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Herd-level risk factors for lameness in freestall farms in the northeastern United States and California

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ABSTRACT

The objective was to investigate the association between herd-level management and facility design factors and the prevalence of lameness in high-producing dairy cows in freestall herds in the northeastern United States (NE; Vermont, New York, Pennsylvania) and California (CA). Housing and management measures such as pen space, stall design, bedding type, and milking routine were collected for the high-producing pen in 40 farms in NE and 39 farms in CA. All cows in the pen were gait scored using a 1-to-5 scale and classified as clinically lame (score $\geq$3) or severely lame (score $\geq$4). Measures associated with the (logit-transformed) proportion of clinically or severely lame cows at the univariable level were submitted to multivariable general linear models. In NE, lameness increased on farms that used sawdust bedding [odds ratio (OR) = 1.71; 95% confidence interval (CI) = 1.06–2.76] and decreased with herd size (OR = 0.94; CI = 0.90–0.97, for a 100-cow increase), use of deep bedding (OR = 0.48; CI = 0.29–0.79), and access to pasture (OR = 0.52; CI = 0.32–0.85). The multivariable model included herd size, access to pasture, and provision of deep bedding, and explained 50% of the variation in clinical lameness. Severe lameness increased with the percentage of stalls with fecal contamination (OR = 1.15; CI = 1.06–1.25, for a 10% increase) and with use of sawdust bedding (OR = 2.13; CI = 1.31–3.47), and decreased with use of deep bedding (OR = 0.31; CI = 0.19–0.50), sand bedding (OR = 0.32; CI = 0.19–0.53), herd size (OR = 0.93; CI = −0.89–0.97, for a 100-cow increase), and rearing replacement heifers on site (OR = 0.57; CI = 0.32–0.99). The multivariable model included deep bedding and herd size, and explained 59% of the variation of severe lameness. In CA, clinical lameness increased with the percentage of stalls containing fecal contamination (OR = 1.15; CI = 1.05–1.26, for a 10% increase), and decreased with herd size (OR = 0.96; CI = 0.94–0.99, for a 100-cow increase), presence of rubber in the alley to the milking parlor (OR = 0.46; CI = 0.28–0.76), distance of the neck rail from the rear curb (OR = 0.97; CI = 0.95–0.99, for a 1-cm increase), water space per cow (OR = 0.92; CI = 0.85–0.99, for a 1-cm increase), and increased frequency of footbaths per week (OR = 0.90; CI = 081–0.99, for a 1-unit increase). The multivariable model included herd size, percentage of stalls containing fecal contamination, and presence of rubber in the alley to the milking parlor, and explained 44% of the variation of clinical lameness. Severe lameness increased with the percentage of stalls containing fecal contamination (OR = 1.23; CI = 1.06–1.42, for a 10% increase) and decreased with frequency of manure removal in the pen per day (OR = 0.72; CI = 0.53–0.97, for a 1-unit increase). The final model included both variables and explained 28% of the variation in severe lameness. In conclusion, changes in housing and management may help decrease the prevalence of lameness on dairy farms, but key risk factors vary across regions.

Key words: deep bedding, gait, management, stall design

INTRODUCTION

Lameness is one of the most important welfare and production problems in modern dairy herds. The current trend in the dairy industry is to house cows in freestalls, but research suggests that freestall housing increases the risk for lameness relative to other housing systems, including tie stalls and straw yards (Cook, 2003; Sogstad et al., 2005). On-farm surveys in North America have reported an average prevalence of clinical lameness of 20 to 55% for freestall-housed herds, with much variability across farms (Espejo et al., 2006; Ito et al., 2010). This variation in prevalence may be due, in part, to differences in how these farms are designed and managed.

