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Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns

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ABSTRACT

Lameness is a severe welfare problem and a production-limiting disease in dairy farming. The objectives of this study were to determine prevalence of lameness and investigate cow- and herd-level factors associated with lameness in dairy cows housed in freestall barns in 3 Canadian provinces. A purposive sample of 40 Holstein-Friesian cows was selected from each of 141 dairy farms in Québec, Ontario, and Alberta. In total, 5,637 cows were scored once for lameness (presence of limping when walking). Data collected included information on individual cows (hock lesions, claw length, body condition score, parity, days in milk, and milk production), management practices (floor and stall cleaning routine, bedding routine, and footbath practices), and facility design (stall dimensions, stall base and bedding type, width of feed alley, flooring type, and slipperiness) hypothesized to be risk factors for lameness. Multilevel mixed logistic regression models were constructed (including farm as a random effect and province as a fixed effect). Herd-level lameness prevalence ranged from 0 to 69% (mean = 21%). Lameness prevalence increased with increasing parity; compared with first parity, cows in parity 2, 3, and ≥4 had 1.6, 3.3, and 4 times, respectively, higher odds of being lame. Furthermore, the odds of lameness were 1.6 times greater in cows with low body condition score (≤2.5) than in cows with a higher body condition score. In addition, injured hocks and overgrown claws were associated with 1.4- and 1.7-fold increased odds of being lame, respectively, whereas every 1 kg increase in daily milk production was associated with a 3% decrease in the odds of being lame. Lameness prevalence was higher in herds with ≤100 cows, but lower in barns with a sand or dirt stall base, or with bedding ≥2 cm deep. Cows exposed to very slippery floors had 2 times the odds of being lame compared with cows exposed to nonslippery floors. We attributed the wide range of lameness prevalence to the great variability in facilities and management practices among farms. Finally, we inferred that the prevalence of lameness could be decreased by improving management of multiparous, thin, or injured cows and by adopting management practices intended to improve cow comfort, namely the floor's slip resistance and the stall's lying surface.

Key words: animal welfare, locomotion, dairy cattle, management, cow comfort

INTRODUCTION

Lameness is one of the most important welfare, health, and productivity problems in intensive dairy farming worldwide. Furthermore, it causes pain (Whay et al., 1998; Rushen et al., 2007), reduces longevity (Booth et al., 2004; Canadian Dairy Information Centre, 2014), milk production (Warnick et al., 2001; Green et al., 2002), and reproductive performance (Hernandez et al., 2001; Garbarino et al., 2004), and consequently has a great economic effect (Ettema and Ostergaard, 2006). The prevalence of lameness varies considerably among farms, regions, and housing systems, although it is generally higher in freestall barns compared with tiestalls (Cook, 2003; Sogstad et al., 2005b), bedded packs (Haskell et al., 2006), and pasture systems (Hernandez-Mendo et al., 2007). In the United States, freestall dairies in Wisconsin and Minnesota had a mean lameness prevalence of 25% (Cook, 2003; Espejo et al., 2006), whereas in California and the northeastern United States, overall lameness prevalence was estimated to be 34 and 63%, respectively (von Keyserlingk et al., 2012). British and German studies reported a lameness

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prevalence of 37 and 48% (Whay et al., 2003; Barker et al., 2010), whereas a prevalence of 16% was reported in the Netherlands (Amory et al., 2006).

Estimates of the prevalence of lameness using locomotion scores in Canada (irrespective of housing system) are scarce. In Ontario, one study assessed lameness prevalence linked to stall design, but estimated lameness based on the presence of back arch (3.2%) and claw rotation (23%) and only in tie-stall barns (Zurbrigg et al., 2005). Another study assessed a wider range of herd-level factors in both tie-stalls and freestalls, but estimated lameness based on the presence of foot lesions (Cramer et al., 2009). The only study that focused on the prevalence of lameness based on locomotion scores in freestalls was conducted in British Columbia (von Keyserlingk et al., 2012). In that study, 35% of the cows were lame, including 7% that were severely lame. However, no risk factor analysis was performed. Lameness scoring systems differed considerably among these studies; therefore, the variation in lameness prevalence estimates among European and North American studies could partly be due to methodology and diagnostic criteria.

