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# Identifying risk factors associated with lameness in pasture-based dairy herds

**S. Ranjbar,*[1] A. R. Rabiee,† A. Gunn,* and J. K. House***
*Livestock Veterinary Teaching and Research Unit, Faculty of Veterinary Science, School of Life and Environmental Sciences, The University of Sydney, Camden NSW 2570, Australia
†Cow Signals Australia, Horsley 2530, NSW, Australia

## ABSTRACT

Lameness is a significant welfare concern for dairy farmers and a major contributing economic loss to the dairy industry. Information is limited on environmental and managerial risk factors associated with lameness in Australian dairy herds. The objective of this study was to explore and quantify the environmental and management risk factors associated with lameness in pasture-based dairy herds. A cross-sectional study was conducted in 63 pasture-based dairy herds between 2011 and 2014, where all lactating cows were locomotion scored (scale 1–4) during a single visit. Environmental and management variables, such as length of main track and animal handling practices, were recorded during the visit. The prevalence of lameness was measured for each farm and associated risk factors were analyzed using a Generalized Linear Model, where farm was the unit of analysis. Estimated average prevalence of lameness was 18.9% (range 5 to 44.5%). The prevalence of lameness was associated with the amount of rainfall during the 30 d before the farm assessment, smoothness of concrete surface and available space per cow in the holding yard, and length of feed-pad available per cow. Inappropriate handling of cows on the track (e.g., causing sideways pushing among cows) was also a contributing risk factor to high prevalence of lameness in these dairy herds. The findings of this study suggest that by managing several environmental and farming practices, producers can reduce the prevalence of lameness, leading to improved productivity of their herds.
**Key words:** lameness, risk factor, pasture, Australia

## INTRODUCTION

Lameness along with mastitis and reproductive failure are recognized as the 3 costliest diseases in dairy herds. The costs incurred due to lameness are derived from reduced milk production, compromised reproductive performance (Lucey et al., 1986; Barkema et al., 1994; Sprecher et al., 1997), culling (Collick et al., 1989), mortality (McConnel et al., 2008), and treatment. Lameness is also recognized as a significant animal welfare issue causing pain and compromising the ability of cows to express normal behavior (Webster, 1986; FAWC, 1997).

The etiology of lameness is multifactorial, and the risk factors associated with lameness may include cow, environmental, management, and nutrition factors. Cow risk factors include parity, breed, age, stage of lactation, body depth, udder depth, and rear leg side view (Wells et al., 1993a; Boelling and Pollott, 1998; Boettcher et al., 1998). Environmental and management risk factors include concrete surfaces (Bazeley and Pinsent, 1984; Somers et al., 2003), season (Wells et al., 1993b), frequency of hoof trimming (Espejo and Endres, 2007), maintenance of cow tracks, and inappropriate animal handling (Chesterton et al., 1989). Dietary risk factors that have been suggested to be associated with lameness and laminitis include clinical and subclinical ruminal acidosis and high protein/low fiber lush rye grass pastures (Vermunt and Greenough, 1994).

The majority of lameness studies reported in the literature originate from intensive housed dairy systems in North America and Europe. There are limited studies evaluating farm-level risk factors for lameness in pasture-based dairy herds. The objective of this study was to investigate the environmental and management risk factors associated with lameness at the herd level using a cross-sectional study of dairy herds in the state of New South Wales (**NSW**) in Australia. Our aim is to use the findings of this study and other available information to develop a herd lameness assessment package for pasture-based dairy herds and to translate the findings of this study into a tool that can be used by herd advisers and farm managers to identify the major risk factors to enable them to prioritize lameness management interventions.

