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Effect of prepartum exercise, pasture turnout, or total confinement on hoof health

R. A. Black,* S. R. van Amstel,† and P. D. Krawczel*[1]
*Department of Animal Science, The University of Tennessee, Knoxville 37996
†Department of Large Animal Clinical Sciences, The University of Tennessee, Knoxville 37901

ABSTRACT

Lameness is a major welfare concern in the dairy industry, and access to physical activity during the dry period may improve hoof health. The objective of this study was to determine the effects of forced exercise, pasture turnout, or total confinement of dry cows on horn growth and wear and sole thickness. Twenty-nine primiparous and 31 multiparous, pregnant, nonlactating Holstein (n = 58) and Jersey-Holstein crossbred (n = 2) dairy cows were assigned to either total confinement (n = 20), exercise (n = 20), or pasture (n = 20) treatments at dry-off using rolling enrollment from January to November 2015. Cows were managed with a 60-d dry period (58.5 ± 5.4 d) divided into far-off (dry-off to 2 wk before parturition) and close-up periods (2 wk before projected parturition). Cows were housed in a naturally ventilated, 4-row freestall barn at the University of Tennessee's Little River Animal and Environmental Unit (Walland, TN) with concrete flooring and deep-bedded sand freestalls. Cows assigned to confinement remained in the housing pen. Exercise cows were walked for a targeted 1.5 h at 3.25 km/h, 5 times/wk until calving. Pasture cows were turned out for a targeted 1.5 h, 5 times/wk until calving. Hoof growth and wear and sole thickness of the rear hooves were measured on d 2 and 44, relative to dry-off. Data were analyzed using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC). Cranial and caudal horn wear was greater for exercise cows than confinement and pasture cows. Exercise cows experienced more equal rates of horn growth and wear cranially. Confined cows tended to increase sole thickness from d 2 to 44, relative to dry-off. Frequent, short duration exercise on concrete did not impair the hoof health of late-gestation dry cows. Further, exercise may improve overall hoof health, potentially improving cow welfare.

Key words: hoof health, prepartum exercise, lameness, physical activity

INTRODUCTION

Lameness continues to be a major concern within the dairy industry, with clinical prevalence averaging 30% and ranging from 5 to 65% in California and averaging 55% and ranging from 10 to 85% in the northeastern United States (von Keyserlingk et al., 2012). Lameness is a welfare concern (von Keyserlingk et al., 2009) because it causes pain (Whay et al., 1998; Shearer et al., 2013), and it also reduces milk production by more than 1 kg/d (Kossaibati and Esslemont, 1997; Warnick et al., 2001; Green et al., 2002) and increases culling (Booth et al., 2004). Infectious disease (i.e., digital dermatitis, foot rot) and claw horn disruptions (i.e., white line separation, ulcers, and hemorrhage) can cause lameness. Alternatively, management factors (i.e., concrete flooring, zero grazing, uncomfortable stalls) increase the risk of lameness (Cook and Nordlund, 2009). Although these factors can be controlled to prevent different hoof disorders increasing lameness risk, management factors may be the most easily controlled.

With the majority of cows housed on concrete flooring (55.6%), few cows have access to softer standing surfaces such as rubber flooring (13.9%), dirt (20%), or pasture (5.1%; USDA, 2010). Concrete flooring was associated with increased incidence of digital dermatitis (48.5%) compared with pasture (28.2%; Wells et al., 1999) and at least one claw disorder (78 to 81%) compared with straw yards (57.5%; Somers et al., 2003), and it can often result in unequal hoof horn growth and wear and heel erosion (Vanegas et al., 2006; van Amstel et al., 2016). Standing and walking on hard solid surfaces (Sogstad et al., 2005; Vanegas et al., 2006) and slippery surfaces (Solano et al., 2015) and walking along poorly maintained or congested cow tracks (Burow et al., 2014; Ranjbar et al., 2016) can have negatively effects leading to lameness. However, offering cows access to softer surfaces may improve hoof health. Housing cows on pasture for 3 wk improved

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[1]Corresponding author: krawczel@utk.edu

locomotion compared to a total confined control group (Hernandez-Mendo et al., 2007), which may have been related to increased activity because cows housed on pasture are more active than those in confinement (Hernandez-Mendo et al., 2007; Legrand et al., 2009; Black and Krawczel, 2016).

