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Effect of lameness and lesion specific causes of lameness on time budgets of dairy cows at pasture and when housed

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ABSTRACT

The aim of the study was to investigate the effect of lameness and specific causes of lameness on standing time, number of lying bouts and test day yield (TDY) in cows at pasture and cows which were housed. Data were collected from 200 cows from 10 farms where cows were at pasture and 200 cows from 10 farms where they were housed. Each farm was visited twice over 3 days between May and August (autumn and winter) of 2009. At the first visit, 10 lame cows, all with locomotion score (LS) 3, and 10 non-lame cows, all with LS 1, were selected per farm. Electronic data loggers were positioned on one hind leg of each cow to record standing time and transitions. These were removed 3 days later at the second visit.

There was no significant difference in standing time between housed and pasture-based cows but lame cows stood for a mean 1.75 (SE 0.36) h/day less than non-lame cows in both systems. Cows with sole damage, wall damage, misshapen feet and infectious lameness all stood for less time than non-lame cows. Housed cows had a mean 1.4 more lying bouts per day than cows at pasture. Lame cows at pasture had 1.2 more lying bouts per day than non-lame cows but housed lame cattle had 0.8 fewer lying bouts than non-lame housed cattle, so overall the number of lying bouts in lame cows, housed or at pasture, was similar. The only lesion associated with a change in the number of lying bouts was sole damage with a mean 1.1 more lying bouts per day across systems than non-lame cows. Lame cows had lower TDY than non-lame cows and TDY was reduced more in lame cows when TDY was greater.

In conclusion, standing times were similar in cows at pasture and in housed cows, but lying bouts were different. However, given the associations between standing time, lying bouts and TDY the results might be most strongly influenced by TDY, rather than system. Future studies investigating the impact of lameness on cow behaviour by system in cows with similar and a range of TDY would be informative.

Introduction

Lameness is a common disease in dairy cows worldwide (Cook, 2003; Espejo et al., 2006; Ito et al., 2009; Rutherford et al., 2009). In Chile, Flor and Tadich (2008) reported a mean prevalence of clinical lameness (locomotion score [LS] ⩾3) of 16.7% in 91 dairy herds. Lame cows are in pain (Whay et al., 1997), produce less milk (Amory et al., 2008; Green et al., 2010), are less likely to become pregnant (Walker et al., 2008) and are more likely to be culled (McDermott et al., 1992; Booth et al., 2004).

The most important natural behaviours for cow health, welfare and productivity are resting, eating, ruminating, and socializing (Krawczel and Grant, 2009). Lame cows have different behaviours from non-lame cows. They lie down for longer whether at pasture (Hassal et al., 1993) or housed (Galindo and Broom, 2002; Blackie et al., 2011) and spend less time feeding per day than non-lame housed cows (Galindo and Broom, 2002; Blackie et al., 2011). In addition, housed lame cows are less likely to start an aggressive action than non-lame cows (Galindo and Broom, 2002).

Legrand et al. (2009) reported that cows at pasture eat less dry matter and produce less milk and tend to have better locomotion than housed cows. Hernandez-Mendo et al. (2007) reported that turning lame cows out to pasture reduced their locomotion score after 4 weeks compared with lame cows that were left housed. The lame cows at pasture also spent considerably less time lying down than lame cows in free stalls (cubicles) (10.9 vs. 12.3 h/day) but had greater loss in body condition and milk production. Both of these studies suggest that cattle at pasture have better welfare as far as lameness is concerned but found that lame cows at pasture produced less milk than lame and non-lame housed cattle.

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Table 1
Mean number of cattle per farm, days in milk and system by date visited for the 20 farms in the study.

Farm ID	Number of cattle	Mean days in milk	System	Date of first visit
1	300	154	Pasture	May-2009
2	182	136	Pasture	May-2009
3	323	201	Pasture	June-2009
4	217	267	Pasture	July-2009
5	267	206	Housed	July-2009
6	320	242	Housed	July-2009
7	470	131	Housed	July-2009
8	208	162	Housed	August-2009
9	340	81	Housed	August-2009
10	549	149	Pasture	August-2009
11	354	128	Housed	August-2009
12	380	125	Pasture	May-2010
13	301	189	Pasture	May-2010
14	170	188	Pasture	June-2010
15	420	161	Pasture	June-2010
16	376	249	Pasture	June-2010
17	350	193	Housed	July-2010
18	300	131	Housed	July-2010
19	250	230	Housed	July-2010
20	341	303	Housed	July-2010

Milk production also affects cow behaviour. Bewley et al. (2010) reported that housed cows in early lactation spent less time lying down than housed cows in late lactation. Similarly, Norring et al. (2012) observed that multiparous high yielding cows spent less time lying than lower yielding cows, despite ready access to stalls. However, Blackie et al. (2011) reported that lying time also affects milk production, with cows that lie down more producing more milk. Krawczel and Grant (2009) quantified this with each extra hour of lying time resulting in an increase of 1.7 kg/day in milk production.

Electronic devices, such as IceTags (Blackie et al., 2011), and data loggers, HOBOware (Ito et al., 2010), are validated alternatives to manual recording of the time budget of dairy cows. Data loggers have been used in several studies to measure the total and duration of individual standing and lying times per day and number of lying bouts in dairy cows (Hernandez-Mendo et al., 2007; Chapinal et al., 2009; Ito et al., 2009, 2010; Ledgerwood et al., 2010). Recent work by Gibbons et al. (2012) demonstrated that IceTags, data loggers or both attached to the hind leg have no significant effect on total lying time, frequency of lying bouts or percentage of time lying on each side in lactating Holstein cows, confirming that such devices can be used reliably to measure activity.

