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Making the case for developing alternative lameness scoring systems for dairy goats

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ABSTRACT

Lameness is a behavioural indicator of pain that negatively affects dairy ruminants' health and welfare. Lameness is generally assessed by subjective methods, based on the observation of the animal's behaviour, using numerical rating scales (NRSs) – the most common scoring system – and visual analogue scales (VASs). A NRS consists of a set of different categories with descriptive definitions associated to each category. A VAS is a continuous scale, generally illustrated by a horizontal line, with descriptors as anchors on both ends of the line. Distinct drawbacks have been associated with both types of scales. NRSs have been associated with a reduced sensitivity to capture variations in lower levels of lameness that may adversely impact animals' welfare assessments. VASs are considered too subjective and associated with low user-acceptance.

Recent literature on health scales has been focusing on the development of modified VASs that define equal ranges along the scales' continuum, with thresholds representing a NRS descriptor. Although good results have been reported in using these modified VASs for lameness scoring, the literature recognizes that it is paramount to test whether existing NRS descriptors are equal spaced in the VAS continuum, as well as research the extent to which lameness intensity varies for different lameness and posture signs used to define NRS descriptors. The answers to these questions are vital for the development of a new modified VAS to assess lameness in goats.

Aiming to address these questions we collected and analyzed lameness scorings using individual VASs to score three lameness and posture signs (gait, head nodding and arched-back). Lameness scorings were performed through a video-based web-survey. We collected a total of 570 valid participations from respondents with different occupations and experience. Because of expected differences in the respondents' ability to assess lameness, we analyzed answers by levels of cardinal consistency. The cardinal consistency levels were designed as increasing filters of consistency between the respondents' assessment and the NRS model used by the experts to score the videos. Our results showed: (1) respondents' difficulties in recognizing and discriminating across some NRS descriptors; (2) these difficulties varied with the lameness severity and with the lameness sign; (3) gait, the basis for NRS lameness descriptors in goats, was not scored evenly spaced along the VAS continuum; (4) similar results were found for the head nodding and arched-back signs.

In conclusion we suggest that the exact location of the thresholds along the VAS continuum should be reassessed, and the inclusion of different lameness and posture signs should receive further attention before new modified VASs are developed. Moreover, the use of NRSs in lameness scoring should only consider their ordinal measurement properties, therefore giving space for developing, validating and using alternative lameness scoring methods in farm animals that allow for higher measurement levels.

1. Introduction

Lameness is an important behavioural indicator of pain caused by claw or limb injury or disease. It has been shown to negatively affect dairy ruminants' feed intake and milk yield (Green et al., 2002; Christodoulopoulos, 2009; Flower and Weary, 2009;

Abbreviations: NRS, numerical rating scale; VAS, visual analogue scale.

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Palmer et al., 2012) and fertility (Eze, 2002; Hernandez et al., 2005; Flower and Weary, 2009). It has also been shown that lameness affects individual (Juarez et al., 2003; Blackie et al., 2011) and social behaviour (Galindo et al., 2000) of dairy animals. Consequently, lameness is regarded as one of the most serious health and welfare problems in dairy ruminants (Webster, 2001; Flower and Weary, 2009).

Lameness can be assessed by objective (based on the use of equipment that collects kinetic and kinematic data) or subjective (based on the observers' ratings using different scoring systems) methods, although the latter are more generally used (Flower and Weary, 2009; Meagher, 2009). Within subjective methods, it is very important to consider the effects of both the observer and the scoring system (Flower and Weary, 2009). Different scoring systems and scales have been used for different animal species. A recent review on locomotion scoring systems in dairy cows identified 25 different scoring systems of which 22 were numerical rating scales (NRSs), and three were visual analogue scales (VASs) (Schlageter-Tello et al., 2014). For sheep we found three NRSs (Ley et al., 1989; Welsh et al., 1993; Kaler et al., 2009) and one VAS, developed by Welsh et al. (1993). For goats we found four NRSs (Hill et al., 1997; Mazurek et al., 2007; Christodoulopoulos, 2009; Anzuino et al., 2010) but no continuous lameness scale, namely VAS.