Most dairy cattle in the United States are housed in tiestalls, stanchions, or freestall barns with no access to pasture (58.9%; USDA, 2016). These barns offer no access to exercise outside of traveling to the milking parlor, waterer, feed resources, and social interactions. However, cows given access to exercise 2 or 7 times/wk tended to have a shorter claw diagonal than nonexercised cows kept in tie-stalls on rubber mats (Loberg et al., 2004). Shorter and steeper claws show less susceptibility to disease (Politiek et al., 1986; Smit et al., 1986) and may be improved with increased physical activity. Therefore, allowing cows access to increased physical activity through pasture turnout may improve hoof health, while walking cows excessively on concrete or hard surfaces may lead to hoof disorders.

These factors may be increasingly important in late-gestation cows in which horn quality is weakened, making them more susceptible to hoof ailments (Kempson and Logue, 1993). Implementing physical activity during late gestation may help to offset reduced horn quality without negative effects on performance. Although studies have determined the effect of different surfaces on hoof health, no studies have examined the effect of the amount of activity on these surfaces on hoof health. Understanding the implications related to regular exercise of cattle, either on concrete or with pasture turnout, will provide insight into the effect of physical activity on hoof health during late gestation. The objective of this study was to determine the effects of exercise, pasture turnout, or total confinement of dry cows on horn growth and wear, sole thickness, and lameness.

MATERIALS AND METHODS

Animals, Housing, and Management

Twenty-nine primiparous and 31 multiparous, pregnant, nonlactating Holstein (n = 58) and Jersey × Holstein crossbred (n = 2) dairy cows were assigned to either confinement (n = 20), exercise (n = 20), or pasture (n = 20) treatments at dry-off using rolling enrollment from January to November 2015. Cows were balanced on parity (1.8 ± 0.9), projected mature-equivalent FCM (13,831 ± 2,028 kg per lactation), and projected calving date. A 60-d dry period (58.5 ± 5.4 d) was used with cows divided into a far-off group (dry-off to 2 wk before parturition) and close-up group (2 wk before projected parturition or signs of parturition).

Cows were housed in a naturally ventilated, 4-row head-to-head freestall barn with drive-through feed bunk at the University of Tennessee's Little River Animal and Environmental Unit (Walland, TN) constructed in 2011. Deep-bedded sand freestalls were 2.4 m long and 1.2 m wide with a 1.2-m-high neck rail positioned 1.7 m from the curb and a 0.6-m-high polyvinyl chloride tube brisket board placed 1.7 m from the curb. Fresh sand was added once per week with manure removed from stalls twice daily before milking (0730 and 1730 h). Concrete alleyways had diamond cut grooving with grooves 10.2 cm apart. Fans turned on automatically when temperatures rose above 23°C. Throughout the study period, study cows were housed in either pen 1, 2, or 6 (Figure 1), with pens measuring 12.1 m wide and 19.4 m long, enclosing 24 freestalls and 26 headlocks (0.6 m wide), and containing 2 waterers, one on each end. Study cows were comingled unless the pen was split into far-off and close-up groups, leaving 12 freestalls and 13 headlocks for each group. Cows were maintained below 80% stocking density, assuming 1 headlock or freestall per cow.

Cows were fed twice daily at 0730 and 1530 h. Far-off cows were fed a TMR from dry-off to 2 wk before projected parturition consisting of 4.5 kg of ryegrass hay, 3.4 kg of orchardgrass hay, 2.3 kg of corn silage, and 2.7 kg of dry cow grain per cow per day. Close-up cows were fed a TMR up to parturition consisting of 3.6 kg of orchardgrass hay, 1.8 kg of clover, 11.3 kg of corn silage, and 3.0 kg of dry cow grain per cow per day. All cows had ad libitum access to water except exercise treatment cows during exercise.

Experimental Treatments

Before enrollment, all cows had been housed in the same freestall barn with no previous experience with exercise, aside from pasture access during the dry period before the previous calving. Cows were enrolled into treatments on the day of dry-off. Cows assigned to confinement remained in the pen at all times, except for general management reasons (i.e., cleaning, rebedding stalls) when cows were moved to an adjacent lane for a maximum of 30 min. Cows were permitted to eat, drink, and move around the pen during treatment periods.

Cows assigned to exercise were removed from the pen 5 times/wk, Monday through Friday, and walked for a targeted 1.5 h at 3.25 km/h beginning at 1200 h along the path denoted by a dashed black line in Figure 1, measuring 250 m for each lap. Cows were walked in a