

Validation of a New Pedometry System for Use in Behavioural Research and Lameness Detection in Dairy Cattle

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Lameness is one of the primary health and welfare concerns in the dairy industry. With increasing consumer demand for welfare-friendly products, the high prevalence of lameness is a large concern (Cramer, 2008). Research into automated methods to identify cows that are showing early signs of developing lameness could allow for earlier detection and treatment of this problem.

Lameness is believed to be a painful condition. Pain can be defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage” (ISAP, 1979). One of the methods for assessing pain in animals is to examine their behaviour (Weary et al., 2006). Animals experiencing pain normally deviate from their normal behaviour by altering activity (either an increase or decrease), posture, gait, appetite and appearance (Anil et al., 2002).

Research has shown that 92% of cows that developed clinical lameness had a decrease in pedometric activity of at least 15% (Mazrier et al., 2006). In addition, extreme lying times, observed through increases or decreases in the amount of time spent lying, have been shown to be predictive of lameness events (Ito et al., 2009). In fact, cows demonstrating extreme lying times were 2.5 times more likely to be identified as severely lame. Further research into the behaviour of cows that are becoming lame would be very beneficial to the dairy industry, especially if automated systems for monitoring step, lying, and standing activity were validated and could identify specific cows for further examination.

The objective of this study was to validate the Pedometer Plus system, which measures pedometric activity as well as lying and standing behaviour.

Materials and Methods

Sixteen Holstein cows housed individually in maternity stalls were used for this validation study in the fall of 2008. In the first trial, eleven cows had a Pedometer Plus (SAE Afikim, Israel) tag on one hind leg and a previously validated IceTag (IceRobotics, UK) on the opposite hind leg. Both devices measure duration and bouts of lying, as well as the number of steps taken by the animal. Allocation of devices to right or left legs was random. In trial two, five cows were fitted with Pedometer Plus tags and IceTags, with both tags on each hind leg.

Results

In trial 1, Pearson product-moment correlation between the two devices for the number of steps taken was $r=0.73$ ($p<0.0001$). In the second trial, correlation between the two devices for the number of steps taken was $r=0.82$ ($p<0.0001$). The distribution plot for this correlation is shown

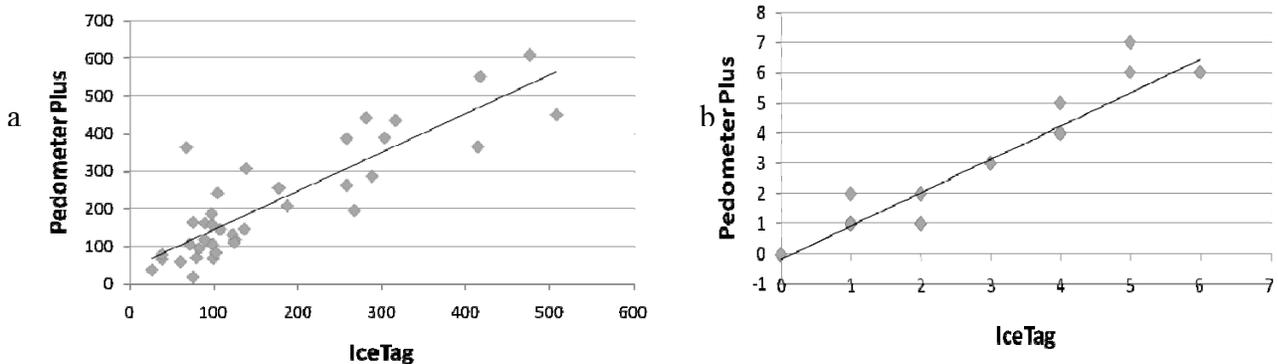


Figure 1: Correlation between IceTag and Pedometer Plus devices, a) shows correlation between activity measured as mean steps/hour, b) shows correlation between number of lying bouts.

in Figure 1a. Additionally, the number of lying bouts (Figure 1b) and the duration of lying time were highly correlated for all cows, $r=0.98$ ($p<0.0001$) and $r=0.90$ ($p<0.0001$), respectively.

Discussion

The initial protocol for validation (Trial 1) was expected to demonstrate similar activity counts by both pedometry systems. However, the alternate leg device placement provided much lower correlation than expected. Examination of digital video taken throughout the validation process revealed that during bouts of lying, there was movement of the upper leg while the lower leg was immobile. This likely explained at least some of the difference in pedometric activity recording between the two legs, and hence the two devices. This led to the second trial where the two devices were recording measurements for the same leg, which resulted in much better agreement between the two devices. The Pedometer Plus device appears to be a useful and accurate tool for the measurement of activity, including steps taken, number of lying bouts, and duration of lying time in dairy cows, making it a useful device for future research. Research currently underway will examine the lying and standing behaviour in addition to activity prior to clinical lameness in cows in an attempt to provide a management tool for producers which would flag potential lameness cases for further examination.

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