



Physical Conditioning of Horses

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Most horses are owned with the intent that they perform exercise. Exercise will impact all the body processes, especially the function of the muscular, skeletal, respiratory, and cardiovascular systems. This OSU Extension Fact Sheet provides an overview of how horses respond to exercise, and how physical conditioning enhances this response.

Physical conditioning refers to the body's long term adaptation to exercise. The goal of conditioning is to increase the ability to perform specific tasks. The capacity to exercise is increased, and the likelihood of injury and related health issues are reduced.

Conditioning is most effective when individualized to the horse and performance goal. Employed methods are directed by the horse's intended use, capabilities and response to exercise, management schedules and routines, the trainer's ability, and the environment. Even so, there are general physiological responses that occur with all conditioning.

Aerobic Capacity and Energy Use

Compounds are broken down to supply energy by pathways which may or may not require oxygen. Pathways that require oxygen are termed aerobic; those that do not are termed anaerobic. Horses perform many different types of exercise, ranging from predominantly aerobic to predominantly anaerobic. One of the largest benefits of conditioning is an increased aerobic capacity. Aerobic capacity is the level of ability to predominately supply energy needed for exercise through oxygen dependent pathways.

Exercise is predominately aerobic as long as there are sufficient fuel supplies, and intensity or length of an exercise bout does not overwhelm the rate of aerobic metabolism. A larger percentage of energy must be fueled by anaerobic pathways as exercise intensity and/or length of a bout increases. Jumping a fence or pulling a heavy object is an example of a highly anaerobic type of exercise. Quarter Horses and Thoroughbred races are predominately anaerobic. Walking and trotting are examples of highly aerobic types of exercise. Some of the arena performance classes, i.e. reining, stadium jumping, and cutting, intersperse short bouts of anaerobic exercise with longer termed aerobic activities. Others, i.e. western pleasure, horsemanship, and equitation, are largely aerobic.

A highly developed ability to utilize aerobic pathways enhances the ability to perform all types of exercise. Some of the more prevalent energy-containing compounds, i.e. fatty acids, must be broken down from oxygen-dependent pathways. Others that can be metabolized anaerobically, like glucose, will produce additional energy if also broken down aerobically. As such, more sources of energy will be available and more energy

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produced if aerobic capacity is increased. There is less of a build up of compounds that may cause fatigue when energy is produced aerobically. The result is horses can perform longer exercise bouts when energy is supplied aerobically.

Conditioning should enhance aerobic capacity, even with horses intended to perform predominantly anaerobic tasks. Aerobic conditioning will delay the time that aerobic systems are overwhelmed, termed the anaerobic threshold, which in turn delays fatigue. Also, the time needed to recover from exercise can be decreased with aerobic conditioning.

The Effect of Conditioning on the Body's Systems

As mentioned previously, exercise and conditioning affect all of the body systems. The systems that receive the most attention among researchers of horses and exercise physiology are the muscular, cardiovascular, respiratory and skeletal system. While these systems will be categorically discussed, it is the coordination of these and other systems that make exercise possible and allow for improvements with conditioning.

Muscular

Muscle tissue is responsible for the mechanical process of movement. Muscle tissue moves the body through series of contractions and relaxations of muscle fibers. Conditioning can increase the availability of substances needed for contraction and relaxation, and the size, contraction strength, and coordination of muscle fibers. The results are increased strength and coordination, delayed fatigue and fewer injuries.

Substances that aid in the production of energy are delivered to the muscle by the cardiovascular system. By-products of metabolism within the muscle are removed by the cardiovascular system. With proper conditioning, changes occur within muscle that result in more blood flow through the muscle tissue, an increase in the capacity to download oxygen from the bloodstream, and an increase in the activity of enzymes that assist metabolism. Conditioning can build up levels of energy-containing compounds, enzymes, and organelles that aid performance ability. Neural control of muscle tissue is enhanced, which in turn increases coordination. Conditioning can also improve the recruitment of specific types of muscle fibers, which in turn increases the ability to perform specific types of exercise.

Cardiovascular

The system of the heart, arteries, capillaries, and veins is responsible for delivering and removing substances from the body's tissues. Conditioning can increase the mass of the heart, the ability of the heart to pump blood, blood plasma volume and red blood cells, the integrity of blood vessels, and the number of capillaries. The overall effect is more efficient transport of substances to and from the muscle which aids to increase performance and delay fatigue.

