

The Effect of Hoof Abnormalities on Sow Behavior Before and After Feeding When Housed in a Farrowing Stall

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Summary and Implications

The objective of this study was to evaluate the effects of excessive toe growth, hoof cracks in the outer hoof wall, and length difference between the inside and outside toe of the hoof on sow behavior in mid-lactation. Sows were classified into three treatment groups and one control group. The treatment groups were 1) presence of cracks in the outer hoof wall 2) length differences between the inside and outer toe of the hoof and 3) excessive toe growth. Some sows had both toe size differences and cracks in the outer hoof wall ($n = 23$). Hoof abnormalities were categorized into 3 scores based on the severity of the lesion. Control sows spent 12.7 % (13.3 min) of the total time (105 min) standing and eating. Before feeding, control sows spent 1.2 % of time standing and eating. Sows with overgrown hooves spent less time standing and eating as lesion severity increased when compared to control sows. Each increase in overgrown hoof lesion score was associated with sows spending 54 % less time standing. Sows classified as having hoof cracks were observed to stand more and lay down less than control sows; however, this may have resulted from the inability to identify hoof lesions that caused pain. As a result, sows with hoof lesions that did not have pain were grouped with sows that had hoof lesions that caused pain and may have reduced the true effect of hoof lesions on behavior. In this study, sows that had differences in toe size were not associated with a deviation from the control sows.

Introduction

Increased hoof abnormality prevalence (e.g. toe and dew claw overgrowth, hoof wall cracks, and hoof pad abrasions) in sow populations observed at harvest suggest that these hoof defects may be detrimental to sow performance, and in turn, the sow productive lifetime. An evaluation of cull sows at harvest reported that 85 % of sows had at least a single lesion impacting one or more hooves. Researchers have reported that lameness is a major factor when culling sows from the breeding herd observed

that 8.6 % of sows in Swedish commercial herds were culled due to lameness, hoof lesions or both. However, it should be noted that the presence of hoof lesions does not mean that a sow is lame. Similarly, not all cases of lameness in sows are a result of hoof lesions. Several researchers have studied the associated decrease in time spent standing and eating when sows have overgrown rear toes. However, these studies did not quantify the performance response associated with varying degrees of hoof lesions. Therefore, the objective of this study was to evaluate the effects of excessive toe growth, hoof cracks in the outer hoof wall, and length difference between the medial and lateral toe of the hoof on sow behavior in mid-lactation.

Materials and Methods

Animals and housing: The project was approved by the Iowa State University Animal Use and Care Committee (IACUC #6-06-6159-S). These studies were conducted on two, 4200-hd sow farms within the same Midwestern system. Building structures and management objectives were similar at both farms. The buildings utilized flush manure system and tunnel ventilation. A total of 188 sows (Supermom, Newsham Genetics, Des Moines, IA) sows were used.

Lactation: Within each farrowing room there were 39 farrowing stalls (3 rows of 13 farrowing stalls in each row; Modern Hog Concepts, Iowa Falls, IA; 51 cm width x 214 cm length x 102 cm height with finger bars extending downwards on each side of the stall). Sows were provided water through nipple water drinkers approximately 84 cm from the floor and 36 cm from the front of the stall. Farrowing rooms were equipped with individual feed drop boxes connected to a delivery system that automatically placed the food in the sows' feeders and subsequently refilled the containers 4 times/d every 6 h at 0245, 0845, 1445, and 2045 h. Mid-experiment, Farm A initiated a change in the time that feed was dropped from the feed boxes and the new feed times were 0215, 0815, 1415, and 2015 h. The farrowing stalls had wire mesh flooring. Lactating sows were provided a commercially available corn-soybean based meal ration formulated to meet or exceed their nutrient requirements during this phase of production. Feed was provided in a metal feeder at the front of each farrowing stall. Prostaglandin F_{2α} was injected following manufacturer's recommendations on approximately d 115 of gestation if the sow did not show imminent parturition signs. High and low ambient temperatures (°C; 30.8 and 19.7°C, respectively) were monitored and controlled for each farrowing room during

lactation using the 6-stage ventilation system control (Airstream TC5 controller, Automated Production System, Assumption IL) located outside of the farrowing room. The temperature sensor was located in the center of each farrowing room, approximately 1.4 m above the floor.

