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ORIGINAL

PHYSIOLOGICAL RESPONSES IN A SIMULATED CANARIAN WRESTLING CONTEST

RESPUESTA FISIOLÓGICA EN COMPETICIÓN SIMULADA DE LUCHA CANARIA

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ABSTRACT

The aim of this article is to describe what happens from a physiological point of view in a Canarian Wrestling (CW) contest. The Spanish National Sports Council recognized Canarian Wrestling as a sport on June 1st, 2009, although its origin is not very well documented. No scientific article exists in the scientific literature to describe what happens physiologically during a CW contest. Twelve high level wrestlers were recruited to simulate a CW match. The study involved data about heart rate (HR), blood pressure (BP) and blood lactate levels (L) at different moments of the combat. The conclusions of the data observed concerning HR, BP and L classify Canarian Wrestling as an intermittent exercise, with intensity peaks that exceed the lactic threshold and high levels of HR and systolic BP. This

is the first paper in which the physiological responses in a Canarian Wrestling competition are reported.

KEY WORDS: Canarian Wrestling, somatotype, body fat, physiology, competition, blood pressure, lactate levels, heart rate.

RESUMEN

La Lucha Canaria (LC) ha sido recientemente reconocida como deporte por el Consejo Superior de Deportes, aunque su origen se pierde en el tiempo. Sin embargo, no hay ningún trabajo en la bibliografía científica que describa qué ocurre fisiológicamente durante la competición en esta modalidad de lucha, y éste es el objetivo del presente trabajo. Con una muestra de 12 luchadores de alto nivel (*puntales*) simulamos el sistema de competición actual en Lucha Canaria. Se estudió la frecuencia cardiaca, la tensión arterial y la concentración de lactato en sangre en diferentes momentos de la simulación. Los patrones observados de respuesta de FC, TA y lactato, caracterizan a la competición en LC como un ejercicio intermitente, con picos de intensidad que superan el umbral láctico y determinan incrementos importantes de FC y TA sistólica. Este estudio es el primero en que se valora la respuesta fisiológica del luchador canario en competición.

PALABRAS CLAVE: Lucha Canaria, somatotipo, porcentaje de grasa, fisiología, competición, tensión arterial, lactato, frecuencia cardiaca.

INTRODUCTION

Canarian Wrestling (CW) is the best known traditional sport in the Canary Islands, but was only recently recognized as a sport by the Spanish National Sports Council on June 1st, 2009[1]. However, its origin dates back to before the Spanish conquest of the Canary Islands, which took place between 1402 and 1496[2], and for a long time Canarian wrestlers were a source of champion wrestlers in other forms of wrestling such as free Olympic, Greco-Roman wrestling or Judo.

Canary wrestling contests consist of teams of twelve wrestlers without any weight differentiation. The team that has one or more unbeaten members at the end of the match wins the match. The strategy of a single combat is important, but the team strategy even more important. Team strategy is decided by the the team manager known as the "*mandador*". A wrestler from one team can face any of the twelve wrestlers from the other team, and sometimes the difference in weights can be large[3]. In order to eliminate a wrestler from the opposing team one wrestler must win two times against that wrestler. Therefore, it is possible that one wrestler wins two times against each member of the opposing team and thereby single-handedly wins the contest for his team. The nature of the contest clearly has a physiological impact. Thus, CW could be considered as a sport of intermittent nature[4], with peaks of high intensity, and maximum recovery times after each fight ("*agarrada*") which are set out in the rules. Two wrestlers face each other up to three times (1.5 minutes each), and if there is no

