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Moderate lameness leads to marked behavioral changes in dairy cows

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ABSTRACT

Lameness is one of the most prevalent diseases affecting the welfare of cows in modern dairy production. Lameness leads to behavioral changes in severely lame cows, which have been investigated in much detail. For early detection of lameness, knowledge of the effects of moderate lameness on cow behavior is crucial. Therefore, the behavior of nonlame and moderately lame cows was compared on 17 Swiss dairy farms. On each farm, 5 to 11 nonlame (locomotion score 1 of 5) and 2 to 7 moderately lame (locomotion score 3 of 5) cows were selected for data collection in two 48-h periods (A, B) separated by an interval of 6 to 10 wk. Based on visual locomotion scoring, 142 nonlame and 66 moderately lame cows were examined in period A and 128 nonlame and 53 moderately lame cows in period B. Between these 2 periods, the cows underwent corrective hoof trimming. Lying behavior, locomotor activity, and neck activity were recorded by accelerometers (MSR145 data logger, MSR Electronics GmbH, Seuzach, Switzerland), and feeding and rumination behaviors by noseband sensors (RumiWatch halter, ITIN + HOCH GmbH, Liestal, Switzerland). Furthermore, visits to the brush and the concentrate feeder, and the milking order position were recorded. In comparison with nonlame cows, moderately lame cows had a longer lying duration, a longer average lying bout duration, and a greater lateral asymmetry in lying duration. Average locomotor activity, locomotor activity during 1 h after feed delivery or push-ups, and average neck activity were lower in moderately lame cows. Eating time and the number of eating chews (jaw movements) were reduced in moderately lame compared with nonlame cows, whereas no effect of moderate lameness was evident for ruminating time, number of ruminating chews and boluses, and average number of ruminating chews per bolus. Moderately lame cows visited the concentrate feeder and the brush less frequently, and they were further back in the milking order compared with nonlame cows. In conclusion, nonlame and moderately lame cows differed in a biologically relevant way in many of the behavioral variables investigated in this study. Therefore, the use of these behavioral changes seems to be promising to develop a tool for early lameness detection.
Key words: dairy cow, lameness, early detection, behavior, automatic recording

INTRODUCTION

Lameness is widespread in dairy cows kept in loose housing systems and represents one of the 3 major causes for early culling (Juarez et al., 2003). Over 90% of all lameness cases are caused by claw disorders (Phillips, 2002), which result from multifactorial risk factors. Potential risks can arise from the husbandry system (e.g., type of cubicles, flooring), management (e.g., permanent indoor housing), and individual genetics (Barker et al., 2010), but also barn hygiene (i.e., bacterial infections), inadequate feeding, and insufficient or poor hoof care (Becker et al., 2014b). A high prevalence of lameness on the dairy cow level was found on farms in England and Wales (36.8%; Barker et al., 2010) and in the northeastern United States (54.8%; von Keyserlingk et al., 2012). In Switzerland, Becker et al. (2014a) reported a lameness prevalence of 14.8% on the cow level and 80.8% on the farm level (i.e., at least one lame cow per farm).

Lameness has a negative effect on the economic viability of farms because it results in reduced productivity (Green et al., 2002) and reproductive performance (Sogstad et al., 2006). Moreover, lameness has severe negative consequences for animal welfare (Whay et al., 2003). Therefore, early detection of lameness is of utmost importance. It allows early intervention and contributes to the prevention of more severe claw disorders, which cause almost 3 times higher costs than mild claw disorders (Charfeddine and Pérez-Cabal, 2017).

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To be applicable on farms, a reliable method for the detection of lameness is essential. The most direct method is visual gait analysis (locomotion scoring; Sprecher et al., 1997). Changes in limb movements occur due to the pain that is associated with claw disorders (Dyer et al., 2007). In multiple studies, however, it has become evident that the reliable detection of lameness by farmers is difficult. In this respect, various attempts have been made to use technical equipment for gait analysis and develop detection systems that automatically warn farmers about lameness incidences. Currently, 2 types of systems are in use on farms (Rutten et al., 2013; Nechanitzky et al., 2016; Jabbar et al., 2017): permanently installed in the housing environment (e.g., weighing platforms, video analysis, 3-dimensional cameras) or cow-attached systems (e.g., pedometer). However, according to Rutten et al. (2013), the current systems are mainly able to detect severe lameness, which can also easily be identified visually.