In southern Chile there is a range of systems for keeping dairy cows. Some farmers house cattle over winter whilst others graze cattle all year round. In winter, the grass growth rate and quality decreases and cattle have to walk further to obtain adequate dry matter intake, although cows are supplemented with silage and concentrate. This requirement for food might affect lame cows' propensity to lie down. To date, research into this has not been undertaken and it is important to know whether the grazing systems in Chile affect lame dairy cow welfare so that measures can be taken to minimise any infringement.

The aim of the current study was to investigate whether there were differences in the standing time and number of lying bouts per day of lame cows compared with non-lame cows both at pasture and housed and whether there was a lesion specific effect. A further aim was to investigate how milk yield was associated with these behaviours and whether milk yield itself was affected by lameness, standing time and lying bouts.

Material and methods

The study was carried out in May–August (autumn and winter) 2009. A total of 400 multiparous Holstein Friesian dairy cows from 20 commercial dairy farms in three regions of southern Chile were enrolled into the study (Tables 1 and 2). The farms were convenience selected on distance from the University and farmer compliance with the study. Cows had an average milk production of 20 kg/day and were milked twice each day. Ten farms had systems where the cows remained indoors 24 h/day in autumn and winter and at the time of the study all cattle were housed 24 h/day. The mean herd size was 320 cattle. The farms used a range of cubicles and bedding including rubber, soil, mattresses and sand. Ten farms had systems where cows were at pasture all year around. They were visited at the same time and visits were intermingled with those of housed cattle (Table 1). The mean herd size of cattle at pasture was 321. Eight of these farms had stone roads to the milking parlour from the paddocks and two had concrete roads. The distance from pasture to the milking parlour ranged from 500 m to 1500 m.

Each farm was visited twice. At the first visit, 10 lame cows, with LS = 3 (Sprecher et al., 1997), and 10 non-lame cows (LS = 1) were selected. Cows with locomotion score 2, 4 or 5 were not eligible for inclusion in the study. Each animal's locomotion was scored when walking on a concrete surface by one observer (GN, a veterinarian trained by NT) to avoid between observer bias. After selection, the cows were examined in a crush and the affected leg, claw and lesion causing lameness were recorded. A photographic atlas[2] was used to aid diagnosis.

Electronic data loggers (HOBO Pendant G Acceleration Data Loggers, Onset Computer Corp.) were attached to the medial aspect of the non-lame hind leg above the fetlock using an adhesive bandage (3 M Health Care, D-41453) and left in place for 3 days. The data loggers were pre-programmed to start recording at midnight after the first visit and recorded data at 1-min intervals. The data loggers were removed from the cows at the second visit 3 days later and the data were downloaded using Onset HOBOware Software (Onset Computer Corporation) (Ito et al., 2010). After the 3 days of data collection, all lame cows were treated by a hoof trimmer.

The data were imported into Excel (Microsoft) and the daily standing time (h/day) and lying bouts (i.e. number of lying periods per day) were calculated for each day for each cow. Foot lesions were categorised into sole damage (sole ulcer/double sole/toe ulcer), wall damage (white line disease/vertical sand crack/abscess), infectious claw diseases (heel horn erosion, interdigital and digital dermatitis, interdigital necrobacillosis), misshapen feet (overgrowth/rotated digit), interdigital growths and sole haemorrhages (with no other lesion present). Monthly test day yield (TDY) nearest to the time of data collection for each cow, date of calving and parity were stored in Excel.

Data were analysed in Excel and MLwiN 2.25 (Rasbash et al., 2009). Factors associated with standing time, lying bouts and milk production were investigated. The models included an autocorrelation structure to account for repeated measures within cow and to account for between farm variation. Standing hours/day, log 10 (lying bouts/day) and TDY (kg/day) were the continuous outcome variables. The standing and log 10 (lying bouts/day) models took the form:

$$Y_{ijk} = \beta o + \sum X_{jk} + v_k \upsilon_{jk} + e_{ijk} \quad (1)$$

where Y_{ijk} was the standing hours or log 10 (lying bouts/day) at observation i for cow j on farm k. βo is the intercept and $\sum X$ is a series of vectors of fixed effects varying jk (cow) with between farm variance v_k, between cow variance υ_{jk}, and residual variance e_{ijk}. log 10 (number lying bouts/day) results were antilogged. For the milk production outcome model the bottom level was dropped because there was only one monthly TDY per 3 days per cow.

The following fixed effects were tested, cow lame or sound, parity, test day yield (kg/day), days in milk (calving date – date of visit), quadratic of days in milk and a function of days in milk (Wilmink, 1987). Significance was set at $P \leqslant 0.05$ using Wald's statistic such that confidence intervals not including zero indicate statistical significance and the standardised residuals of the final models were plotted to check for normality.

Results

Cattle were recruited randomly from both systems between May and August of 2009 (Table 1). There were a total of 190 lame cows and 198 sound cows with complete data; 12 cows' data were omitted because data loggers failed. The distribution of parity and mean days in milk was similar in both systems, however, the mean test day yield of housed cattle was greater than that in cows at pasture (Table 2). All foot lesions observed in cows with LS 3 were present in both systems, with the exception of digital dermatitis which was not observed in cows at pasture (Table 3). There were non-significantly more cows with white line disease at pasture and more cows with sole diseases that were housed (Table 3). The mean days in milk were similar in both systems but lame cows were older and produced less milk than non-lame cows (Table 2). The adjusted mean standing time was 15.2 h (95% confidence

[2] See: www.bienestaranimal.cl, developed from http://template.bio.warwick.ac.uk/E+E/lamecow/public_html/colour_atlas.pdf.