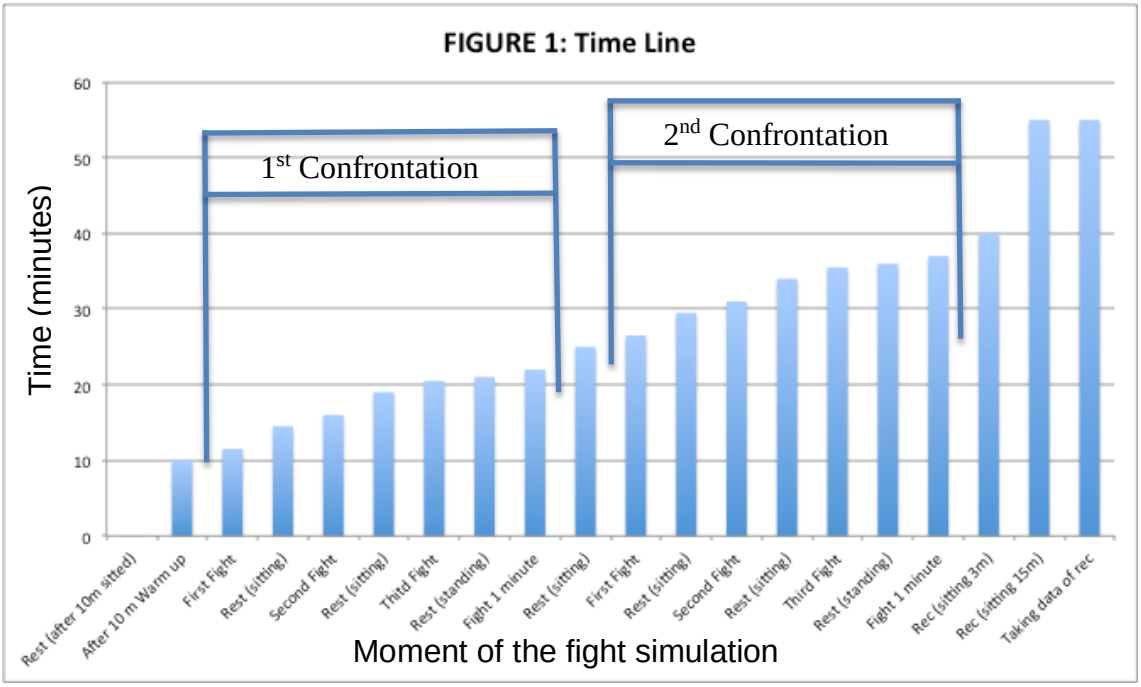
winner then there is another deciding combat of one minute. The winner continues in the match and the loser is eliminated.

The intensity of the peaks and the number of confrontations in which the wrestler participates can determine aerobic and anaerobic components of their participation in competition. A study of the physiological response of the wrestler during competition will determine the cardiovascular and metabolic response to this sport, and can help in the physical preparation of the athlete by adjusting the number and intensity of his training sessions. The main objective of this study is to verify the physiological response of heart rate, blood pressure and blood lactate levels during and after a simulated Canarian Wrestling contest.

MATERIAL Y METHODS

According to the competition rules a wrestler can be active for up to 90 seconds each time he faces an opponent and then he rests until two other pairs of wrestlers have fought each other. Depending on the outcome of each combat (bearing in mind that not all combats last the maximum time of 90 seconds), the recovery time between confrontations of each pair is variable. In the event that after the third combat between the same pair there is no result, that pair then go on to fight for another 60 seconds which begin 30 seconds after the end of the third combat. The wrestler who beats another wrestler must obligatorily compete with a second wrestler, if he wins again, he can rest and resume later on if the manager thinks this is better for team strategy.

The design of the field test was chosen to take the effort of a pair of wrestlers to the limit (effort equal to or greater than 17 on the Borg rating of perceived exertion[5]) in a combat where the two fighters face each other twice, requiring the two contenders to maintain the intensity of the fight until reaching the maximum times of a fight. In each confrontation in the test, the pair performs three combats of 90 seconds, with 3 minutes rest between them, and after 30 seconds, another combat of 60 seconds. After 4 and half minutes of recovery, the confrontation is repeated; finally, after 15 - 20min. recovery the test was ended (see timeline Figure 1). Twelve high level fighters, known as "*puntales*", were selected at the end of the competition season for the study. The wrestlers selected for the study were specifically chosen because they had more than ten years of experience in competition. The distribution of the pairs was designed so that fighters of similar physical characteristics and athletic performance faced each other.



