los toreros profesionales? (Differences in the performance of bullfighters during a bullfight. Does bull behavior have direct influence on the variables determining professional bullfighter's performance?). *Retos, 53*, 178–182. https://doi.org/10.47197/retos.v53.102571

Velásquez-González, H., Peña-Troncoso, S., Hernández-Mosqueira, C., Pavez-Adasme, G., Gómez-Álvarez, N., & Sáez de Villarreal, E. (2023). Perfil de esfuerzos de alta velocidad considerando la posición de juego de futbolistas profesionales chile-nos, registrados por un dispositivo GPS: un estudio piloto (Profile of high-speed efforts considering the playing position of Chilean professional soccer players, rec-orded by a GPS device: A Pilot Study). *Retos, 48*, 590–597. https://doi.org/10.47197/retos.v48.97014

Zafrilla, V. M., Terrados, N., & Tejero-González, C. M. (2015). Heart rate of a professional bullfighter in training and real bullfight. Archivos de cardiologia de Mexico, 85(1), 84–86. https://doi.org/10.1016/j.acmx.2014.05.004

Authors' and translators' details:

Luis Teba-del Pino	coach.luisteba@gmail.com	Author/Translator
Julio Calleja-González	julio.calleja@ehu.eus	Author
Juan Mielgo-Ayuso	jfmielgo@ubu.es	Author
Eduardo Sáez de Villarreal Sáez	esaesae@upo.esjuan	Author