



Short communication

Increase of fat-free mass and low percentage of body fat in Brazilian sport horses training under tropical climate[☆]



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ABSTRACT

This study aimed to determine the subcutaneous fat layer thickness, percentage of body fat, fat mass, and fat-free mass of Brazilian sport horses at different levels of training for and competing in eventing and the effects of a tropical climate in the body composition of athletic horses. The study included 17 Brazilian sport horses aged between 4 and 10 years. Group 1 included young horses aged from 4 to 6 years training for Fédération Equestre Internationale (FEI) one-star events, and group 2 comprised adult horses aged from 7 to 10 years in training for FEI two-star events. The training protocol comprised exercise for 5 days a week for 60 min, including flatwork, aerobic conditioning, and jumping, both track and natural obstacles. The equines were weighted, and rump fat layer was determined by measuring the thickness of subcutaneous adipose tissue at the region of the gluteus medius muscle using ultrasound. The ultrasound evaluation was performed at the end of the equestrian season, which lasted 9 months. An increase in the body weight, fat layer, percentage of body fat, fat mass, and fat-free mass was observed in group 2 compared with the overall group and group 1, although the difference was not statistically significant ($p > 0.05$). Despite the important increase in the percentage of body fat between young and adult horses, $4.87 \pm 1.22\%$ and $5.64 \pm 1.90\%$ found in group 1 and 2, respectively, it did not differ statistically ($p=0.3775$). This fact may contribute to a decline in their performance because fat can be a key source of energy. Lower mean values of all parameters were observed in group 1 than in group 2. In conclusion, Brazilian sport horses training for and competing in eventing under tropical conditions have the body composition accustomed for this equestrian discipline. Brazilian sport horses training for and competing in eventing have high values of fat-free mass and low percentage of body fat and fat mass, demonstrating the athletic capability of these horses. There were no significant changes in the body condition of young and adult Brazilian sport horses. A hot, humid environment led to an increase of weight and body condition.

1. Introduction

Eventing is often considered to be a complete test of a horse and rider. The 3-day event comprises dressage, which tests discipline and precision; cross-country, which tests strength and 'bravery'; and show jumping, which tests accuracy. Furthermore, small, lean horses with Thoroughbred lineage are considered to have good ratios of bone circumference to body weight and can withstand the hard and fast work

of eventing training (Marlin, 2007).

Schaeffer (2014) states that event horses must have strong and naturally balanced conformations and also a calm and relaxed temperament. The training is based on the conditioning of three systems: cardiovascular, respiratory and musculoskeletal. Horses training for and competing in eventing have extreme demands placed on their musculoskeletal systems (Dyson, 2000). Kearns et al. (2002) concluded that lean mass appears to be a predictor of eventing performance in

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Table 1

Means, standard deviations and medians of the body weight, fat layer, percentage of body fat, Fat Mass and Fat-Free Mass of Brazilian Sport Horses in training and competition for eventing.

Parameters	Total		Group 1		Group 2	
	Means ± S.D.	Medians	Means ± S.D.	Medians	Means ± S.D.	Medians
Body Weight (kg)	495.53 ± 32.11 ^a	511	494.07 ± 35.22 ^a	512	502.33 ± 10.07 ^a	501
Fat layer (cm)	0.46 ± 0.24 ^a	0.31	0.44 ± 0.22 ^a	0.31	0.58 ± 0.35 ^a	0.50
Percentage of body fat (%)	5.01 ± 1.32 ^a	4.17	4.87 ± 1.22 ^a	4.17	5.64 ± 1.90 ^a	5.21
Fat Mass (kg)	25.34 ± 7.54 ^a	21.33	24.67 ± 7.16 ^a	21.17	28.47 ± 10.15 ^a	26.08
Fat-Free Mass	470.19 ± 29.39 ^a	476.30	469.40 ± 32.54 ^a	486.33	473.86 ± 0.92 ^a	473.39

Group 1: Young Brazilian Sport Horses; Group 2: Adult Brazilian Sport Horses. Results with the same letter did not differ statistically. Significance level of 0.05.

Standardbred horses. This conclusion is based on the fact that the percentage of skeletal muscle in a horse is directly associated to lean body mass, which may be indicative of the ability to generate power. Carter et al. (2009) indicated that accurate methods of measuring body fat are key to clarifying the link between obesity and health problems in horses.

An anaerobic metabolism specifically related to a high intensity physical activity can affect the body condition due to postexercise lipid utilization, which enhances body lipid deficit following exercise (Tremblay et al., 1994; Ekelund et al., 2001; Chia-Hua and Brennan, 2016). Furthermore, horses can experience heat stress in hot, humid environments (Backhouse, 2000) such as that in Brazil. Therefore, training for and competing in a strenuous modality can be more challenging for animals living under these conditions. This study aimed to determine the subcutaneous fat layer thickness, percentage of body fat, fat mass, and fat-free mass of Brazilian sport horses at different levels of training for and competing in eventing and the effects of a tropical climate in the body composition of athletic horses.