Besides the Borg rating, the wrestlers' the blood pressure, blood lactate levels and heart rate (in continuous recording) were also taken. Blood pressure was determined with a homologated[6] and fully automated compact sphygmomanometer, model OMRON 705IT. Systolic and diastolic pressures at rest (sitting) were recorded after 10 minutes of warm up, after each of the 1st, 2nd and the sixty second fights, and after 15 minutes of recovery. Lactate levels in blood were measured with a portable lactate analyzer (Lactate Pro, LT- 1710 from ARKRAY Inc.). The blood sample was obtained by puncture of the fingertip with a sterile lancet. Lactate levels were assessed after warm up, after the 4th fight (of 1 minute), after the end of each confrontation and after 15 minutes of recovery. A continuous heart rate recording (recording speed with averages of 5 seconds) was performed using a POLAR heart rate monitor (model S810) throughout the test and subsequent recovery, and the Polar Precision Performance software (V. 3.0) was used to analyze the recorded data.

Anthropometric data were collected by using the SECA 770 scales and SECA 220 stadiometer for weight and height, respectively. A Holtain caliper (Holtain LTD, Crosswell, Crymych, Dyfeld SA41 34F, UK) was used to measure eight skinfolds (subscapular, triceps, mid-axillary, pectoral, supraspinal - formally suprailiac of Heath-Carter - abdominal, anterior thigh and calf) and the fat mass was calculated using the Ball et al. (2004) formula[7]. Lean mass was calculated by subtracting the fat mass from the subject's weight. The body mass index (BMI) was calculated, and the somatotype according to the Anthropometric Method of Heath-Carter (1975)[8] by measuring two circumferences (contracted arm and medial calf with a HOLTEIN tape, model 110 P) and two bone breadths (epicondyles of humerus and femur with a Harpenden anthropometer); and the somatotype can be seen in the somatochart.

The obtained data were incorporated into a spreadsheet for Microsoft Excel 2010, where comparisons between predictor variables and result variables

through regression curves were made, obtaining significance by Pearson's correlation coefficient. SPSS version 17 (Statistical Package for Social Sciences) was used for the statistical analysis. Results are expressed as mean and standard deviation. The comparisons of the mean values of each variable at each moment of the simulated fight were analyzed using an ANOVA of repeated measurements. In all cases the level of significance was $p < 0.05$.

RESULTS

The results are presented in the following tables and figure.

TABLE I. Anthropometric data

		Mean		SD	Min	Max
Height	(cm)	176.61	±	5.75	167.5	184.9
Weight	(kg)	103.92	±	13.76	81.1	121.7
Body mass index	(kg/m^2)	33.19	±	3.41	27.4	39.3
Fat mass	(%)	21.33	±	4.13	12.8	26.4
Fat mass	(Kg)	22.61	±	6.58	10.38	32.13
Fat-free mass	(%)	81.3	±	7.78	69.71	91.84
Fat-free mass	(Kg)	81.28	±	7.77	69.7	91.8
Endomorphy		6.1	±	1.3	3.2	7.8
Mesomorphy		6.36	±	1.33	4.5	8.8
Ectomorphy		0.22	±	0.23	0.1	0.8

TABLE II. Blood pressure (mmHg)