Treatment: Sows were classified into three treatment groups and one control group by the same trained observer while sows were standing in gestation stalls approximately 1 d before sows were placed in farrowing stalls. The treatment groups were 1) presence of cracks in the outer hoof wall [CK], 2) length differences between the medial and lateral toe of the hoof [TS], and 3) excessive toe growth [OG] (Table 1). Some sows had both toe size differences and cracks in the outer hoof wall ($n = 23$). Hoof abnormalities were categorized into 3 scores based on the severity of the lesion, and those categories are shown in Table 1. The number, length, location, and lesion severity was recorded for each toe and for all sows in all treatment groups. The length difference between the medial and lateral toe were obtained using a ruler (3.5 cm width x 30.5 cm length, measured at 0.32 cm increments) placed on the floor of the gestation stall between both toes and parallel to the long axis of the sow and leg. Sow toes classified as OG were measured using the same ruler, placed parallel to the long axis of the sow and leg, but each toe was measured beginning at the coronary band and extending to the leading edge of the overgrown toe. For each treatment sow, a case-control sow [C] was identified that matched body condition score and parity as her treatment counterpart. Because of the difficulty finding both ideal treatment and control sows within the same parity within the same farrowing group, treatment and control sows were paired and considered a match using the following parity categories: 1, 2, 3 to 5, and 6 or greater parities. Within a farrowing room, treatment and control sows were placed in 2 rows of farrowing stalls extending the length of the room. Sows were placed in farrowing stalls in a pre-determined order so that an experimental and control sow were housed next to each other; however, treatments were alternated throughout the allotted spaces in the farrowing room. The case-control sows were alternated in the farrowing stalls to remove microclimate effects in the farrowing rooms on any particular treatment group.

Sow Behavior. Behavior was filmed using one 12 V closed circuit color television camera (Model WV-CP484, Panasonic Matsushita Co. Ltd, Kadoma, Japan) per parity matched treatment-control group and information was recorded onto a digital video recorder (RECO-204, Darim Vision, Pleasanton, CA) at 10 frames/s. Sows were recorded when the lactation length averaged 10 d (± 3 d). Prior to independently scoring sow behavior, two trained observers practiced scoring the same video using the Observer software (The Observer, Ver. 5.0.25 Noldus Information Technology, Wageningen, The Netherlands). Behavior

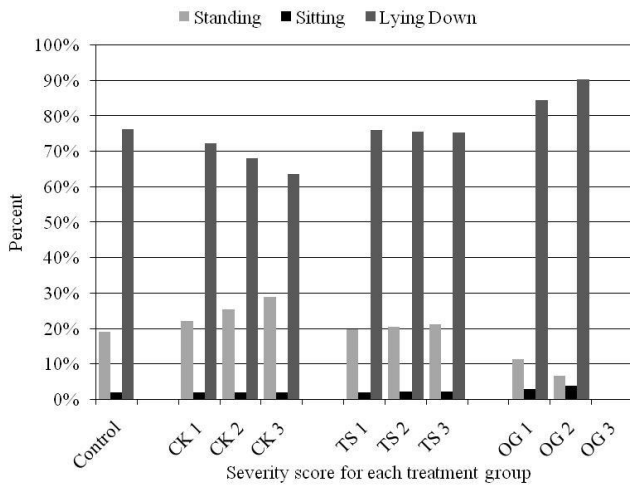
times scored by each observer were compared and agreement (all behaviors and postures were correctly identified and times were ± 15 s of each observer) was achieved before any video was scored. Observers were blind to treatment during behavioral scoring. The behavioral ethogram included **standing** that was sub categorized into 4 behaviors: eating, drinking, defecating/urinating, and just standing. **Sitting** was sub categorized into 3 behaviors: eating, drinking, and just sitting. **Lying down** was categorized as lying sternal or as lying lateral on their left or right side. Each sow observation was recorded for 45 min prior to feed delivery and 1 h after feed was available (a total of 105 min / observation) and this provided 24,780 minutes or 413 h. Two investigators entered the farrowing room immediately after feed was dropped and made each sow stand by placing a hand on the sow's back. The investigators verified that each sow was standing before leaving the room, and sows were not disturbed by caretakers until the behavioral recording ended.

Statistical Analysis: Sows were blocked within room and farm. Behavior data were transformed using the logit function. The sow served as the experimental unit. In Experiment 1, lesions and their severity were evaluated using multiple regression of each behavior, similar to the analysis conducted for performance data. Block was included in the model as a fixed effect. Sow within block was used as a random effect to account for correlations between the day of observation (10 and 11 d of lactation) for sows that had repeated measurements. An environmental impediment during several lying down events was observed for one sow in Experiment 1. This caused her to stand nearly the entire time after feeding and was not a result of her lesion score. Therefore, this sow was removed from behavior analyses. The percent of time spent standing before feeding was used as a linear covariate for the percent time spent standing after feed delivery. Odds ratios were calculated and presented in the text as one unit increases represents either a percent increase or decrease in time spent in the specific behavior or posture.

