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Original Research

# Improved Ability to Maintain Fitness in Horses During Large Pasture Turnout

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ABSTRACT

The objective was to compare horses' maintenance of fitness during extended periods of no forced exercise with that after stall confinement. Horses were divided into three groups: pasture turnout (P), stalled and exercised (E), or stalled with no exercise (S). Pre- and post-study body fat and bone mineral content were estimated, and horses performed a standardized exercise test (SET). Horses wore global positioning units to estimate distance traveled. The P group traveled a greater distance daily compared with the E and S groups ($P < .01$). Lateral bone density was greater for the P group after the study ($P = .05$). Comparing first and second SETs, the P group had lower heart rates at the trot ($P < .01$) and hand-gallop ($P = .028$), the E group had lower heart rates at the hand-gallop ($P < .01$), and the S group had higher 1-minute recovery heart rates ($P < .01$). Plasma lactate concentrations were higher at the peak of exercise ($P < .01$) and 10-minute recovery ($P = .015$) for the S group, whereas the P and E groups had lower rectal temperature at the peak of exercise ($P = .029$) and 10-minute recovery ($P = .031$ and $P = .041$, respectively). These data suggest that the S group lost fitness, whereas the P group remained as fit as the E group. The improvement for the P group compared with the E or S group was greater bone mineral content. Access to pasture appears to help maintain bone strength and exercise fitness ability.



## 1. Introduction

Maintenance of fitness can be problematic during periods of no forced exercise owing to weather or injury. Horses often lose muscle mass and bone density [1] during these detraining periods. Horses confined to stalls have limited movement, and this may exacerbate the problem. Serrano et al. [2] observed that previous improvements in conditioning adaptations such as hypertrophy of type IIA muscle fibers, increases in aerobic muscle enzymes, and increases in capillary density were reverted with 3 months of detraining. McGowan et al. [3] observed a decrease in the time to fatigue, a decrease in the $VO_2$ max, and a decrease in buffering capacity in horses during detraining.

These detraining effects could delay the return to previous fitness levels and interfere with training progress [4]. The objective of this study was to compare the horse's ability to maintain fitness levels during an extended period of pasture turnout with no forced exercise with that after stall confinement with either no forced exercise or daily forced exercise.

## 2. Materials and Methods

### 2.1. Horses and Exercise

Sixteen horses of light horse type averaging 591.1 ± 10.4 kg and 16.4 ± 1.2 years of age were randomly divided into three groups: pasture turnout (P; n = 6), stalled and exercised (E; n = 5), and stalled with no exercise (S; n = 5). All of the horses had previously participated in 12 weeks of 1-2 hours of light-to-moderate exercise per day in the college's riding program. Following this period, the P group was

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turned out into an approximately 100-acre pasture, which could be described as moderately hilly for 14 weeks. The E and S groups were stalled during the day and had paddock (approximately 1 acre) turnout at night during the 14 weeks. Horses in the E group and S group were fed a grass hay that averaged 1.7 Mcal digestible energy/kg (DE/kg) and 8.2% crude protein (CP) along with a concentrate that averaged 3.3 Mcal DE/kg and 15.8% CP. The pasture composition varied between 2 and 2.5 Mcal DE/kg and between 15.7 and 17.5% CP over the course of the 14 weeks (April through August). The E group horses received 1-2 hours of light-to-moderate exercise 5 days per week consisting of walking, trotting, and cantering under saddle over the course of the 14-week study. Heart rates were monitored periodically (Polar s610i, FitMed, Mill Valley, CA) to ensure consistent exercise intensity. Body weight was evaluated using an electronic scale (Cambridge Scaleworks Model AL660-LA, Honey Brook, PA), and body condition score was evaluated using a standardized scale [5]. Both parameters were evaluated every 2 weeks. The protocol followed the procedures of International Animal Care and Use Committee (IACUC) in the care and use of the animals throughout the study.

