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Fact sheet

Stress Management for Equine Athletes

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It's hard to imagine that an animal, though it may receive optimal care, can experience psychological stress that ultimately can affect its health. But horses, which can be very "emotional" creatures, are affected by stress, and how each animal responds to a situation differs. Research conducted by Malinowski and her colleagues at Cook College and the New Jersey Agricultural Experiment Station is aimed at finding out if horses perceive certain routine training and management practices as "stressful"; and how such situations may impact the animal's well-being.

The basis for research studies involving stress management for equine athletes is to reach a goal that all horseowners should strive for: the promotion of management techniques which allow the horse to perform to its maximum genetic potential, under humane conditions. These types of studies are extremely important and should be supported and funded by the horse industry because, in view of animal rights activists movements, factual information is going to be needed when it comes to providing information about industry practices.

Stress can be defined as a general term which describes the combination of psychological and biological responses of an animal to novel or threatening circumstances. While the physiological response to stress is a highly complex subject, and certainly is not completely understood, scientists agree that there are two types of stressors. Physical stressors are things such as injury, change in the environment and exertion. Psychological stressors typically include situations that make the animal anxious or fearful. Uncertainty and fear of the unknown can be categorized as two of the major psychological stressors.

Dr. Malinowski and her students have been investigating the horse's physiological response to stress under a variety of conditions by analyzing hormones which are released when a situation is perceived as stressful. The stress syndrome begins with an endocrine response. The production of stress hormones (catecholamines and glucocorticoids) eventually leads to changes in cardiovascular function, energy producing mechanisms, digestion, immunity, and reproduction.

When a horse is stressed, the first component of the endocrine response to be activated is the sympathetic nervous system, which potentiates the release of the catecholamines epinephrine and norepinephrine. Catecholamines mediate the classic fight-or-flight response, increasing heart rate, blood pressure, and respiration rate. During severe or chronic stress, the second arm of the stress response is activated (hypothalamic-pituitary-adrenal axis). Initially, sympathetic activation of the hypothalamus causes the release of Corticotropic Releasing Factor (CRF) which potentiates, at the level of the pituitary gland, the release of Adrenocorticotropic Hormone (ACTH). ACTH causes the release of glucocorticoids from the adrenal gland. The primary glucocorticoid secreted in horses is cortisol. Cortisol acts to assist the animal in relieving stress by increasing glucose metabolism to provide energy which enables the horse to escape from the stress.

In the short-term, cortisol release is beneficial to the horse to help it cope with a stressor. However, chronic stress and subsequent release of cortisol has been implicated in many deleterious conditions including aggressive behavior; decreased growth and

reproductive capability; inhibition of the immune system; and increased risks of gastric ulceration, colic, and diarrhea.

Previous studies examining the effects of exercise on adrenocortical function in humans and horses have yielded conflicting results. Short-term exercise with light or moderate workloads may produce an increase, decrease, or no change in plasma cortisol concentration. The progressive rise in plasma cortisol associated with exercise is dependent upon the intensity and duration of the exertion as well as the fitness of the individual.

It is recognized that the amount of psychological stress that an animal encounters determines the degree of response of the pituitary-adrenal axis. In athletes, the added emotive stress of competition is an important element in the adrenal response. However, the role of psychological stress in horses remains unclear.

Plasma lactate concentration and heart rate have been proposed as indicators of both exercise workload and fitness level in horses. Together, heart rate and plasma lactate concentration can be used to quantify performance.

Because the effect of competition on stress levels in equine athletes remained to be elucidated, Dr. Malinowski has focused her research in the past decade on this important question.

Initially, a study conducted by Malinowski and Cook College students investigated the physiological response to stress in previously untrained Standardbred yearlings. Serum cortisol and lactate concentrations were measured before and after exercise throughout the 21-week duration of the study compared to at-rest levels. Interestingly, the significant post-exercise rise in cortisol observed did not change over weeks of training or as physical workload increased (horses were training faster and for longer distances). Post-exercise lactate and heart rate levels, however, did change concomitantly with increased metabolic demands. By week 21, lactate levels were 70 times higher than they were after exercise in the first week of training. This preliminary study demonstrated that horses do display a classic physiological stress response and that psychological factors were responsible for the increased rise in plasma cortisol post-training bout.

To measure the impact of stress on the immune system, early research conducted by Malinowski and colleagues evaluated cell-mediated immunity. When presented with a foreign substance, the immune system can respond in two ways. The first, cell-mediated immunity, involves blood cells (T lymphocytes) which recognize and can attack the foreign body. A second response, termed humoral, is defined as the production of antibody by B lymphocytes which is specific to the foreign substance.

Investigations measuring cell-mediated immunity in horses thus far utilized a lymphocyte proliferation assay. This assay measures the reaction of lymphocytes when stimulated by a foreign substance (mitogen). Lymphocyte proliferation (growth) is suppressed when challenged with a mitogen if the animal is faced with stressful conditions. This assay provides scientists with a technique by which to evaluate the horse's immunocompetence (ability to respond to infection) when exposed to stress.