Heart rate is an accurate indicator of how well a horse is responding to exercise. Normal resting heart rates of mature horses are monitored generally within the range of 30 to 40 beats per minute. Conditioning doesn't greatly affect the resting heart rate of horses. Maximum heart rate depends on age, but may be as high as 240 beats per minute.

Heart rate increases more or less linearly as exercise rate or length increases. Exercise levels that elicit small increases in heart rate are largely supplied by aerobic pathways. Energy must be supplied progressively more anaerobically as exercise level increases. Heart rate responses fewer than 150 to 180 beats per minute indicate that exercise is largely aerobic. Heart rates over 150 to 180 beats per minute indicate that exercise levels have overwhelmed the aerobic pathways so energy is supplied largely by anaerobic pathways. Conditioning allows for lower heart rates at the same level of exercise or higher levels of exercise at similar heart rates.

Respiratory

The respiratory system is comprised of the airways and lungs. The system delivers oxygen to the blood and removes carbon dioxide from the body. Similar to heart rate, respiration rate increases almost linearly with increasing workload. The system responds to exercise by dilating airways which reduces resistance and increases airflow. Frequency of lung contraction and dilation is increased with exercise so more air transfer can occur within a given time. The production of carbon dioxide increases as exercise level increases. Respiration rates, or number of breaths per minute, increase so the build up of carbon dioxide can be expelled from the body. This response also allows for more uptake of oxygen.

Conditioning may increase the elasticity of airways, the transfer of blood gases to and from the blood, and the integrity of lung and diaphragm tissue. However, conditioning has less of an effect on the respiratory system as compared to the previously mentioned systems. The increases in oxygen uptake and decreases in ventilation rate seen with conditioning is for a large part a result of improvements in muscular and cardiovascular systems.

Skeletal system

Bone, tendons, and ligaments function to provide the framework for movement. Bone strength is related to bone mass and density, which relates to bone shape and the arrangement and levels of bone minerals. Movement causes stress on bone, and stress is essential for improvement of bone mass and density. As such, conditioning can improve the ability of bone to prepare for and handle the stress of movement.

However, like all tissue, excess magnitude or frequency of exercise can overwhelm the capacity of bone to handle stress. The results of excess stress include stress fractures, abnormal growth and bone failure (breaks). The conditioning of bone

and connective tissues is less predictable as compared to the body systems previously mentioned. Differences between horses, age, stage of conditioning, training environment, and desired skills have a large impact on bone integrity. As such, condition of the skeletal system, especially the bones, tendons and ligaments of the leg, are monitored closely to detect small changes that if undetected might lead to damage, especially when conditioning young horses.

Comparatively less is known as to conditioning effect on tendon, ligament and joint integrity. Tendon elasticity and strength can decrease with lack of exercise, and there are significant changes in the composition of the makeup of tendons with conditioning. Cartilage thickness as well as joint flexibility and lubrication may increase.

Other systems

As previously stated all body systems are affected with exercise and conditioning. Rate of flow of digesta may be altered with exercise, although intake and diet effects seem to be larger influences. Water balance is affected, as increased losses through respiration and sweat require higher intakes. The nervous system adapts by altering the control of muscle tissue. Memory influences the ability to perform and the capacity to accomplish more highly skilled tasks.

Principles of Conditioning

No article or book can provide all the information needed to design the optimal conditioning program for your horse. There are many variables that direct the design of the conditioning program. Successful application of techniques requires judgment, and judgment for a large part is dependent upon experience and observation. Nonetheless, there are several principles that apply to conditioning programs in general. These principles direct the design elements that are shared components of all conditioning programs.

Step-wise training and progressive loading

As mentioned above, exercise causes stress on the horse's body, and the goal of conditioning is to use this stress to advance the horse's performance ability. Stress level is affected by exercise intensity, frequency, and duration. Step-wise training adjusts these components to progressively provide moderate levels of stress on the horse's body systems. The exercise level is incrementally increased over time as a horse's body adapts to exercise. For example, horses that pull objects should build strength by initially pulling lower weight objects. The weight of the objects is increased incrementally as the horse's ability to handle the existing loads becomes evident.

Exercise intensity may be adjusted by altering the speed of exercise. Initial phases of conditioning incorporate large amounts of slow speed work. This allows for the horse to gain neural control of the skill, while allowing for moderate stress load on muscle, skeletal, and cardiovascular systems.