### 2.2. Sampling and Analysis

Before the start and at the end of the study, the horses' rump fat measurements were determined using ultrasonography to estimate body fat. The ultrasound probe was placed approximately 5 cm lateral of the point of the croup. The depth of the subcutaneous fat layer was measured in centimeters and used to calculate body fat percentage based on the previously reported regression $Y = 8.64 + 4.7X$, where Y is body fat percentage and X is centimeter of rump fat [6]. Radiographs of the left third metacarpal were taken just distal to the carpal to estimate bone mineral content. An aluminum step wedge was exposed on the film to estimate radiographic bone aluminum equivalence (RBAE) as an estimate of bone mineral content, as previously described by Meakim et al. [7]. Radiographs were done both at the start and end of the study. Each horse also performed a standardized exercise test (SET) before the start and at the end of the study to evaluate fitness. Heart rate measurements were taken during the SET. The SET consisted of 5 minutes of walking (1.5 m/s), 5 minutes of trotting (3.5 m/s), 3 minutes of cantering (6 m/s), 5 minutes of trotting (3.5 m/s), 2 minutes of hand-gallop (8 m/s), and a 10-minute recovery at the walk (1.5 m/s). Blood samples were obtained through jugular puncture at rest, the peak of exercise (within 1 minute of completing the hand-gallop), and at 10 minutes of recovery. Plasma was separated and immediately analyzed for $pCO_2$, $pO_2$, pH, $HCO_3^-$, and lactate using a blood gas machine (VetStat, IDEXX, Westbrook, ME). Rectal body temperature was taken at each blood sampling time to correct blood gas analysis for body temperature as well as to monitor changes in body temperature during exercise and recovery. Every 4 weeks during the study, horses had global positioning units (GPS; Garmin Foretrex 101, Garmin International Inc., Olathe, KS) secured to their halters during their turnout time to estimate distance traveled. Horses on pasture wore the GPS for a 24-hour period. The use of GPS to quantify distance travelled and speed has previously been evaluated by Clingman et al. [8].

### 2.3. Statistical Analysis

Data were summarized as least square means with standard errors. An analysis of variance was performed using the PROC GLM procedure of SAS (Cary, NC). The level of significance was set at $P < .05$.

## 3. Results

Horses maintained body weight and body condition score during the study. Horses averaged 591.1 ± 10.4 kg at the start of the study and 594.9 ± 11.2 kg at the end of the study. Not surprisingly, the P group horses traveled a greater voluntary distance (10.76 ± 0.4 km) on a daily basis during their turnout compared with either the E group (5.09 ± 0.4 km) or S group (4.51 ± 0.4 km) ($P < .01$). It should be noted that the E group would have also have had forced exercise, which would increase the distance travelled. Because exercise occurred indoors, GPS could not be used to determine distance travelled, but based on exercise time and ring size, it was estimated to be 8 km on each exercised day. There were no differences in ultrasonic rump fat measurements between groups. There were no differences in bone mineral content between groups at the start of the study. Bone mineral content measurements revealed greater lateral bone mineral content for the P group (23.9 ± 0.75) at the end of the study compared with the start of the study (21.7 ± 0.75; $P = .05$). The E group and S group did not have significant changes between the start and end of the study. Overall, the P group had a tendency to have more lateral bone mineral content (23.8 ± 0.51) compared with either the E group (22.8 ± 0.53) or the S group (22.8 ± 0.53; $P = .078$). Bone mineral content data are shown in Table 1.

Both SETs were conducted in an indoor arena. The first SET was conducted in April with an average temperature of 12°C and 80% humidity, and the second SET was conducted in August with an average temperature of 21°C and 78% humidity. Heart rates during the first SET were different between groups for the walk ($P < .05$), 1-minute recovery ($P < .05$), and 10-minute recovery ($P < .05$). There were no differences in heart rates between groups at any other time during the first SET. During the second SET, the P group had lower heart rates at the trot ($P < .01$) and hand-gallop ($P = .028$) compared with the SET at the start of the study. Horses in the E group also had lower heart rates at the hand-gallop ($P < .01$) in the second SET compared with the first, whereas horses in the S group had higher 1-minute recovery heart rates ($P < .01$) during the first SET

**Table 1**
Bone density measurements for pastured (P), exercised (E), and stalled (S) horses before the study and at the end of the study

| Area | Pastured (P) | | Exercised (E) | | Stalled (S) | | SE |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | |
| Lateral bone, mg Al | 21.7[a] | 23.9[b] | 22.5 | 23.1 | 23.1 | 24.5 | 0.75 |
| Medial bone, mg Al | 23.8 | 25.8 | 23.6 | 24.5 | 26.9 | 25.7 | 1.30 |

mm AL, millimeters of aluminum equivalence.
[a,b]Different pre versus post $P < .05$.