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[1]Corresponding author: shahab.ranjbar@sydney.edu.au

## MATERIALS AND METHODS

### Farm Criteria and Visits

A cross-sectional study (n = 63 farms) was carried out to explore and quantify the association among environmental, farm-level management practices and prevalence of lameness in pasture-based dairy herds. Sixty-three pasture-based dairy herds milking 90 cows or more were identified across 4 dairy regions on the eastern coast of NSW and enrolled in the study to investigate the prevalence of lameness and associated risk factors. Study farms included both seasonal and non-seasonal calving herds, several farms used feed-pads, and none had facilities for housing cows. This study was approved by the Human Ethics Committee of the University of Sydney. Each herd was visited once, and the assessments were undertaken between June 2011 and June 2014. The same observer performed the locomotion scoring and collected environmental and farm practice variables during the visit.

### Environment Assessment

Herd assessments and data collection were conducted using a data collection package developed by the study investigators. The package included a (1) herd data sheet, (2) investigator data sheet, and (3) locomotion scoring sheet.

***Herd Data Sheet.*** Herd demographic data collected included the date of visit, farm address, predominant breed of cows, average daily milk production per cow, calving pattern, and feeding system.

***Investigator Data Sheet.*** The investigator data sheet was used to record environmental and management data pertaining to the holding yard, track design, animal handling along the tracks and during milking, footbaths, and feed-pad.

***Track Design and Herding Along Tracks.*** The main track was defined as the track identified by the farmer being used most frequently by cows during the year. The length of the main track was measured using a measuring wheel with an accuracy of ±0.10 m. The gradient of the main track was measured every 50 m using a 1-m level and a ruler. At these points, the width and slope of the main track were also measured. Overall steepness of the farm was also assessed along with other features such as water drainage and existence and efficiency of a dirt track-concrete barrier at the junction of main track and milking cow holding yard. The farm staff and cow interactions were also recorded, when cows were brought up to the milking parlor and during milking, particularly if cows were pushed or drifted toward the dairy and the behavior of cows during walking (e.g., high head carriage, excessive pushing, or reversing).

***Foot Bath.*** Presence and the type of footbath were recorded along with the dimensions to calculate the volume of solution in the bath.

***Feed-Pad.*** In those herds that used a feed-pad to feed a partial mixed ration before or after grazing, the length of feed-pad was measured to determine the available space per cow (m/cow). None of the feed-pads had dividers or separators (such as vertical bars or headlocks) between the cows.

***Holding Yard and Milking.*** A diagram of the holding yard was drawn and the total area was calculated. Once the gates to the holding yard were closed behind the last cows, the number of cows in the yard was calculated by subtracting the number of cows being milked and the number of cows that had already exited the dairy from the total number of cows in the milking herd. Space per cow was calculated according to yard area divided by number of cows in the yard. Holding yard gradient was measured at 4 points to calculate the mean gradient of the yard (points were at entrance to the yard, entrance to the parlor and the other 2 were between the 2 former points). The width of entrance from the track on to the holding yard was measured to calculate entrance width per 100 cows (i.e., 4-m entrance in a dairy milking 400 cows provides 1-m entrance width per 100 cows). Holding yard surface was assessed and scored according to the method used by Faull et al. (1996), and the presence of concrete grooves was also noted.

The following parameters were recorded, when cows were brought up to the holding yard during afternoon milking time: (1) number of cows in the yard when the gates were shut, (2) number of cows holding their heads up (sign of limited space) in the holding yard when gates were shut, (3) duration of use of backing gate every time it was moved, (4) procedures that were used by farm personnel to push or move cows into the milking parlor, and (5) the total number of sharp turns that cows had to make when entering and exiting the milking parlor.

***Locomotion Scoring.*** All lactating dairy cows were locomotion scored when cows exited the milking parlor. Due to the rate of cows exiting the milking parlor during locomotion scoring, the locomotion scores were recorded as a tally rather than on individual cows. The locomotion scoring system that was used in this study was a modified locomotion scoring system that has been developed by Nordlund et al. (2004). These modifications facilitated scoring of multiple cows at the same time when cows exited the dairy parlor, and we were able to score cows that seemed to have multi-limb lameness (i.e., thin soles on both hind limbs).