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## Technical note: The development of a reliable 5-point gait scoring system for use in dairy goats

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### ABSTRACT

Numerical rating scales are frequently used in gait scoring systems as indicators of lameness in dairy animals. The gait scoring systems commonly used in dairy goats are based on 4-point scales that focus on detecting and judging the severity of a definite limp. An uneven gait, such as a shortened stride or not “tracking up,” is arguably the precursor to the development of a limp; thus, identifying such changes in gait could provide opportunity for early treatment. The objectives of this study were (1) to develop a 5-point gait scoring system that included an “uneven gait” category and compare the distribution of gait scores generated using this system to scores generated using a 4-point system, and (2) to determine whether this system could be reliably used. Forty-eight Saanen cross 2- and 3-yr-old lactating does were enrolled from a commercial dairy goat farm. Two observers carried out weekly live gait scoring sessions for 7 wk using the developed 5-point scoring system. The first 2 wk were used as training sessions (training sessions 1–2), with the subsequent 5 wk completed as gait assessments (assessments 1–5). In addition to training session 1 being live scored, the goats were also video-recorded. This allowed observer 1 to re-score the session 4 times: twice using the developed 5-point system and twice using the previously used 4-point system. Comparisons of score distributions could then be made. Using the 4-point system, 81% of the goats were assigned score 1 (normal gait). Using the 5-point system, only 36% of the goats were assigned score 1 (normal gait), with 50% assigned score 2 (uneven gait). High levels of intra-observer reliability were achieved by observer 1 using both gait scoring systems [weighted kappa ( $\kappa_w$ ) = 1.00: 4-point,  $\kappa_w$  = 0.96: 5-point]. At training session 1 (wk 1), inter-observer reliability was only moderate ( $\kappa_w$  = 0.54), but this was improved during the subsequent training session 2 ( $\kappa_w$  = 0.89). Inter-observer reliability

was high among assessments 1 to 5 ( $\kappa_w$  = 0.90–1.00). During the training sessions, sensitivity for gait scores 1 and 2 was 77 and 65% (training session 1) and 89 and 94% (training session 2), respectively. Sensitivity was high among assessments 1 to 5 (score 1: 83–100%, score 2: 97–100%). This highlights the likely reason why existing gait scoring systems for dairy goats do not include an “uneven gait” category, as distinguishing it from a normal gait was challenging without training. In conclusion, with training, a 5-point gait scoring system could be reliably used. The 5-point system was found to be more sensitive than the 4-point system, allowing for a potential precursor to lameness to be identified. Further work is needed to determine whether the score can be reliably used in an on-farm setting.

**Key words:** welfare, lame, uneven gait, limp

### Technical Note

Lameness, a painful condition (Whay et al., 1997) that impedes a normal walking gait, is one of the most serious welfare issues faced by dairy animals (von Keyserlingk et al., 2009). As lameness compromises animal welfare (Whay et al., 2003), it is essential that the lameness status of dairy animals can be quickly and reliably identified to facilitate the prompt detection and treatment of lame animals.

Gait scoring systems, which use a numerical rating scale to rank an animal’s walking ability, are commonly used as an indicator of lameness presence and severity. Systems assessing gait have been established for several species (sheep: Ley et al., 1989; chickens: Weeks et al., 2000; cows: Flower and Weary, 2006; goats: Anzuino et al., 2010; pigs: Nalon et al., 2014).

The 4-point gait scoring systems frequently used for dairy goats require a definite limp to be recognized (Hill et al., 1997; Anzuino et al., 2010; Muri et al., 2013) for an animal to be identified as lame. Gait scores are then assigned based on limp severity (Table 1). A limp can be defined as an altered gait due to reluctance to bear weight on the affected limb (Leach et al., 2009). This reluctance results in an uneven foot fall

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because a sound limb will be moved more quickly than the lame limb (Leach et al., 2010). With the exception of injuries, many cases of lameness develop over time (de Mol et al., 2013). Therefore, the development of an uneven gait could be a precursor to a limp developing. An uneven gait may be recognized as a shortening of stride, the animal not “tracking up” (i.e., the hind hoof not stepping into the placement of the front hoof) when walking, or as swinging of the affected leg inwards or outwards at each stride (van der Waaij et al., 2005; Haskell et al., 2006).