Several studies reported associations between lameness and factors such as flooring type and slipperiness (Somers et al., 2003; Telezhenko and Bergsten, 2005); the amount, cleanliness, and type of stall bedding (Cook, 2003; Cook et al., 2004a; Ito et al., 2010; Chapinal et al., 2013); stall dimensions (Sogstad et al., 2005a; Espejo and Endres, 2007; Dippel et al., 2009), access to pasture, and footbath frequency (Chapinal et al., 2013). Therefore, differences in lameness estimates among studies could also be attributed to management and housing differences across farms that lead to the presence or absence of risk factors for lameness.

High lameness prevalence estimates and their variation highlight the need for a better understanding of the multifactorial origins of lameness, and the combination of risk factors related to the environment, management, and the individual cow (Vermunt, 2007). Despite increased awareness of lameness as a problem in Canada, apparently no epidemiological study has been done to identify prevalence (and associated risk factor analysis) in freestall barns. Therefore, the objectives were to determine (1) prevalence of lameness, (2) herd-level management and facility design factors related to lameness prevalence, and (3) the association between herd and cow-level factors, as related to the prevalence of lameness.

MATERIALS AND METHODS

The present study was part of a larger research study examining dairy cow comfort and longevity. Methodology for farm and cow selection, and assessment of animal-based measures, management practices, and facility design have been described (Zaffino Heyerhoff et al., 2014; Vasseur et al., 2015). Several standard operating procedures were developed and validated as described on the Canadian Dairy Research Portal (https://www.dairyresearch.ca/animal-comfort-tool.php). Based on hypothesized biological cause-and-effect relationships and previous research, a causal diagram was drawn to identify variables to measure on farms and to consider in analyses (Figure 1).

Farms

A total of 141 freestall dairy farms were enrolled as part of a larger study. Farms were located in 3 Canadian provinces: Alberta [(**AB**) n = 81], Ontario [(**ON**) n = 40], and Québec [(**QC**) n = 20]. Data were collected between May 2011 and July 2012 by trained graduate students and research assistants from the University of Calgary (Calgary, AB, Canada), University of Guelph (Guelph, ON, Canada), and Université Laval (Québec City, QC, Canada). Because of practical reasons and availability of students, farms were visited from May 2011 to July 2012 in AB, May to November 2011 in ON, and January to April 2012 in QC. All methods were approved by the Animal Care Committees and Research Ethics Boards of each participating academic institution.

Eligible farms received a recruitment request by mail. Those who were interested replied by mail or fax and had to return a letter indicating willingness to participate in AB and ON, or they were called by a DHI (Valacta Inc., Sainte-Anne-de-Bellevue, QC, Canada) advisor in QC. They were then contacted by telephone, after which it was determined whether they met the study criteria. To ensure that participating farms were representative of the majority of freestall herds in Canada, farms had to be enrolled in an organized milk recording system provided by CanWest DHI (Guelph, ON, Canada) or Valacta Inc. and have a herd size $\geq$40 Holstein-Friesian lactating cows. In ON and QC, farms were also selected on the basis of longevity and having mean milk production $\geq$7,000 kg/cow per yr (Vasseur et al., 2015). Farms were excluded if lactating cows were subjected to uncommon management practices (e.g., access to an outdoor exercise area or pasture for >2 h/d). To ensure that animal-based measures reflected housing conditions, the current freestall facility for lactating cows had to be in use for at least 1 yr. In Alberta, farm recruitment was also based on participation in the Alberta Dairy Hoof Health Project (Alberta Milk, 2013), a collaborative study that collected data on foot lesions based on the records of professional hoof