		Systolic BP			Diastolic BP		
Test phase	n	Mean		SD	Mean		SD
Rest	12	133.1	±	15.8	75.7	±	9.3
After warm up	12	145.1	±	15.6	81.8	±	9.7
(E1) After 1st *agarrada*	12	171.2*	±	16.4	81.4	±	9.3
(E1) After 2nd *agarrada*	11	160.9*	±	20.6	77	±	8.9
(E1) After 1 minute *agarrada*	12	152.3*	±	20.2	74.5	±	9.6
(E2) After 1st *agarrada*	11	152.2*	±	16.6	77.6	±	4.2
(E2) After 2nd *agarrada*	12	150.2*	±	19.4	77.7	±	9
(E2)After 1 minute *agarrada*	12	150.9*	±	12.6	76.3	±	7.2
After recovery	12	128.6*	±	11.9	74.3	±	7.5

E1 and E2: First and second confrontation respectively.*P<0.05 for ANOVA of repeated measurements.

TABLE III. Lactate levels (mMol/l)

		Lactate	
Test phase	(n)	Mean	SD
After warm up	11	2.5 ±	1
(E1) After 1 minute *agarrada*	11	13.7* ±	4
(E2) After 1 minute *agarrada*	11	11.8* ±	2.6
After 15 minutes of recovery	11	6.1* ±	1.8

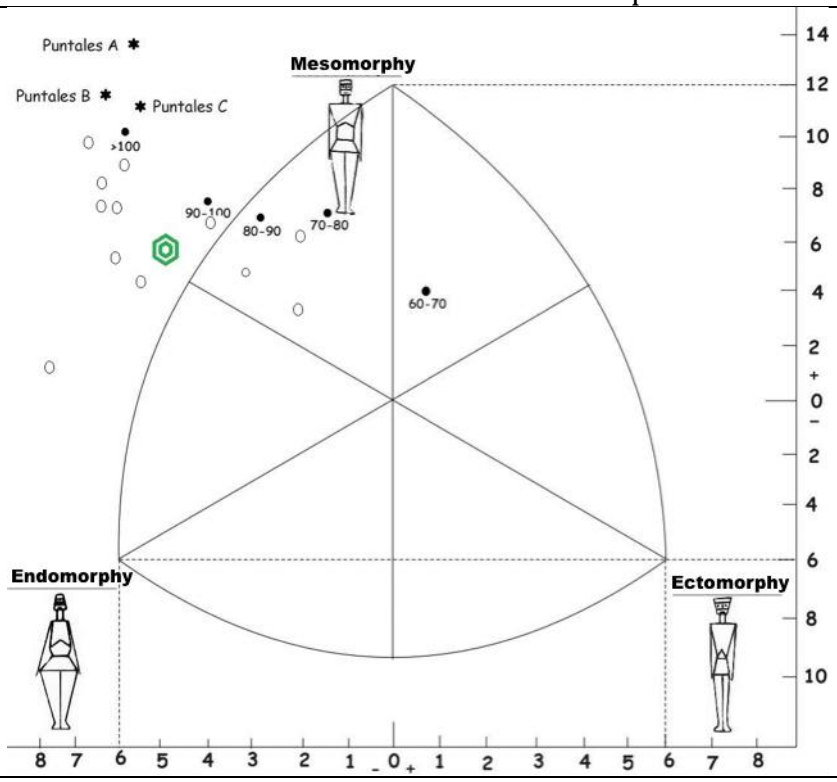
E1 and E2: First and second confrontation, respectively. *P<0.05 for ANOVA of repeated measurements.

TABLE IV. Heart rate (HR) (beats/min)