The frequency of exercise bouts may be limited in early training. More frequent or longer duration exercise bouts are completed as conditioning increases. Duration of exercise influences stress tremendously. Younger horses will fatigue quickly from exercise partially because of the immaturity of the skeletal system. As such, exercise bouts for young or unfit horses usually are much shorter in duration. In order to

achieve the desired exercise level, initial stages of conditioning may require frequent, short duration bouts.

Specificity of exercise

The body's response to exercise is specific to the type of exercise included in the conditioning program. For example, race horses must incorporate racing into conditioning, just as a horse intended to jump must incorporate jumping into conditioning. The body will adapt to the stress by altering the capabilities to handle similar types of stress in the future. Muscle fiber type is an example of this specificity.

Muscle contains several different muscle fiber types. Types are based largely on the capability to utilize anaerobic or aerobic energetic pathways, diameter, and contraction speed. The structure of certain fiber types allow for quick and forceful contraction, which aids in short term, high intensity tasks such as pulling heavy loads, sprinting, or jumping. Other fiber types are more suited for slower, longer duration exercise as metabolites and cellular structures used for aerobic metabolism are more prevalent. Muscle tissue of different breeds of horses may have larger percentages of a particular muscle fiber type. Draft horses will have a higher percentage of muscle fibers with fast contraction speeds, large diameters, and lowered ability to utilize oxygen as compared to Arabians. Individuals within certain breeds, for example Quarter horses, may vary largely from one another in their relative distributions of muscle fiber type. Although relative distributions of the types are genetically based, each is adaptable to specific forms of conditioning.

The need to consider specificity of exercise is just as important for conditioning bone, cardiovascular, and respiratory systems. While this principle will direct types of exercise throughout the conditioning program, specificity increases in importance as the horse's fitness approaches levels needed to perform. Exercise bouts will mimic speeds and conditions of performance after the need for building aerobic and strength in general.

Thermoregulation and Acclimatization to Hot, Humid Environments

One of the products of exercise is heat, and excess levels of heat must be removed quickly from the body. This is accomplished with the assistance of the cardiovascular system, respiratory system, and the skin's sweat glands. The ability to handle the removal of excess heat is aided by conditioning as fit horses should be able to perform a set amount of exercise with less heat buildup, and there may be small improvements in the ability to dissipate heat through sweat.

Thermoregulation is especially important when horses are moved to hotter, more humid environments. The time it takes for the horse's body to respond favorably to this environmental change is termed the acclimatization period. It is likely that the horse's normal behavior and appearance will be negatively affected prior to acclimatization. Acclimatization generally takes a minimum of one or two weeks. Exercise intensity is usually reduced, and the horse's response to exercise should be monitored closely during the acclimation period. Water losses are likely to require larger intakes in the hotter, more humid environment.

Warm-up and Cool-down

Although there is limited research conducted with horses on the subject of warm-up and cool-down, studies with human

athletes stress the importance of both for optimum performance and quick recovery. Warm-up can improve running speed, the range of motion (flexibility) and strength of movement. Aerobic metabolism and oxygen consumption during the initial stage of exercise may be enhanced. Blood flow and temperature of the muscle may be increased to desired levels prior to the actual exercise bout.

Of added importance with horses, warm-ups may increase the accuracy or precision of performance. Horses may need warm-up for psychological preparation as a warm-up may provide the cue for mental preparedness of an impending performance. Similarly, warm-up periods should allow trainers to detect changes in a horse's soundness or other responses to exercise prior to more strenuous effort.

Warm-up routines vary with trainers and events. Low intensity stretching and suppling exercises are usual. Warm-ups may be limited to walking, trotting and slow loping, or may emphasize repetitions of specific actions required in the actual performance. Some trainers may incorporate passive methods such as the use of heat lamps or pre-ride rub downs.

A structured cool-down post exercise has several benefits, most related to injury prevention and recovery rate. Horses that are walked or trotted following exercise have faster clearance of blood lactate, a by-product of anaerobic metabolism, as compared to horses left standing. This faster clearance rate may enhance recovery time. Similar to warm-up, cool down also allows trainers to assess the recovery of the horse, and provide a means for monitoring signs of fatigue or failure of a body system.

