

^c Departamento de Gabinetes, UMAE Hospital de Cardiología del Centro Médico Nacional Siglo XXI, Instituto Mexicano del Seguro Social (IMSS), México, D.F., México

^d Departamento de Cardiopediatría, UMAE Hospital de Cardiología del Centro Médico Nacional Siglo XXI, Instituto Mexicano del Seguro Social (IMSS), México, D.F., México

* Autor para correspondencia. Avenida Cuauhtémoc n.º 330, Colonia Doctores, Delegación Cuauhtémoc, CP 06720, México, D.F., México.

Correo electrónico: luis.santosma@imss.gob.mx (L.E. Santos-Martínez).

<http://dx.doi.org/10.1016/j.acmx.2014.11.006>

Heart rate of a professional bullfighter in training and real bullfight



Frecuencia cardiaca de un torero profesional en entrenamientos y corridas de toros

Dear Director:

The bullfighter's professional activity is nowadays a professional field involving many hours of specific physical activity in trainings, rehearsals and during public performances. In fact, the professional standards of bullfighting entail the need for adequate physical preparation. To date, the study of professional bullfighters has been almost exclusively focused on neuromuscular injuries surgery and emergency medical treatment of bullfighters,¹ and the research on the physiological demands of bullfighting is very limited, probably because of the difficulties of performing studies during a real bullfighting. This study analyzed the heart rate (HR) response of a professional bullfighter during his real activities.

A 23-year-old professional bullfighter volunteered to participate in this study. We recorded HR continuously in 24 situations with wild animals divided equally into three types of activity: training with wild cows, training with wild bulls and bullfights before an audience. Previously, the bullfighter underwent a maximal exercise test on a treadmill, to get maximum heart rate (MaxHR), aerobic threshold (AeT) and anaerobic threshold (AT). HR was recorded by means of Polar Team2Pro® (Polar, Finland) from the first contact with the animal until the last action. The device was programmed to obtain a value of HR every second. Registered data were transferred to a personal computer (PC) for further analysis. A member of the research team, always the same one, put the heart rate monitor on the participant at the time of wearing the bullfighter suit, and simultaneously activating a timer (Casio Hs-3, Japan) and a camera (Sony A100, Japan) synchronized with the heart rate monitor. The study was approved by the Ethics Committee of the University of Oviedo, Spain.

As [Table 1](#) and [Fig. 1](#) show, the results registered in a maximal exercise stress test on a treadmill indicated a maximum heart rate of 184 bpm, with an aerobic threshold of 150 ppm (81.52% HRmax) and anaerobic threshold of 165 bpm (89.67% HRmax). The mean duration of training with cows was 15 min, showing a heart rate of 136 bpm (SD = 20, range = 87–164), corresponding with a 74% of HRmax, 35% of the HR in training with cows were located

above the AeT and only 5% exceeded the AT. When training with bulls, of 15 min duration, the mean heart rate reached 157 bpm (SD = 16, range = 103–177), which represented the 85% of HRmax, where 73% of the HR exceeded AeT and 36% exceeded AT. Finally, according to real bullfighting with public attendance, despite having a shorter duration than training with cows or bulls (13 min), the mean heart rate was 164 bpm (SD = 15, range = 121–182), being 89% of HRmax; it should be noted that 79% of ppm were above the AeT and 61% of AT.

The average values of HR ranged from 121 to 182 bpm. These values were classified as "heavy" and "very heavy" according to the intensity levels of effort.² Mean HR was, however, even more relevant than Maximum HR, since its values reveal the intensity of the sustained effort during each performance, all placed in our data between the "mild" and "heavy" or "hard" levels.² Based on the ACSM classification, this % MaxHR in bullfight stands for a "heavy" level of work intensity.³ In the case of training sessions, these HR values correspond to intensity levels ranging between "heavy" and "very heavy".² Mean HR values were moderate during training. Of note is that during bullfighting before an audience, HR reached an average of 164 bpm (=89% HRmax), in training with bulls, the mean HR was also very high, 157 bpm (=85% HRmax), and even in training with wild cows the mean HR was 121 bpm (=74% HRmax). Based on these data, it can be interpreted that bullfights before an audience and trainings with bulls pose a high cardiac demand (80–89% of maximum heart rate), and trainings with wild cows pose a moderate demand (60–79% HRmax), without reaching, in any case, very high cardiac demands ($\geq 90\%$ FCMax).⁴ Those HR values should be taken into account for the medical care of these professionals. Despite this, we consider that in the practice of professional bullfighting, there are psychological factors that may influence the cardiac response. In this sense, the relationship between stress and heart function is indisputable, as the HR may be interpreted as a stress indicator, and has even been observed that the HR can be altered without any physical activity.⁵ This can be illustrated in [Iñesta et al.](#),⁶ who studied the heart rate in professional musicians, finding statistically significant differences between a practice or rehearsal and a public concert, where HR was as high as 98% of HRmax.