It is well accepted that exhaustive exercise will lead to immune deficiencies. During exercise, blood cell populations will change much in the same way they do during the stress response—total white cells and neutrophils increase and lymphocyte and other granulocyte populations generally decrease. These changes are usually associated with elevated plasma cortisol.

Cell-mediated immune response has also been shown by a various researchers to be affected by exercise. Humans displayed decreased proliferative response to mitogen in isolated lymphocytes after prolonged exercise. This decrease in immune function was related to elevated cortisol levels.

Horses involved in competition can provide an excellent model to study the exercise-induced stress response. The change in white cell counts and lymphocyte proliferative response have been shown to respond as they do in humans and rodents. At twenty seconds post-training gallop, horses displayed a significant increase in total white cell counts. With

more rigorous exercise, such as cross-country driving, both white cells and neutrophils increased. Lymphocyte proliferative response also showed a sensitivity to cortisol. Horses exercising on a treadmill to exhaustion showed a decrease in lymphocyte proliferative response up to one hour post-exercise. This decrease was associated with increased plasma cortisol concentration.

Malinowski and colleagues investigated the effect of a psychological stressor on cell-mediated immunity by evaluating the effects of weaning on the physiological stress response and lymphocyte proliferative response in both mares and foals. Two types of weaning protocols were examined. Half of the foals were weaned with a buddy and half were weaned alone. It was found that cortisol rose after weaning in both mares and both groups of foals. Concentrations were elevated for approximately 24 hours in mares and 40 hours in foals. Interestingly, cell-mediated immunity was suppressed in mares and only those foals that were weaned in pairs. Foals weaned alone did not display suppressed immune function even when faced with elevated cortisol levels.

The behavior response of the foals weaned alone may be critical in explaining why cell-mediated immunity did not decrease in this group of weaners. Foals weaned alone were much more vocal and agitated in their behavior, and appeared much more "stressed" than their paired weaned counterparts. This aggressive behavior may have been an adaptive mechanism and actually helped the foal "cope" with the situation of isolation. In contrast, the intimidation factor of being isolated away from "mom" with a peer may have been perceived by the foals weaned in pairs to be more stressful, and they responded behaviorally with a feeling of helplessness.

The research with weaned foals concluded that: 1) psychological stressors do indeed cause a physiological stress response; 2) stress does suppress cell-mediated immunity in horses; and 3) horses fall into different categories of behavior.

Horses are like humans in that they each respond to a situation differently, and what may be stressful to one may not be to another. Stress is dependent on the animal's **perception** of the situation. Perception certainly is determined by the individual's genetic makeup. Three factors determine whether a situation is perceived as stressful. First is the experience of the individual. Novel situations are often perceived as being threatening or stressful. Horses certainly do appear to fear the "unknown." Second is the sense of control the individual has in a situation. Being out of control is a major stressor to some personality types. Attitude also is a major factor in how an individual perceives stress.

More recently, Malinowski and her students examined the physical and psychological effects of show-jumping on stress levels by comparing horses' stress response at a horse show compared to their familiar home environment. Twenty-six horses were sampled in both show and farm environments from three levels of horse show experience (least experience, schooling jumpers; moderate experience, intermediate jumpers; and most experienced, open jumpers). Blood samples were taken at three time points both at the show and farm (baseline at rest, upon reaching the schooling area but before exercise, and post-performance over a jump course). Stress responses were assessed through changes in plasma cortisol concentrations. Physical exertion was evaluated by heart rate and plasma lactate concentrations.

Schooling jumpers displayed higher baseline cortisol concentrations at the horse show when compared to the other experience levels and to their own when sampled at the home farm. In all, horses plasma cortisol levels did not differ from normal, at-rest concentrations after jumping at the horse show. As would be expected, plasma lactate and heart rates were elevated after jumping the course of fences. While schooling jumpers showed elevated cortisol concentrations in the horse show environment, more experienced horses did not. These data suggested that physically conditioned show jumpers that have previously been exposed to horse show environments do not appear stressed upon completion of a jumping competition.

In the early spring of 1992, Dr. Malinowski and colleagues at the University of Connecticut, Storrs, looked at the effects of polo competition on stress

levels and on both cell-mediated and humoral immunity.

Polo ponies from two stables were sampled once monthly for 5 months. Heart rates and blood samples were taken at the following time points: baseline, at rest, after saddling, after the first chukker, after the second chukker, and 30 minutes post-competition. Six representative ponies were also sampled at rest and both 8 and 24 hours post-competition for lymphocyte proliferative response analysis. Cortisol concentrations rose post-competition, only when ambient temperature reached 22° C. Heart rates and lactate concentrations were elevated in the polo ponies after each chukker, but had reached at-rest levels by 30 minutes post-play. There was no difference in the lymphocyte proliferative response to mitogen in the 6 horses sampled prior to and subsequent to competition.

Taken together these data suggest that polo competition does not cause an elevation in a physiological factor that is normally associated with the stress response and that this type of competition and exercise does not change cell-mediated immune response in horses.

Presently Clint Burgher and Drs. Fagan and Malinowski at Rutgers are investigating the effect(s) of steroidal versus non-steroidal anti-inflammatory drug use on the susceptibility to infection in horses. This work is being conducted at the equine research facility on the Cook College campus.

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