NRSs are explicit grading methods in which each individual is scored accordingly to different lameness descriptions that correspond to a whole number (Gaynor and Muir, 2008). This suggests that the different descriptors represent an equal increase or decrease in lameness intensity, which may not be true (Gaynor and Muir, 2008). Therefore NRSs are artificial constructs as lameness should be seen as varying in a continuous trait – when we only allow observers to support the score on a limited number of descriptors, we reduce the assessment sensitivity and loose valuable information (Streiner and Norman, 2008; Nalon et al., 2014). Therefore the VAS, as a continuous scale, may be considered a better alternative for lameness scoring. This scale was first developed for use in pain assessment in humans (Scott and Huskisson, 1976) and since then has been used to measure a variety of subjective phenomena in the behavioural and social sciences and is considered of potential value for the measurement of different clinical conditions (Wewers and Lowe, 1990). The VAS has the advantage of not imposing a choice for limited and closed categories, being possible to score a change on the VAS even if a change between categories would not occur, and hence being more sensible to small variations in signs (Welsh et al., 1993; Paul-Dauphin et al., 1999; Averbuch and Katzper, 2004). Nonetheless, VASs have not made their way into lameness scoring as they are generally viewed as being too subjective, with low user-acceptance, and difficult to use in farm conditions (Engel et al., 2003; Kaler et al., 2009).

Current research in scale development has recently been focusing on the development of modified VASs to assess different health indicators, for example, pain in humans (Averbuch and Katzper, 2004) and lameness in dairy cows (Tuyttens et al., 2009) and in sows (Nalon et al., 2014). According to these studies, the modified VAS holds some of the NRS strengths, as it provides extra help by placing thresholds, functioning as additional anchors or cues, along the scale to guide observers in their scorings, increasing perception, helping the observers to make consistent choices and hence increasing inter-observer reliability while keeping a higher resolution and lower error probability. These examples of modified VASs split the continuum into equal segments, placing (underlying) NRS descriptors as thresholds and to which a text box with different lameness and posture signs is added. However, it is imperative to assess if the distribution of the NRS descriptors along the VAS is even.

In this study we assess the grounds for developing a modified VAS to assess lameness in goats by investigating the distribution of different lameness and posture signs along the scales' continuum. We did so by adopting a two-stage approach: first by examining the survey respondents ability to recognize the increase or decrease in signs' intensity, which is needed to discriminate the underlying lameness descriptors; and then, by analysing how different gait and posture signs are scored individually in a VAS.

2. Materials and methods

2.1. Web-survey and data collection

2.1.1. Web-survey

The web-survey consisted of three parts. In the first part guidelines explaining the scope and how respondents should conduct the scoring were presented. In the second part the respondents were asked about (1) their age and gender, (2) level of education (primary, secondary or higher), (3) occupation (farmers and stockpersons, animal scientists, veterinarians, researchers in animal behaviour or students), (4) country of residence, and (5) experience in scoring goat lameness (inexperienced, little experience, experienced or very experienced). In the third part of the survey, the respondents were asked to answer a survey. Each survey was composed by nine videos, randomly selected from a pool of 82 videos. The order in which each video appeared was randomized and each respondent could watch the videos as many times as desired.

2.1.2. Experts video scoring

The videos were previously scored by three experts using a commonly used four-descriptor NRS (Anzuino et al., 2010) which was developed for similar type of animals and farms. This scale considers one level for normal gait and therefore for absence of lameness (lameness descriptor 0), and three consecutive increasing levels of lameness: slightly lame (lameness descriptor 1), moderately lame (lameness descriptor 2), and severely lame (lameness descriptor 3) (detailed lameness descriptors displayed in Table 1). This scoring system was used as the basis to compare the respondent's scores with an overall lameness scoring. As in lameness scoring no gold standard is available, we used the expert's scoring consensus to establish the overall lameness status, thereby adopting a similar strategy to other studies that have looked into the validity and reliability of lameness scoring scales (Engel et al., 2003; Tuyttens et al., 2009; Van Nuffel et al., 2009; Nalon et al., 2014).

2.1.3. Data collection

In each survey the respondents were asked to score three different lameness signs separately, rather than using the scale previously validated by the experts, the Anzuino et al. (2010) lameness scoring system. The first sign to be scored was "gait", as this is the only sign used in all lameness scales for goats. Additionally, we selected two other signs – head nodding and arched-back – that address specific lameness posture signs. Our choice was driven by other studies that have included arched-back (Sprecher et al., 1997;

Table 1
Lameness scoring system developed by Anzuino et al. (2010).

Lameness descriptor	Description
0	Goat places full weight on all four limbs, moves forward freely with an even gait.
1	Goat has a definite limp on one or more legs, but bearing weight and moves forward freely.
2	Goat has some difficulty moving forward, severe limp, bearing little weight on one or more legs, may be a degree of goose-stepping.
3	Goat has some difficulty moving forward, not bearing weight on one or more legs, or may 'goose-step' high or walk on the knees.