We understand that the physical activity performed by a bullfighter in full professional activity consists of intermittent and intense efforts, with little recovery time, whether in training, rehearsals or real bullfights. However, despite performing a similar physical activity in the three situations studied, it was during real bullfights that the highest levels of HR were found. This may be caused by the influence of

Table 1 Descriptive statistics of central tendency, dispersion and frequency.

Situation	Performances	T'	Bpm				% HRmax	% Bpm	
			M	SD	Min	Max		>AeT	>AT
Trainings with wild cows	1	15'56"	152	14.4	105	170	82.60	75.2	8.9
	2	14'10"	12.65	19.1	80	155	68.75	2.8	0
	3	16'52"	118.4	19.5	68	147	64.34	0	0
	4	13'13"	130.2	22.2	80	161	70.76	13.4	0
	5	14'05"	141.9	19.2	96	163	77.11	52.8	0
	6	13'59"	145.5	19.8	101	169	79.07	52.1	12
	7	21'00"	138.3	28.2	82	179	75.16	46.2	19.2
	8	15'17"	142.6	19.8	88	171	77.50	43.9	3.5
	Average	15'47"	136.9	20.2	87.5	164.3	74.41	35.8	5.45
Trainings with wild bulls	1	15'42"	159.3	16.7	110	175	86.57	75.1	55.6
	2	14'10"	160.6	23.6	107	189	87.28	68.6	56
	3	13'03"	167.5	14.2	108	184	91.03	87.4	71.9
	4	13'36"	143.6	20.2	101	169	78.04	48.2	10.7
	5	13'33"	156.6	14.9	103	174	85.10	74.9	26.8
	6	17'19"	164.7	14.2	110	181	89.51	87.6	60.9
	7	19'10"	151.6	16.1	88	176	82.39	71.7	10.7
	8	17'33"	153.7	11.9	98	168	83.53	76.9	2.8
	Average	15'30"	157.2	16.4	103.1	177	85.43	73.8	36.9
Real bullfight before an audience	1	13'58"	157.4	16.9	114	175	85.54	67.4	49.8
	2	13'07"	161.9	18.6	104	182	87.98	76.5	56.8
	3	12'33"	165.7	17.5	110	185	90.05	82.3	61.1
	4	13'33"	164.3	12.8	121	179	89.29	81.7	56.8
	5	14'46"	167.1	15.0	124	182	90.81	81.5	70
	6	15'47"	168.4	13.1	134	184	91.52	88.4	66.9
	7	13'43"	169.6	15.1	135	185	92.17	80.8	72.4
	8	13'50"	164.7	16.6	131	186	89.51	74.9	58.4
	Average	13'54"	164.8	15.7	121.6	182.2	89.6	79.1	61.5

T', time in minutes; Bpm, beats per minute; M, arithmetic mean of the Bpm; SD, standard deviation of the Bpm; Min, ppm minimum value; Max, ppm maximum value; % HRmax, percentage of the maximum heart rate that the Bpm arithmetic mean is positioned; % Bpm >AeT, Bpm percentage above the aerobic threshold; % Bpm >AT, Bpm percentage above the anaerobic threshold.

psychological factors that we think are present during the performance of a bullfighter in a real bullfight.

The results of this first study on cardiac demand in a professional bullfighter will help to improve the training

methods of bullfighters, in order to get a better adaptation to the high cardiovascular demands that they suffer in bullfights. Thus, relating the responses of heart rate found and based on research on training methods and impro-

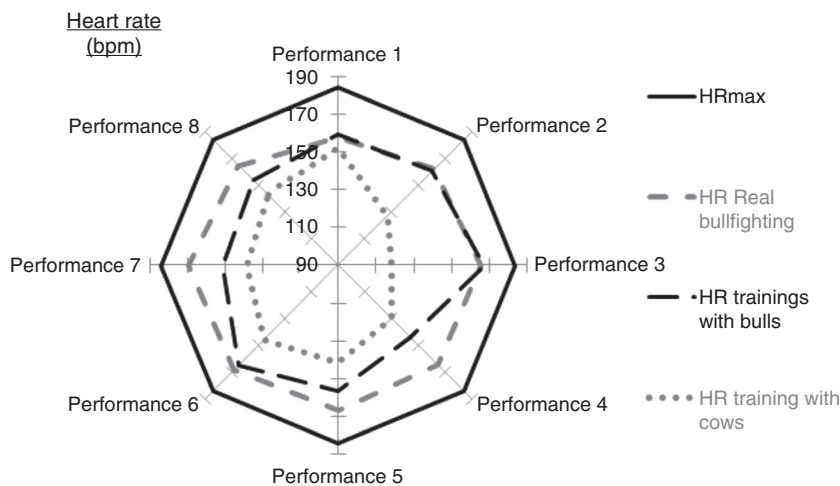


Figure 1 Hart rate (bpm).