Phase of the test	(n)	Heart rate		% of recovery	
		Mean	SD	Mean	SD
Basal (sitting)	9	75.6 ±	11.1		
At the beginning	9	103.2 ±	21.7		
max HR, 1st-E1	9	181.6* ±	11.3		
Rec 1m, 1st-E1	9	150.3* ±	16.1	29.21 ±	8.22
Rec 2m, 1st-E1	9	119.4* ±	14.1	58.68 ±	7.91
max HR, 2nd-E1	9	181.7* ±	8		
Rec 1m, 2nd-E1	9	151.8* ±	16	27.68 ±	12.81
Rec 2m, 2nd-E1	9	124.8* ±	14.7	53.32 ±	10.15
max HR, 3rd-E1	9	180.7* ±	7.2		
Rec 30s, 3rd-E1	9	175.2* ±	9.6	5.25 ±	7.66
max HR, 4th-E1	9	182.6* ±	6		
Rec 1m, 4th-E1	9	155.2* ±	13.6	25.41 ±	8.22
Rec 2m, 4th-E1	9	125.2* ±	11.4	53.57 ±	4.96
max HR, 1st-E2	9	180.2* ±	6.7		
Rec 1m, 1st-E2	9	155.7* ±	15.2	23.16 ±	9.51
Rec 2m, 1st-E2	9	126.1* ±	10.9	51.62 ±	6.17
max HR, 2nd-E2	8	179.5* ±	9		
Rec 1m, 2nd-E2	8	153* ±	13.5	23.16 ±	9.51
Rec 2m, 2nd-E2	8	124.4* ±	9.3	51.62 ±	6.17
max HR, 3rd-E2	9	182.8* ±	10.1		
Rec 30s, 3rd-E2	9	175.4* ±	7.7	6.86 ±	4.53
max HR, 4th-E2	9	181.7* ±	10		
Rec 1m, 4th-E2	9	159* ±	16.7	21.49 ±	7.72
Rec 2m, 4th-E2	9	125.9* ±	10.4	52.7 ±	3.74
Rec 3m	9	117* ±	9.5	60.99 ±	6.25
Rec 15m	9	108.1* ±	7.7	69.48 ±	6.88
min HR en rec	9	98 ±	8.8	79.02 ±	4.9

Rec: Recovery; max HR: maximum Heart Rate, min HR: minimum Heart Rate, s: seconds, m: minutes; *P<0.05 for ANOVA of repeated measurements.

FIGURE 2. Somatochart of the sample



Somatochart with Reference Somatotypes for Canarian Wrestling by classification[3] (*Puntales* A, B and C) and for weight category (kg). Empty circles are our sample somatotypes, and the hexagon is their mean.

Regarding comparisons between predictor variables and result variables, heart rate and blood pressure showed a positive correlation to the percentage of fat, fat-free mass, body mass index, endomorphy and mesomorphy, with $p < 0.001$, and, on the other hand, the blood lactate level and the Borg rating of perceived exertion were negatively correlated, with $p < 0.01$ for the first and $p < 0.05$ for the second.

DISCUSSION

After each fight or *agarrada*, an increase was observed in systolic pressure but not in diastolic pressure (Table 2); this is a profile of a hypertensive response to exercise more like that of an exercise of dynamic resistance to a static exercise of counter-resistance[10], although Canarian Wrestling as a sport combines both types of exercise. It is important to note that the pressure measurements were performed with the wrestler sitting and not before 20 seconds after the end of each confrontation; although we do not know if higher levels of systolic pressure occurred in the course of one *agarrada*. However, after 15 minutes of recovery, the measured systolic pressure was similar to that during rest. These data suggest that the popular belief that the Canarian wrestlers have high blood pressure as a result of this type of exercise is not true. The reason why many wrestlers have high blood pressure is probably more associated with nutritional habits than with this type of exercise. Therefore, the blood pressure response of

our subjects to competitive effort was normal, although it was more similar to that shown by sportsmen involved in dynamic strength sports.