A 5-point gait scoring system is frequently used as an indicator of lameness in dairy cows (O’Callaghan et al., 2003; Espejo et al., 2006; Flower and Weary, 2006). The dairy cow 5-point scoring system includes an “uneven gait” category, which allows for discrimination of slight variation from a “normal gait,” and therefore may facilitate earlier detection of developing lameness. Not including an “uneven gait” category in scoring systems such as the 4-point system often used in goats (Hill et al., 1997; Anzuino et al., 2010; Muri et al., 2013) may result in animals that have a slight variation from a normal gait being scored as “normal.” These animals will only be detected once a definite limp has developed.

An uneven gait is not necessarily indicative of lameness. For example, conformation, posture, and udder fill of the animal may affect gait (Flower and Weary, 2009). However, using a gait scoring system that includes this category provides an opportunity to investigate the cause of the unevenness. Then, if deemed necessary, interventions such as remedial hoof trimming or veterinary treatment can be administered, potentially preventing deterioration of the condition (Leach et al., 2012).

Simplifying a gait scoring system by reducing the number of categories may improve inter-observer reliability and repeatability (Schlageter-Tello et al., 2014). This could explain why the previously used dairy goat gait scoring systems have fewer than 5 categories and often focus on identifying severe lameness. However, for cows, it is reported that with extra training, similar inter-observer reliability can be achieved using a 5-point system and a 4-point system (Brenninkmeyer et al., 2007). This suggests that the repeatability of a gait scoring system is determined not just by the sensitivity of the score, but also by the observers and their level of training and experience.

This study had 2 objectives: (1) to develop a 5-point gait scoring system for goats that includes a category for “uneven gait” with no limp, and to compare the distribution of gait scores generated using this system to scores generated using a 4-point system that focuses on identifying a limp; and (2) to determine whether the 5-point system can be reliably used.

The study was conducted at the AgResearch Goat Research Facility (Hamilton, New Zealand) and was approved by the AgResearch Ltd. Animal Ethics Committee (13700). Forty-eight Saanen cross 2- and 3-year-old lactating does were enrolled in October 2016. The goats were housed singly or in pairs on rubber matting and shavings in the indoor facility as part of a larger feeding trial.

The same 2 observers carried out weekly gait scoring sessions for 7 consecutive weeks: the first 2 wk were training sessions, followed by 5 assessment sessions. All gait scoring sessions were conducted at approximately 1600 h, following the afternoon milking, to reduce any effect of milk fill and udder distention on gait (Flower et al., 2006). Goats were assessed while walking from the milking parlor back to their pens on a combination of hard rubber matting and concrete flooring. They left the milking parlor and walked toward the observers, passed them laterally at a distance of 3 to 5 m, and then continued away from the observers to their home pen. This allowed for at least 4 full strides of walk to be viewed. Efforts were made by the observers to keep an equal distance from the goats. However, due to the layout of the housing facility relative to the milking parlor, this was not always possible. Goats exited the parlor one at a time, enabling the observers to view and score each before another was allowed to exit. They exited in an indiscriminate order at each gait scoring session, which would have minimized the risk of observers becoming familiar with the order and recognizing individual goats.

In the first week, the 2 observers live scored the goats using the 5-point scale (see below) to evaluate reliability. This session was completed with the observers scoring independently, allowing an initial inter-observer reliability to be calculated. Inter-observer agreement was only moderate [weighted kappa ( $\kappa_w$ ) = 0.54; Table 2]. The observers aimed to achieve almost perfect agreement (0.81–0.99; Viera and Garrett, 2005) before assessments could begin; therefore, further training was needed. Thus, training session 2 was completed, with the observers being able to discuss scores being assigned; this improved agreement ( $\kappa_w$  = 0.89; Table 2).

In wk 1, the goats were also video-recorded ( $n$  = 42; 6 missed due to goats rushing; HC-V270, Panasonic Camcorder, Osaka, Japan) to allow comparison of the distribution of scores generated using the 4- and 5-point systems. At the completion of the 7-wk trial, observer 1 scored these video recordings 4 times: twice using the 5-point system and then twice using a 4-point system (Anzuino et al., 2010). Each scoring occurred 1 wk apart to minimize the risk of observer 1 being familiar with the goats and the order they appeared on the video.

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