Recovery

The time needed for recovery is influenced by conditioning, the exercise level, environmental conditions, and capabilities of the horse. Conditioning will lower the level of stress from a sub-maximal exercise bout. Also, conditioning should aid in the removal of body heat after exercise. As such, conditioning should lower the level of recovery needed, and hasten the rate of recovery from sub-maximal exercise.

Heart rate response following exercise is an accurate indicator of recovery from exercise. Recovery heart rate decreases more rapidly as fitness increases. If abnormally elevated, recovery heart rates may indicate overstress or an impending failure of a body system. For accurate comparisons, recovery heart rates must be taken at the same points in time after exercise and under similar environmental conditions.

Recovery respiration rate is also utilized as an indicator of fitness. However, breath rate and breath volume are highly variable as compared to heart rate, so monitoring of respiration rate may be of less value.

Fatigue

Fatigue has a number of definitions, ranging from when a decrease in optimal performance is first apparent to the point that exercise cannot continue at all. Fatigue from maximal intensity exercise is thought to occur from a variety of physiological responses to exercise. Fuel sources may become depleted. Products of energy metabolism may cause decreases in pH of muscle which in turn causes normal metabolic processes to decrease. Fatigue from submaximal intensity exercise may also result from increased temperature in muscle or fluid shifts in or from the body.

One of the goals of conditioning is to lengthen the time or heighten the level of exercise before the onset of fatigue. Conditioning may increase stores of energy-containing substances in the muscle (i.e. glycogen), heighten the efficiency to mobilize substrates, for example fatty acids, or increase the amount of energy produced from substrates (i.e. glucose). Damage caused by exercise stress may be repaired more efficiently. Enzymes and hormones that assist performance may be mobilized faster or stored in larger quantities.

The onset of fatigue is recognized by observing respiration rate, sweating rate, heart rate and body temperature. In addition, changes in behavior, coordination and stride are noted. Recognizing small differences will allow treatment and adjustment in conditioning routines before the point of failure of one or more of the body systems. Observed responses are compared to experiential knowledge of past responses of the particular horse and comparative responses from other horses.

Design of Conditioning Programs

The variety of desired skills and the need for specificity require conditioning programs to be individualized for the horse, trainer and activity. Additionally, the conditioning program must fit into other management routines, environmental conditions and performance schedules. The rate that additional stress is applied depends on the horse's response to existing exercise levels. The design should begin with low intensity, aerobic conditioning.

Long slow distance (Backgrounding)

Aerobic conditioning is prioritized initially. The purpose is to enhance aerobic capacity, and progressively challenge the body without applying intense pressure. Exercise intensities need to elicit heart rates at or slightly below 150 to 160 beats per minute. Exercise bouts may be as short as 20 to 30 minutes per session. Trotting and slow gallops will elicit the range of desired heart rates. Routines will vary with horses, trainers and successive exercise bouts. Horses may be trotted for the majority of the time. Horses may be galloped for a few minutes, allowed to recover by trotting or walking, and galloped again in a single bout. Longer workouts will necessitate more frequent recovery periods within the exercise bout, especially in initial stages or with young horses.

The number of bouts per day or per week depends on the desired progression rate and the horse's response. Forced exercise bouts every other day are the usual minimum. Ideally, horses are turned out in exercise paddocks for free exercise on other days. Daily bouts are more characteristic, even in the initial phases of conditioning. Because fatigue may occur more rapidly in young horses, the daily exercise level may need to be split into two, shorter duration workouts.

This initial phase of conditioning will typically last a minimum of six to eight weeks before more intense exercise becomes a significant part of the routine. Skill work is introduced during this phase for those horses intended to perform specific tasks such as arena performance.

Speed or strength work

Training will gradually incorporate speed work into the exercise bouts as cardiovascular, muscle, and bone strength is built through long slow distance conditioning. Initially, speed work is completed during one or two days of the week while

long slow distance exercise continues on the other days. Exercise intensity is raised to reach heart rates of 150 to 180 beats per minute. The length of time that these heart rates are maintained in a single bout depends on the design of the conditioning program and the fitness level of the horse.

Some trainers will employ workouts at speeds that continuously elicit these rates for 10 to 15 minutes, more or less. Others use more of an interval training approach which incorporates repetitive bouts of more intense speed work within a largely aerobically oriented workout. With interval training, the speed work bouts are shorter in length, and will be repeated several times during a workout. These repetitions are interspersed with slow work that allows for partial recovery between repetitions.

