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Lying times of lactating cows on dairy farms with automatic milking systems and the relation to lameness, leg lesions, and body condition score

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ABSTRACT

Lying down and resting are important for optimal cow health, welfare, and production. In comparison with free stall farms with a milking parlor, farms with automated milking systems (AMS) may place less constraint on how long cows can lie down. However, few studies report lying times on AMS farms. The aims of this study were to describe the variation in lying times of dairy cows in AMS farms and to understand how much of the variation in individual lying times is related to cow-level factors, including lameness, the presence of hock and knee lesions, and body condition score (BCS). We visited 36 farms in Canada (Quebec: n = 10; Ontario: n = 10; British Columbia: n = 4; and Alberta: n = 5), and the United States (Michigan: n = 7). Gait scores, presence of hock and knee lesions, and BCS were recorded for 40 Holstein cows from each herd. Parity and days in milk were retrieved from farm records. Lying time was recorded across 4 d using accelerometers (n = 1,377). Multivariable analysis was performed. Of scored cows, 15.1% were lame (i.e., obviously limping; 203 of 1,348 cows). Knee lesions were found in 27.1% (340 of 1,256 cows) and hock lesions were found in 30.8% (421 of 1,366 cows) of the animals. Daily lying time varied among cows. Cows spent a median duration of 11.4 h/d lying down (25th–75th percentile = 9.7–12.9 h), with a lying bout frequency of 9.5 bouts/d (25th–75th percentile = 7.5–12 bouts/d) and a median bout duration of 71 min (25th–75th percentile = 58–87 min/bout). Lameness was associated with cows lying down for 0.6 h/d longer in fewer, longer bouts. Increased lying time was also associated with increased parity, later stage of lactation and higher BCS. Older cows (parity ≥3) spent about 0.5 h/d more lying down compared with parity 1 cows, and cows with BCS ≥3.5 lay down on average 1 h/d longer than cows with BCS ≤2.25. Hock lesions were associated with shorter lying times in univariable models, but no associations were found in the multivariable models. We concluded that only a small proportion of the variation between cows in lying time is explained by lameness, leg lesions, and BCS.

Key words: automated milking system, hock lesions, injury, knee lesion

INTRODUCTION

Lying down and resting are important for optimal cow health, welfare, and production (Munksgaard and Simonsen, 1996; Munksgaard et al., 2005), and longer lying times are hypothesized to reflect better welfare (Jensen et al., 2005). However, if cattle lie down for a long time, this may also reflect problems changing position, or lameness (Jensen et al., 2005). Cows seem to be highly motivated to lie down for 12 to 13 h/d in indoor housing (Jensen et al., 2005; Munksgaard et al., 2005), and when access to feed or lying areas is restricted, lying time has been shown to have a higher priority than eating time and social contact (Munksgaard et al., 2005). A minimum lying time of 12 h/d is therefore recommended under the Canadian Code of Practice for Dairy Cattle (DFC-NFACC, 2009). In free-stall herds with a milking parlor, the cows' time budget may be disrupted and lying time decreased as cows are brought as a group to a holding pen where they must stand waiting before milking (Charlton et al., 2014). In AMS farms, cows may have more freedom to control their own time budget, possibly resulting in more undisrupted rest. On the other hand, cows in AMS herds have fewer synchronized behaviors (Wagner-Storch and Palmer, 2003), which may create disruptions when individual cows are moving to and from the resting area

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at all times throughout the day. For cows to access the AMS, a considerable amount of time can also be spent queuing in the waiting area, limiting the time available for rest, especially for low-ranked cows (Melin et al., 2006; Halachmi, 2009) and cows with a high milking frequency (Helmreich et al., 2014).

Studies on commercial non-AMS farms show a large variation between cows and between farms in how long cows lay down (Ito et al., 2009; Charlton et al., 2015), and to use measures of lying time to assess animal welfare, it is important to understand the causes of this variation. Some of the variation may result from lameness or leg injuries. In non-AMS free-stall farms, lameness is associated with a longer time that cows spend lying down (e.g., Chapinal et al., 2009; Ito et al., 2010), whereas in tie-stall farms, an association is also present between shorter lying time and the presence of leg lesions (Charlton et al., 2015). However, little is known of the relationship between lying time and lameness or leg lesions in AMS farms. One key to successful robotic milking is voluntary attendance. Lameness reduces visits to the milking unit (Borderas et al., 2008; Miguel-Pacheco et al., 2014), and lame cows are manually brought to the milking unit more often, which increases labor requirements (Bach et al., 2007). Thus, it is important to understand the factors that affect lying time and the relationship between lying time, lameness, and leg lesions on AMS farms. In addition, lameness has been found to be associated with low BCS (Green et al., 2014; Randall et al., 2015), but a possible association between BCS and lying time has to our knowledge not yet been reported.

Our objectives were to describe the variation in lying times of dairy cows in AMS farms and to understand how much of the variation in individual lying times is related to cow-level factors, including lameness, the presence of hock and knee lesions, and BCS.

MATERIALS AND METHODS

The study was approved by the Institutional Animal Care Committees and Research Ethics Boards at Laval University, the University of Guelph, the University of Calgary, and Michigan State University.

Herd Selection

Between April 2011 and November 2012, we visited 36 farms with an automated milking system (**AMS**) in Canada (Quebec: n = 10; Ontario: n = 10; British Columbia: n = 4; and Alberta: n = 5), and the United States (Michigan: n = 7). Farms had to have at least 40 Holstein milking cows and to have operated the AMS for at least 6 mo. Farms were invited by mail to participate in the study, with the number of farms based on an expected positive response rate of 20%. When letters were returned indicating the willingness to participate, the producers were interviewed by telephone to determine if they met the additional study inclusion criteria, which included having cows stall-housed in their present barn for at least 1 yr, and no access to outdoor exercise area or pasture for milking cows. The mean (±SD) number of milking cows in the participating farms was 155 ± 105 (range 42–495 cows) and the mean annual milk production was 9,346 ± 772 kg [retrieved from Valacta (Sainte-Anne-de-Bellevue, Quebec, Canada) and CanWest DHI Herd Recording data (Guelph, Ontario, Canada), which were available for 17 farms]. The characteristics of the AMS farms are shown in Table 1.

Cow Selection

Based on previous work on representative sample sizes for lying time (Vasseur et al., 2012), we selected

Table 1. Description of the automated milking system (AMS) characteristics on participating farms (n = 36)

Item	Level	Number of farms	%
Type of system	Free traffic	28	78
	Forced traffic	8	22
Number of AMS units	1	18	50
	2	11	31
	3	3	8
	4	2	6
	8	2	6
Number of cows per unit	≤40	5	14
	41–50	8	22
	51–60	12	33
	≥61	11	31
Brand of AMS	DeLaval (Tumba, Sweden)	15	42
	Lely (Maassluis, the Netherlands)	20	56
	Other	1	3