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Prevalence of and risk factors for hock and knee injuries on dairy cows in tiestall housing in Canada

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ABSTRACT

Leg injuries on dairy cows are a common and highly visible welfare concern on commercial dairy farms. With greater attention being placed on food animal welfare and limited research being conducted on tiestall farms, this study aimed to identify prevalence and risk factors for hock and knee injuries on dairy cows housed in tiestall barns in Ontario (n = 40) and Quebec (n = 60). A sample of 40 cows was purposively selected per farm and several animal- and farm-based measures were taken. Both hocks and both knees on each cow were scored as injured (presence of lesions or swelling) or not injured (no alterations or hair loss), and the highest score of each of the 2 knees and the 2 hocks was considered the cow's hock or knee score. Possible animal- and farm-based risk factors were incorporated into 2 separate multivariable logistic models for hock injuries and knee injuries respectively at the cow level. Mean (±SD) percentage of cow with hock injuries per farm was found to be 56 ± 18% and mean percentage of knee injuries per farm was found to be 43 ± 23%. Animal-based factors found to be associated with a greater odds of hock injuries at the cow level were increased days in milk (DIM), lower body condition score (BCS), lameness, higher parity, higher cow width, median lying bout duration, and median number of lying bouts. Environmental factors found to be associated with hock injuries at the cow level were province, stall width, tie rail position, stall base, chain length, and age of stall base. Animal-based factors found to be associated with knee injuries at the cow level were DIM, BCS, and median lying time. Environmental factors found to be associated with knee injuries at the cow level were stall width, chain length, province, stall base, and bed length. Quadratic and interaction terms were also identified between these variables in both the hock and knee models. This study demonstrates that hock and knee injuries are still a common problem on tiestall dairy farms in Canada. Several animal- and housing-based factors contribute to their presence. Further research to confirm causal relationships between these factors would help identify the cause of knee and hock injuries and determine how to best reduce the incidence of injuries in cows on commercial tiestall dairy farms in Canada.

Key words: dairy cow, Canada, hock injury, knee injury, tiestall

INTRODUCTION

Leg injuries on dairy cows are a common problem in commercial dairy herds. Injuries are most commonly seen on the tarsus (hock) and carpus (knee) joints of the cow (Laven and Livesey, 2011). These types of injuries are widely accepted as a welfare concern for dairy cattle (Whay et al., 2003) and efforts to reduce them have been addressed in the Code of Practice for the Care and Handling of Dairy Cattle in Canada (National Farm Animal Care Council, 2009) and internationally with programs such as the Farmers Assuring Responsible Management (**FARM**) program in the United States (National Milk Producers Federation, 2015).

The average herd-level prevalence of hock and knee injuries for cows in free-stall herds has been estimated to range from 23 to 73% in Canada and internationally (Veissier et al., 2004; Lombard et al., 2010; von Keyserlingk et al., 2012; Zaffino Heyerhoff et al., 2014). Some of this variation can be explained by differences in scoring systems and region. However, limited research has been conducted on tiestall systems, even though this housing system makes up 72.4% of the farms in the Canadian dairy industry, housing an estimated 36% of the dairy cows in Canada (Canadian Dairy Information Center, 2014).

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Hock and knee injuries have been found to be associated with several housing-, management-, and animal-based factors within Canada and internationally. The most commonly identified animal-based factors associated with leg injuries include early lactation (Busato et al., 2000; Kielland et al., 2009), high or low BCS (Busato et al., 2000; Lim et al., 2015), lameness (Brenninkmeyer et al., 2013; Burow et al., 2013), older age (Kielland et al., 2009; Potterton et al., 2011), and lower lying time (Rushen et al., 2007). The most commonly identified farm-based risk factors for injuries include hard stall surfaces (Livesey et al., 2002; Barrientos et al., 2013; Burow et al., 2013; de Vries et al., 2015), lack of bedding (Barrientos et al., 2013), long and short stalls (Regula et al., 2004; Kielland et al., 2009; Potterton et al., 2011), and no outdoor access (Keil et al., 2006; Barrientos et al., 2013; de Vries et al., 2015).

The objectives of this study were to provide an estimate of the prevalence of hock and knee injuries and identify risk factors for them among Holstein dairy cows housed on tiestall farms in Ontario and Quebec, Canada.

MATERIALS AND METHODS

All methods were approved by the respective University of Guelph and Laval University Animal Care Committee and Research Ethics Board (Guelph REB # 10DC021, AUP # 10R110; Laval CPAUL # 2010127). All standard operating procedures for this study can be found online on the Canadian Dairy Research Portal (2015).

Study Design

Data for this study were collected as part of a national cross-sectional study undertaken in 2011 (Vasseur et al., 2015). Tiestall farms (n = 100) were visited from January to December 2011 in the provinces of Ontario (n = 40) and Quebec (n = 60). Together these 2 provinces account for 95.3% of Canada's tiestall dairy farms (Canadian Dairy Information Center, 2014). One hundred farms was the maximum number of farms that could be assessed within the budgetary and time limitations of the project.

Herd Selection

Eligible tiestall herds for this study were selected from those enrolled in a milk recording program through Canwest DHI in Ontario, and Valacta in Quebec (Vasseur et al., 2015). Participation in this study was voluntary, with no financial compensation provided to the herd owners. The number of eligible tiestall herds sent invitation letters was based on an expected response rate of 10% and totaled 1,319 letters. Producers who responded to their invitation letter with interest were interviewed by telephone to further determine whether they met all inclusion criteria, and if so, to schedule farm visits. The criteria were the milking herd did not have outdoor access within 2 mo of the time of the visit and mean milk production was ≥7,000 kg/cow per year. A minimum herd size of 40 milking Holstein cows was required, and the facilities housing the milking herd had to have been in use for at least 1 yr.

Cow Selection

Based on previous work determining sample sizes for accurately estimating lying time at the herd level (Ito et al., 2009; Vasseur et al., 2012), 40 focal cows per herd were purposively selected for observation. Cow selection was balanced for parity, whenever possible, to reflect the proportion of primiparous and multiparous cows within the milking herd. Cows were purposively selected based on DIM, selecting cows 10 to 120 DIM whenever possible. This selection was done owing to the evidence that early lactation cows are at increased odds of having leg injuries (Kielland et al., 2009). Cows under 10 DIM were not selected because of a lack of opportunity for habituation to their environments postcalving. If a herd had fewer than 40 cows between 10 and 120 DIM, the selection window was extended beyond 120 DIM until the target sample size of 40 was reached. Based on the average size of tiestall herds in Ontario and Quebec (Canadian Dairy Information Center, 2014), a sample size of 40 cows per herd allowed us to sample an average of 70.5% of the adult dairy cows in each herd.

Animal-Based Measures

Injuries. Hock and knee injuries were the 2 outcome variables of interest. Cows were scored for hock and knee injuries according to the criteria in Table 1 (adapted from Gibbons et al., 2012) while in their stalls. Both hocks and both knees on each animal were scored. Due to poor lighting in some barns, a headlamp was used to facilitate cow assessment.

BCS. Body condition score was recorded on a 5-point scale in 0.25 increments (Ferguson et al., 1994), using the procedure described in Vasseur et al. (2013).

Lameness. Lameness was assessed using in-stall lameness scores developed by Leach et al. (2009) and validated by Gibbons et al. (2014). Cows were individually video recorded using a Sony DCRSR88 camera (Sony, Tokyo, Japan) in their stalls from behind for 2.5 min. The 4 following behaviors were scored: resting a