Results and Discussion

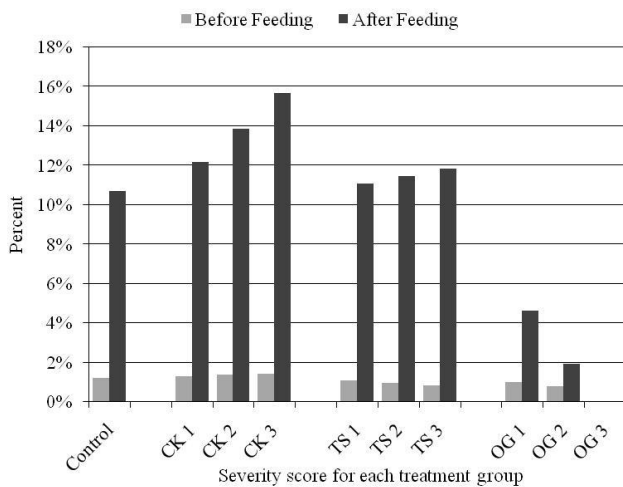
Time budgets for 3 postures (standing, sitting, and lying down) by treatment group are shown in Figure 1. Sows in the control group spent 18.9 % (19.9 min) of the 105 min observation period standing, 1.3 % (1.4 min) sitting, 0.3 % (0.3 min) kneeling, and 76.1 % (79.9 min) of the time lying lateral or sternal.

Figure 1. Time budget of sows for 45 min prior to and 1 h post feeding by treatment and lesion severity on lactating sow behavior.



Each increase in OG lesion score was associated with sows spending 54 % less time standing ($P = 0.01$). No significant associations were observed for the total amount of time spent sitting for any treatment group compared to control sows. Odds ratios for times spent lying down were 0.8, 1.0, and 1.3 for each score increase in CK, TS, and OG lesions, respectively. Control sows spent 12.7 % (13.3 min) of the total time standing and eating. Before feeding, control sows spent 1.2 % of time standing and eating (Figure 2). However, after feed delivery, sows increased time spent standing and eating to 10.7 %.

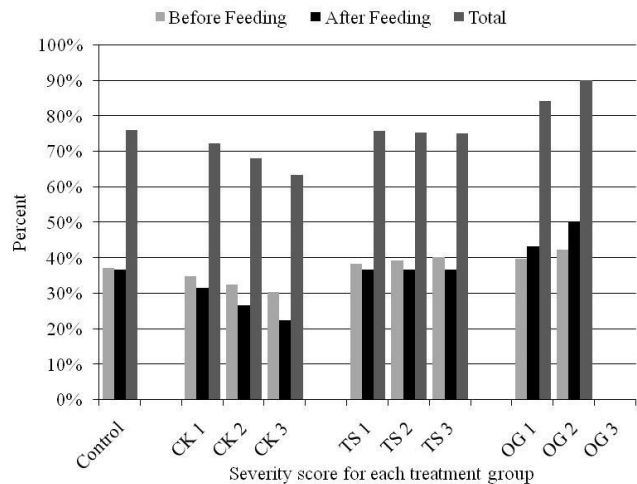
Figure 2. Time budget of sows standing and eating for 45 min prior to and 1 h post feeding by treatment and lesion severity on lactating sow behavior.



Before feed delivery, there was no evidence ($P > 0.15$) that sows from the different treatment severity levels were associated with varying times spent standing and eating when compared to control sows. Post feeding, each increase in overgrown lesion score was associated with a 40.0 % decrease in time spent standing and eating. These results were consistent for total time spent standing and eating during the observation period [Odds Ratio (OR) = 0.45]. A positive odds ratio (1.19, $P = 0.06$) was observed for total time spent standing and eating for sows in the CK group. A negative association was observed between total time spent standing during the 105 min observation and increasing overgrown lesion score. Each increase in lesion score was associated with a 54 % decrease ($P = 0.01$) in time spent standing when compared to control sows. However, an odds ratio of 1.2 ($P = 0.02$) was observed for each lesion score increase on total time spent standing for CK sows.

Sows categorized in the CK group spent less ($P = 0.01$) time for the total observation period lying down compared to their control counterparts (Figure 3). As the severity of overgrown lesion increases, total time spent lying down increases (OR = 1.69, $P = 0.02$). In contrast, CK lesion scores were negatively associated with time spent lying down before ($P = 0.06$) and after ($P < 0.01$) feeding..

Figure 3. Time budget of sows lying down for 45 min prior to and 1 h post feeding by treatment and lesion severity on lactating sow behavior.



In conclusion, sows classified in the OG treatment spent less time standing and eating as lesion severity increased when compared to control sows.