Besides changes in gait, lameness leads to other changes in cow behavior. In lame dairy cows, recent studies found, for example, reduced locomotor activity (Thorup et al., 2015), longer lying duration (Solano et al., 2016), and reduced usage of an automated grooming brush (Mandel et al., 2018) as compared with nonlame cows. However, most studies grouped cows of different lameness scores, whereas less is known about lameness-induced behavioral changes in moderately lame cows specifically.

The aim of this study was to identify behavioral variables that have the potential to be used as indicators for automatic early lameness detection. Therefore, the behavior of nonlame and moderately lame cows was compared on 17 Swiss dairy farms during 2 data collection periods of 48-h each, separated by an interval of 6 to 10 wk. Lying behavior, locomotor and neck activity, feeding and rumination behaviors, brush and concentrate feeder visits, and the milking order were examined in the same cows in both periods. It was hypothesized that the behavior of moderately lame cows would be affected in a similar direction as has been described for severely lame cows but to a smaller extent. In addition, we analyzed the lateral asymmetry in lying behavior and locomotor activity of cows during 1 h after feed delivery or push-ups, behavioral patterns that, to the best of our knowledge, have rarely been investigated as indicators of lameness.

MATERIALS AND METHODS

Farms and Cows

Ethical approval for the study was obtained from the Veterinary Office of the Canton Zurich (Switzerland; ZH061/15, approval no. 26475). Data were collected between October 2015 and March 2016. The study was conducted on 17 dairy farms in Switzerland. Farmers were informed about the study by personal inquiry or public advertisement (online homepages of breeding associations and a print magazine). Farms were qualified for participation in the study if their loose housing systems provided an indoor area with cubicles (15 farms had cubicles with deep bedding, 2 farms with rubber mats and thin bedding; $\geq$1 cubicle per cow) and a permanently accessible outdoor area. Cows were milked in a milking parlor twice daily. Roughage was provided ad libitum at a feed fence (with head lock; $\geq$1 feeding place per cow), and concentrate was offered in automatic feeders (except on one farm, where no concentrate feeder was available). At least one automatically rotating brush was available for the cows. Farm management remained unchanged for the study; however, no access to pasture was granted to the cows from at least 3 d before and during data collection.

Herd size ranged from 31 to 91 (mean $\pm$ SD: 55.9 $\pm$ 17.4) lactating cows. Based on visual locomotion scoring, the prevalence of lameness in the herds ranged from 9.4 to 72.3% (mean $\pm$ SD: 29.8 $\pm$ 15.7%). In each herd, samples of 5 to 11 nonlame and 2 to 7 moderately lame lactating cows were selected as focal cows. Cows were included in the study if they had no apparent disease or veterinary treatment during the 4 wk before data collection and a lactation stage of more than 14 DIM at the beginning of data collection. Furthermore, the most recent corrective hoof trimming had to have taken place at least 2 wk before data collection. Focal cows were aged from 2 to 15 yr (mean $\pm$ SD: 5.9 $\pm$ 2.7), were between their first and twelfth lactation (mean $\pm$ SD: 3.7 $\pm$ 2.3), ranged from 14 to 694 DIM (mean $\pm$ SD: 174 $\pm$ 110.8), and belonged to the breeds Brown-Swiss (n = 79), Fleckvieh (n = 22), Holstein-Friesian (n = 75), and Red Holstein (n = 57). The majority of the focal cows were between their third and sixth lactation (64% nonlame, 61% moderately lame) and between 55 and 265 DIM (62% nonlame, 60% moderately lame).

Experimental Design and Visual Locomotion Scoring

On each farm, data were collected during 2 identical 48-h periods (A, B) separated by an interval of 6 to 10 wk. Between the 2 periods, but at least 2 wk before period B, corrective hoof trimming was performed either by the farmer or by a professional hoof trimmer. Including the pre- and postrecording times, each period lasted 4 d. On d 1 of period A, a preliminary visual locomotion scoring was conducted on the entire dairy herd to select the focal cows. The selected cows were fixed in the head lock of the feed fence to attach the measuring devices