The frequency and intensity of the speed or strength work phase likely will be a larger part of conditioning for those horses intended to perform anaerobically, i.e. racing or pulling. Exercise level may also be increased by changing the amount of work by incorporating gradients, the load carried or the load pulled during an exercise bout. Technique training is also increased in frequency and intensity as conditioning programs advance from the backgrounding phase.

Technique or skill work

Skill training requires the horse to practice the same tasks required during performance. Exercise intensity, frequency, and duration should be at a minimum the level needed during the performance. Technique or skill work will likely be a part of backgrounding and strength training phases of conditioning. However, horses that have been backgrounded and developed a capacity for speed work will be able to commit more time to skill work when conditioning.

For example, this may entail a race horse receiving an exercise bout of successive speed works that elicit heart rates above 180 to 200 beats per minutes. These sprints of near maximal exercise are interspersed with several minutes of long slow distance exercise to allow partial recovery before the next fast work bout. This process may be structured into a formal program of interval training. Regardless, the length of an exercise bout at near maximum is shorter than times characteristic of strength or backgrounding phases.

Individualizing Conditioning

The length and type of conditioning will depend on the desired increase in fitness, the horse and the performance goal. Many uses do not require a high level of fitness, and conditioning increases only because performances become more frequent. The need to individualize the conditioning program will rise as performance goals become more specific. As a general guide, long, slow distance work will be needed for unfit horses for a minimum of three to four weeks.

Speed work, if conducted at all, will be delayed until aerobic training is apparent. The level of speed work will depend on the performance goals. Weekly exercise protocols may vary between days so that horses receive predominantly long slow distance two or three times per week, with speed or skill work on alternate days. Some horses, once fit, may perform best when exercised only two or three times per week, whereas others require more of a daily routine.

The behavioral aspects of conditioning and performance have not been part of the previous discussion. Behavioral desire to perform, although partially dependent on physical

fitness and physical health, is also influenced by the frequency and type of exercise. Human athletes practice with an intended goal in mind. Horses do not have that connection with the conditioning program. As such, horses are prone to become behaviorally 'flat' when exercise bouts are too repetitious, or when skill exercises are practiced too frequently. So there is merit in varying routines in workouts, especially with arena performance horses that are required to perform intricate skills or movement patterns on a routine basis. Otherwise, practicing individual tasks causes mental fatigue, which results in habits of evading maximal output.

Monitoring Fitness

As stated previously, the most practical means of quantifying response to exercise stress is monitoring heart rate during and recovering from exercise. The easiest way to monitor heart rate while the horse is standing is to listen to the heart sounds with a stethoscope. Beats, the sound of heart valves closing, can be counted for 15 seconds and values multiplied by a factor of four to obtain beats per minute. On-board heart rate monitors have been available commercially for several years, and are used routinely as part of standardized fitness tests conducted by researchers and veterinarians who specialize in equine health and exercise physiology. In order to be of benefit, comparative heart rate response must relate to a standard exercise level and environmental condition. As such, high speed treadmills are used by those who specialize in fitness testing of horses.

Respiratory volumes and ventilation rates are also part of fitness tests. The electrical activity of muscle may be recorded or biopsies taken to assess muscle function and type. The

mechanics of stride movement may be assessed with video, or force plates may measure the dynamics of foot placement.

Most of the aforementioned tests are conducted only when a horse is suspected to have health issues. Trainers will employ more subjective methods that relate to how the horse is behaviorally responding to a conditioning program. Stride mechanics, breathing and behavior during exercise are noted, and attended to when responses are abnormal. The ability to recognize small changes in a horse's response and accurate recordkeeping of past performances provides a competitive edge.

Trainers employ a variety of field tests to assess fitness and health. These tests may range from periodic visual appraisal of body condition, physical appearance, and behavior to more quantifiable testing such as veterinarian directed blood tests, ultrasound, and x-rays. Regardless, the more a horse is assessed as an individual, and the more experienced the trainer, support staff and veterinarians, the better will be the likelihood of achieving the performance goal.

This OSU Extension Fact Sheet provides an overview of the physiological response to conditioning and the basis for conditioning programs of horses. There are many additional, important components to successful conditioning. There are several texts on the subject of training and conditioning horses that are current and authored by specialists in research or by successful trainers.

The following OSU Facts are suggested for further information on physical conditioning of the Horse:
ANSI-3970 Nutritional Concerns for Exercising Horses
ANSI-3915 Training Horses Safely

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