ved cardiovascular capacity,⁷ a recommendation could be the high intensity intervalic training, since the results of the latest research suggest that high-intensity training is more effective in improving cardio respiratory fitness than moderate-intensity training with equivalent energy cost.⁷

Even though in many sports and professional activities HR response has been studied,⁸ this is the first study conducted during real bullfighting in order to analyze the cardiac response of a professional bullfighter in different situations of his profession with all that entailed, at least: with presence of fighting bulls and cows, with an audience or in a bullfight and wearing a bullfighter costume. However, the data do not allow to extrapolate these results to other bullfighters, or know the way in which the biological, personal or contextual variables influence the cardiovascular response during a bullfighter's activity and if this influence is relevant or not. Nowadays, there is no research about the heart rate of bullfighters in different situations.

In the light of these findings and since physical exercise has a demonstrated modulator effect over HR⁹ and enhances tolerance to stress,¹⁰ regular exercise would be a strong recommendation for professional bullfighters, especially those who take part in a many bullfights. A practical recommendation could be to structure training sessions based not only on the technical needs of the bullfighter but also adding high intensity intervalic training, that enables sufficient cardiovascular conditioning for this profession.

Acknowledgements

We gratefully acknowledge to the professional bullfighter volunteer who participated in this study. We also thank to Vicente Ferrer Lopez for the medical test of the bullfighter.

Bibliografía

1. Rudloff U, Gonzalez V, Fernandez E, et al. Chirurgicaltaurina: a 10-year experience of bullfight injuries. *J Trauma*. 2006;61:970-4.
2. Åstrand PO, Rodahl K. Textbook of work physiology. 3rd ed. New York: McGraw-Hill; 1986. p. 237-73.
3. American College of Sports Medicine (ACSM). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc*. 1998;30:975-91.
4. Fernández-García B, Pérez-Landaluce J, Rodríguez-Alonso M, et al. Intensity of exercise during road race pro-cycling competition. *Med Sci Sports Exerc*. 2000;32:1002-6.
5. Terrados N, Mora R, Padilla S. La recuperación de la fatiga del deportista. Madrid Ed Gymnos. 2004:173-90.
6. Iñesta CJ, Terrados N, García D, et al. Heart rate in professional wind instrument players. *Journal of Occupational Medicine and Toxicology*. 2008;3, <http://dx.doi.org/10.1186/1745-6673-3-16>.
7. Gibala MJ, Jones AM. Physiological and performance adaptations to high-intensity interval training. *Nestlé Nutrition Workshop Series*. 2013;76:51-60, <http://dx.doi.org/10.1159/000350256>.
8. Galante J, Hernández A, Colín L, et al. Registro electrocardiográfico continuo durante el primer salto en paracaídas. *Archivos del Instituto de Cardiología de México*. 1988;58:325-31.
9. Tulppo MP, Mäkikallio TH, Takala TES, et al. Vagal modulation of heart rate during exercise: effects of age and physical fitness. *Am J Physiol*. 1998;274:424-9.
10. Terrados N. Effects of aerobic training in midlife populations. In: Gordon SL, González-Mestre X, Garret WE, et al., editors. *Sports and exercise in midlife*. Rosemont, IL, USA: American Academy of Orthopaedic Surgeons Publ.; 1993. p. 309-15.

Víctor M. Zafrilla^a, Nicolás Terrados^{b,c},
Carlos M. Tejero-González^{d,*}

^a Bullfighting School of Albacete, Department of Physical Training, Albacete, Spain

^b Sports Medicine Regional Unit of Principado de Asturias, Avilés, Spain

^c Oviedo University, Department of Functional Biology, Oviedo, Spain

^d Autonomus University of Madrid, Department of Physical Education, Sport and Human Movement (Madrid), Spain

* Corresponding author at: Facultad de Formación de Profesorado y de Educación, Universidad Autónoma de Madrid, Ctra de Colmenar, Km15, 28049 Madrid, Spain.
Tel.: +34 91 497 67 56; fax: +34 91 497 84 80.
E-mail address: carlos.tejero@uam.es
(C.M. Tejero-González).
URL: <https://www.uam.es/carlos.tejero>
(C.M. Tejero-González)

<http://dx.doi.org/10.1016/j.acmx.2014.05.004>