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Original Research

The Effect of Different Physical Exercise on Plasma Leptin, Cortisol, and Some Energetic Parameters Concentrations in Purebred Arabian Horses

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ABSTRACT

Leptin is a hormone that coordinates food intake, energy expenditure, and metabolic rate; it is, however, unknown how exercise influences plasma leptin concentration in horses. The aim of the study was to evaluate the exercise-induced changes in plasma leptin concentration in purebred Arabian horses competing in races and endurance rides. A total number of 26 horses (12 purebred Arabian racehorses aged 3–5 years and 14 endurance horses aged 7–14 years) were studied during performing routine physical exercise. From each horse, blood samples were collected at rest and immediately after the exercise session. Concentrations of plasma leptin, cortisol, lactic acid, uric acid, triacylglycerols, glycerol and free fatty acids were determined. Exercise-induced increase in cortisol and free fatty acid values were higher in endurance horses than in racehorses. Neither endurance nor race exercises influenced the plasma leptin concentration. Further research is needed to elucidate the effects of different types of exercise on leptin synthesis and secretion in horses.

1. Introduction

Leptin is a hormone that originates mainly from adipose tissue; it regulates the energetic balance, feed intake, and reproductive capacity [1]. In horses, plasma leptin concentration is related primarily to the body fat mass [2] and to the feeding regimen [3,4]. Moreover, in this species, the concentration of leptin in blood plasma is associated with the occurrence of some somatic and behavioral disorders, such as crib biting, insulin resistance, and mortality in foals [5–8]. High level of leptin often accompanies elevated concentration of plasma triacylglycerols in horses (TG) [9–11]. In pigs and rats, leptin also promotes lipolysis and fatty acids oxidation, thus promoting the partitioning of energy away from lipid utilization rather than from glycolysis [12,13]. Increased rate of lipolysis results in increased release of free fatty acids (FFA), which may decrease the leptin secretion [14]. Hormones, including insulin and cortisol, are the most important known regulators of plasma leptin level as they stimulate leptin synthesis in mammals [15,16]; adrenaline, which plays an opposite role, is also deemed as an important hormonal plasma leptin level regulator [15].

Endocrine balance and energetic metabolism are strongly affected by physical effort; however, previous studies on horses have shown that the exercise either increased, decreased, or had no effect on plasma leptin concentration [9,17–19]. For example, Kędzierski and Kapica [9] and Gordon et al [18] have noted an increase in plasma leptin concentration observed just after Standardbred trotters had been exercised, whereas Gordon et al [19] did not find any change. According to authors' best knowledge, endurance and racehorses have not been examined in this context. It is

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Table 1
Medium age, withers height, body weight, body condition score (BCS), and feeding regimen for race and endurance horses

	Race Horses	Endurance Horses
Age (y)	3.6	9.7
Height (cm)	152	158
Weight (kg)	438	472
BCS	4.4	4.6
Feeding regimen (kg/horse)		
Oats	5.5	2.0
Meadow hay	6.0	7.0
Fed concentrate	0.75	1.0
Fed concentrate contain (%):		
Fat	4.4	3.2
Protein	30.2	11.8
Fiber	5.4	11.9

known, that long-lasting endurance exercise primarily caused an increase in cortisol release rate, whereas short-term high-intensity exercises resulted in elevated catecholamines and decreased plasma insulin concentrations determined after exercise [19–22]. Thus, exercise leads to changes in endocrine profile, but its final effect on plasma leptin level is still not clear.

Achieving good results in any kind of competition requires maximal adaptation of the horse to the specific conditions of the particular discipline. Purebred Arabian horses are used in two extremely different activities. Young horses take part in flat races on racetracks, whereas older horses compete in endurance rides. These two types of effort are completely different physiologically, and thus require completely different adaptation of the organism to achieve the set task. High-velocity activity requires the adaptation of the organism to anaerobic metabolism and to the accumulation of the lactic acid (LA) produced during glycolysis. On the contrary, endurance activity bases first of all on aerobic exchanges of fatty acids as a source of energy. It is known that adaptation to long-distance exercise involves several mechanisms, including changes in muscle fiber composition, antioxidant response, and acute phase response [23,24].

The aim of the study was to evaluate exercise-induced changes in plasma leptin concentration in purebred Arabian horses competing in races and endurance rides. Plasma leptin concentration was analyzed in the context of changes in plasma cortisol and in the concentration of the main energetic metabolites (LA, uric acid [UA], TG, glycerol, and FFA).

2. Materials and Methods

2.1. Horses

All 26 horses used in the study were purebred Arabian horses, bred in Poland. Twelve horses (aged 3–5 years, six stallions and six mares) were studied at the Sluzewiec (Warsaw, Poland, 52°14'N 21°14'E) racetrack (group R). All the horses from group R were trained by one trainer and kept in one stable; the horses were trained 5 days a week during last 3 months before the study commencement. The second group (group E) included 14 endurance horses (aged 7–14 years, seven stallions, four mares, and three geldings) were studied during official competitions. They were trained and maintained in Champion Stable Training Centre (Ciosny, Poland, 51°55'N 19°23'E). All the horses from group E have competed in official endurance rides before, and they were fed with the standard diet designed for professional horses. Detailed data were shown in Table 1. Mineralized salt block and fresh water were available ad libitum. For each horse, the body condition score (BCS) was determined by a veterinarian with the use of the rating system devised by Henneke et al [25], scores ranging from 1 to 9 (Table 1). The horses did not show clinical symptoms of illness nor did the fillies show external symptoms of estrus at any time during the study.

The study was accepted by the Local Ethics Review Committee for Animal Experimentation and conducted according to the European Community regulations concerning the protection rules of experimental animals.

2.2. Exercise Protocol

Horses from group R were studied during their training session, which was part of their routine training. On the day of the study, the training session was performed between 7 AM and 9 AM, the weather was fair, and the temperatures were ranging between 18°C and 20°C. Horse's training session was characterized by 10-minute warm-up trot and canter followed by a simulation of 1,200 m race at a speed of 6.0 m/s with a speed's increase to 12.8 m/s for the final 800 m, and, finally, 5-minute trot.

Horses from group E were studied during official rides covering the distances of 120 km. However, seven horses (subgroup E1: four stallions, two mares, and one gelding) were excluded at the middle of the competition by veterinary inspections because of their elevated heart rate. The other seven horses (subgroup E2: three stallions, two mares, and two geldings) finished the whole distance.

Table 2 showed detailed data concerning the type of exercise which the horses were submitted. From each horse, blood samples were collected by jugular venipuncture in 9 mL EDTA K3 tubes at rest (in the morning, about 1 hour after last meal, in the boxes) and about 5 minutes after the end of exercise. Then samples were immediately centrifuged at 2,000 × *g* for 10 minutes for plasma separation. The obtained plasma samples were stored at −20°C until assayed.

Table 2
Technical conditions of the exercises performed by the studied groups of horses

Characteristic	Race Training Session	Endurance Ride 60 km	Endurance Ride 120 km
Duration	4.3 min	4–5.6 hr	9.8–11.8 hr
Velocity (m/s)	8.7	3.3–4.5	3.0–3.6
Length (m)	2,000	60,000	120,000
Other conditions	Gallop on the sand track	Walk and trot	Walk and trot