The blood lactate level (Table 3) increased from 2.5 (SD: 1.0) mmol/l, measured after warm up to 13.7 (SD: 4.0) mmol/l and 11.8 (SD: 1.8) mmol/l, measured respectively after the first and second confrontation. The average peak levels coincide with those observed by Bucksport Sandoval (2010) [(11)] in judokas and freestyle wrestlers (13 mmol/l), and by Callas et al. (1998)[(12)] in wrestlers, where the average lactate level reached was 13.5 mmol/l. In a study by Callister et al (1990)[(13)] in judokas, in order to over train them, they observed that blood lactate levels were higher during simulated competition (*randori*) than after work on the treadmill, which speaks of the magnitude of the effort made during combat, simulated or not, and which in our case is also reflected in very high numbers (peaks up to 18 mmol/l after the third combat of the first confrontation). After 15 minutes of recovery blood lactate levels decreased to 6.1 (SD: 1.8) mmol/l. Franchini et al (2005)[(14)] did not find such high levels in their work on elite judokas, but they worked with longer periods of fighting (5 minutes). The measurements obtained in our study show that during competition the stress intensity exceeded the lactate threshold[(15)], and recovery to basal levels required more than 15 minutes of inactivity, as shown when testing them after that period of time, a fact which is also reported in the aforementioned work of Franchini et al (2005)[(14)]. This simulation of the competition gives us the peak levels of blood lactate reached, as well as the recovery time for the next confrontation, which is useful for planning the training of wrestlers in Canarian Wrestling. Thanks to this it is possible to adjust the number and intensity of the training exercise series and the recovery time between exercise series, and the need for greater aerobic workout that helps improve the metabolism of lactate is clear.

The heart rate response observed during the simulated competition shows quite high values (182.8 ± 10.1l/min), near to the theoretical maximum heart rate for athletes of that age (Table 4). In each combat, and after 1 minute of recovery, the heart rate decreased to 29.21% (SD: 8.22%) of the observed increase. After two minutes, it decreased to 58.68% (SD: 7.91%). It is noteworthy that the recovery was greater after the first combat; in successive combats it worsened slightly. In the period prior to the one minute combat, and after 30 seconds of recovery resting, the heart rate only dropped 6.86 % (SD 4.53 %). During the 15-minute recovery period, the heart rate decreased by 79.02% (SD: 4.9%) of the maximum observed increase. Although the level of recovery between combats appears acceptable, the recovery was not complete after15 minutes. This shows that it is necessary to be in good aerobic conditions to withstand the demands of the competition, especially when the wrestlers may have to face more than two opponents, which could well happen in the course of a contest.

The high physical demands of this sport are the main physiological characteristic, especially when the wrestlers are people with high fat percentages and high BMIs. And although some authors (Olds and Kang, 2000[(16)]); Pieter et al., 2002[(17)]) report that experience is a more important factor than anthropometric data for success in competition, these data play an important role in a sport where balance is of paramount importance (the losers are those wrestlers that touch the floor first with any part of their body other than

the feet). A heavier wrestler, with more fat-free mass, is more likely to succeed than one with less of these features, but it is true that has a higher physiological price, they will have higher systolic blood pressure and will move into a higher heart rate range. Katralli and Goudar (2012[18]) reported that higher percentages of fat are correlated with lower performance. However, as the results obtained here show, a higher fat percentage presented lower blood lactate levels and a reduced sensation of perceived effort.

CONCLUSIONS

- The present study is the first where the physiological response of Canarian wrestlers in competition is evaluated.

- This work characterizes a Canarian Wrestling competition as an intermittent exercise, with peak intensities exceeding the lactate threshold and which produce significant increases in heart rate and systolic blood pressure, taking into account the observed response patterns of heart rate, blood pressure and levels of lactic acid in blood.

- And in the wake of the results presented here, we can recommend the length of training exercise series, and the intensity of them and even the recovery time between series. Thus, the training sessions should be aimed at improving the anaerobic system which is responsible for the high-intensity actions, and at improving the aerobic system which is responsible for the recovery process between these high intensity actions.

The extension of this field test to a larger number of wrestlers will allow a more precise definition of the physiological response patterns of the Canarian wrestler in competition. The field test can be used to characterize abnormal individual responses and, by using sequential evaluations, assess the progress in the physical condition of each wrestler throughout the competition season.

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