2. Materials and methods

This study was approved by the Ethics Committee for Use of Animals, Universidade Federal Fluminense (protocol number 276/2013). The experiments were performed at the Horse Performance Evaluation Laboratory (Laboratório de Avaliação do Desempenho de Equinos) located at the Brazilian Army Cavalry School (Vila Militar, Deodoro, Rio de Janeiro/RJ, Brazil).

The historical average minimum temperature in Rio de Janeiro ranges between 17 °C and 18.5 °C in winter and between 21.5 °C and 23 °C in summer. The maximum temperature ranges between 26 °C and 27.5 °C in winter and 32 °C and 33.5 °C in summer. Maximum annual precipitation is approximately 2500–2800 mm and the minimum is 700 and 1300 mm, according to Silva and Dereczynski (2014). The averages maximum and minimum temperatures during the year of the study, according to the Brazilian National Institute of Meteorology were 29 °C and 21.3 °C, respectively. The average relative humidity was 72.25% (INMET, 2016).

Seventeen Brazilian sport horses, eight females and nine geldings, aged between 4 and 10 years, were included. The horses were fed coast-cross hay [*Cynodon dactylon* (L.) Pers.] and commercial concentrates containing guaranteed levels of the following nutrients: crude protein [minimum (min)], 120 g/kg (12%); ethereal extract (min), 40 g/kg (4%); fibrous matter [maximum (max)], 150 g/kg (15%); acid detergent fiber (max), 180 g/kg (18%); mineral matter (max) 120 g/kg (12%); calcium (min), 15 g/kg (1.5%); calcium (max), 20 g/kg (2%); phosphorus (min), 5000 mg/kg (0.5%); digestible energy (min), 2700 kcal/kg; methionine (min), 1800 mg/kg; lysine (min), 4800 mg/kg; vitamin A (min), 5000 UI/kg; vitamin D3 (min), 1000 UI/kg; vitamin E (min), 100 UI/kg; vitamin B1 (min), 5 mg/kg; vitamin B2 (min), 4 mg/kg; copper (min), 20 mg/kg; iodine (min), 0.5 mg/kg; manganese (min), 64 mg/kg; selenium (min), 0.2 mg/kg; cobalt (min), 0.14 mg/kg; and zinc (min), 80 mg/kg. An amount equivalent to 1% of

body weight (BW) was provided thrice a day. The animals were supplemented with 50 g mineral salt, and all horses had unrestricted access to water.

The Brazilian sport horses were subdivided into two groups. Group 1 included young horses aged from 4 to 6 years training for Fédération Equestre Internationale (FEI) one-star events (2005), and group 2 comprised adult horses aged from 7 to 10 years in training for FEI two-star events (2005), according to CBH (2006). The training protocol consisted of exercise for 5 days a week for 60 min, including flatwork twice a week, aerobic conditioning twice a week, and jumping, both track and natural obstacles, once a week alternately.

The equines were weighed on a mechanical scale, and the measurement of the rump fat layer was determined by measuring the thickness of the subcutaneous adipose tissue at the region of the gluteus medius muscle using ultrasound. Ultrasound evaluations were performed at the end of the equestrian season, which lasted for 9 months. The equation used to calculate the percentage of body fat was established by Kane et al. (1987): % body fat = 2.47 + 5.47 × fat layer in centimeters. The fat mass (in kilograms) of each Brazilian sport horse was calculated by multiplying the weight of the horse by the percentage of body fat and the fat-free mass (also in kilograms) was determined by subtracting the fat mass from the weight of the horse.

Routine statistical methods were used to calculate means, standard deviations (SDs), and medians. A *t*-test was used to compare differences between the groups. A 5% confidence level was used. InStat 3 software was used for statistical analyses.

3. Results

The means, SDs, and medians of the body weight, fat layer, and percentages of body fat, fat mass, and fat-free mass of Brazilian sport horses training for and competing in eventing are shown in Table 1. We found no statistically significant differences between the two groups (group 1 and group 2) and between each group and the overall study group ($p > 0.05$) (Table 2). An increase in the body weight, fat layer, and percentages of body fat, fat mass, and fat-free mass was observed in group 2 compared with the overall study group and group 1, but the

Table 2

P-values found for the different groups of Brazilian Sport Horses in training and competition for eventing for body weight, fat layer, percentage of body fat, Fat Mass and Fat-Free Mass.

Parameters	Total X Group 1	Total X Group 2	Group 1 X Group 2
Body Weight (kg)	p=0.9048	p=0.7256	p=0.7213
Fat layer (cm)	p=0.8123	p=0.4614	p=0.3764
Percentage of body fat (%)	p=0.7633	p=0.4805	p=0.3775
Fat Mass (kg)	p=0.8030	p=0.5335	p=0.4457
Fat-Free Mass	p=0.9391	p=0.8032	p=0.8201

Group 1: Young Brazilian Sport Horses; Group 2: Adult Brazilian Sport Horses. Significance level of 0.05.

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