Few studies have investigated the complex interaction between lameness and herd-level risk factors for modern freestall herds. Factors associated with lameness in previous studies include stall features (Espejo and

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Endres, 2007; Dippel et al., 2009), lying surface (Cook, 2003; Espejo et al., 2006; Ito et al., 2010), time spent away from the pen for milking (Espejo and Endres, 2007), the use of automatic alley scrapers (Barker et al., 2007), and hoof trimming practices (Amory et al., 2006; Espejo and Endres, 2007). Some of these differences across studies can be explained by geographical differences in facility design and management, resulting from different availability of resources for facility construction and popular opinions of best practices in the area.

We recently completed a large, cross-farm study examining herd differences in the prevalence of lameness in 2 regions of the United States with different environmental conditions and different traditions of barn design and management: the northeastern United States (Vermont, New York, and Pennsylvania; **NE**) and California (**CA**). As reported in our companion paper (von Keyserlingk et al., 2012), the prevalence of clinical lameness averaged 55% in NE and 31% in CA, but with a large variability within region. When only severely lame cows were considered, the estimated prevalence was 8 and 4% for NE and CA, respectively. The objective of the current paper was to investigate the association between herd-level management and facility design factors and the prevalence of lameness in high-producing dairy cows in freestall herds in these 2 regions.

MATERIALS AND METHODS

Farm Selection and Visits

As described by von Keyserlingk et al. (2012), 40 farms in NE (New York n = 28, Pennsylvania n = 8, and Vermont n = 4) and 39 farms in CA were selected within the C.O.W.S. program, a partnership between The University of British Columbia and Novus International Inc. (http://www.novusint.com/en/Market-Segments/Dairy/COWS) for this cross-sectional study. Consulting nutritionists (n = 8 in CA; n = 24 in NE) were asked to randomly select farms from among their lists of clients, considering 2 inclusion criteria: freestall housing and provision of a TMR. All methods used to collect data were approved by the University of British Columbia's Animal Care Committee, which follows the standards outlined by the CCAC (2009).

Farms were visited from March to May 2010 in CA and from July to October 2010 in NE. Each farm was visited twice, with approximately 3 to 5 d between visits. The same 2 trained observers performed all animal and facility-based measures (Table 1) on all farms in each of the 2 regions. One group of high-producing and primarily multiparous cows was assessed on each farm; this high-producing group was identified by the producer.

Lameness Assessment

All cows housed in the assessment group were gait scored as they exited the parlor using a 5-point Numerical Rating System (NRS), where 1 = sound and 5 = severely lame (Flower and Weary, 2006; Chapinal et al., 2009). Cows with NRS $\geq$3 were considered clinically lame, and cows with NRS $\geq$4 were considered severely lame. The proportion of clinically and severely lame cows was calculated for each farm.

Management and Facility Design Measures

Management and facility design measures for the herd and the assessment pen were collected using direct observation of environment and management, an interview with the herd manager during the farm visits, bedding samples, and compilation of herd records. Because of differences in management and facility design, some of the variables considered differed between regions (Table 1).

General Management. General herd and management factors included herd size (obtained from farm records), barn age (estimated by the herd manager), rearing of replacement heifers on site, and access to pasture during the dry period (NE) or to the exercise corral (CA).

Pen Space and Flooring. Variables such as pen space/cow, flooring, and method of manure removal were assessed in the high-producing assessment pen. The overall pen area available (m^2), calculated as the total length × width of the pen (i.e., including stalls, alleys, and crossovers), was divided by the number of cows housed in the assessed pen to determine the space per cow. Most of the farms had concrete floors (except for 3 in NE with rubber). Therefore, the only floor variable considered was whether there was rubber in at least part of the pen. The alley was considered dirty if manure evenly covered the floor at a depth of at least 2 cm. In NE, manure was removed either continuously (or at high frequency) using an automatic scraper or just a few times per day using other methods, such as flushing or a skid steer. Therefore, a dichotomous variable was created for the presence of automatic scraper versus other methods with a lower frequency of manure removal. In CA, manure removal was accomplished several times per day by flushing, skid steer, or a combination of both. Given the available variation, the frequency of manure removal per day was considered in the analysis.